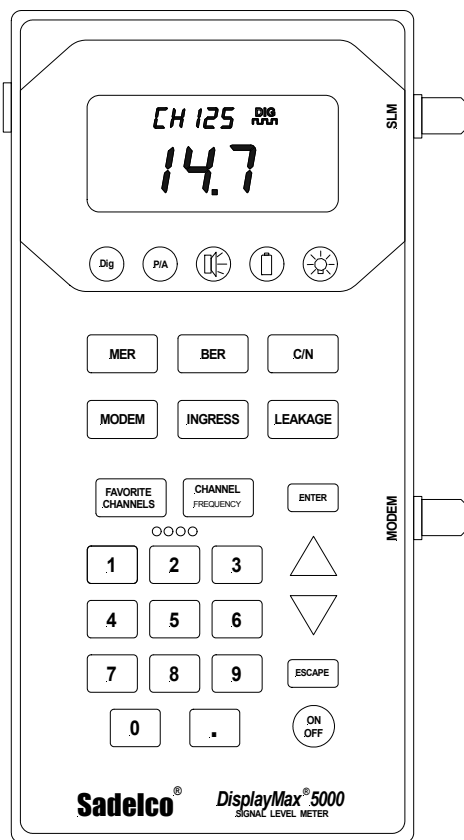


DisplayMax[®] 5000



Operator's Manual

Introduction

The DisplayMax 5000 provides a complete test solution for today's installation workforce. Test options include signal level and signal quality of analog and digital channels, modem upstream level, as well as ingress and leakage; all in a single, easy to use and rugged field instrument.

Analog and digital channels require specific signal level and quality parameters to insure the picture quality that customers demand. The DisplayMax 5000 meets these demands through signal level, MER, BER and C/N measurements.

Modems on the other hand, require additional verification of return path levels. This is important since certain defects in cabling or components can cause problems in the return path while not affecting the forward path. Since modem upstream signals are very complex, they can not be measured directly by a signal level meter; upstream signals can only be reported by an actual DOCSIS modem. The DisplayMax 5000 has a built-in DOCSIS cable modem that automatically connects with the CMTS and reports the upstream level.

Forward and return services are both prone to disruption from interfering off-air signals. These off-air signals are known as ingress. Ingress enters the cable system through bad shielding; generally from loose connections, poor quality splices or damaged cables. The same fault allows forward channels to leak from the cable system; these signals are referred to as leakage signals. The DisplayMax 5000 offers both ingress and leakage test functions, providing the installer with the tools he needs to quickly identify, isolate and repair any shielding problems in the home.

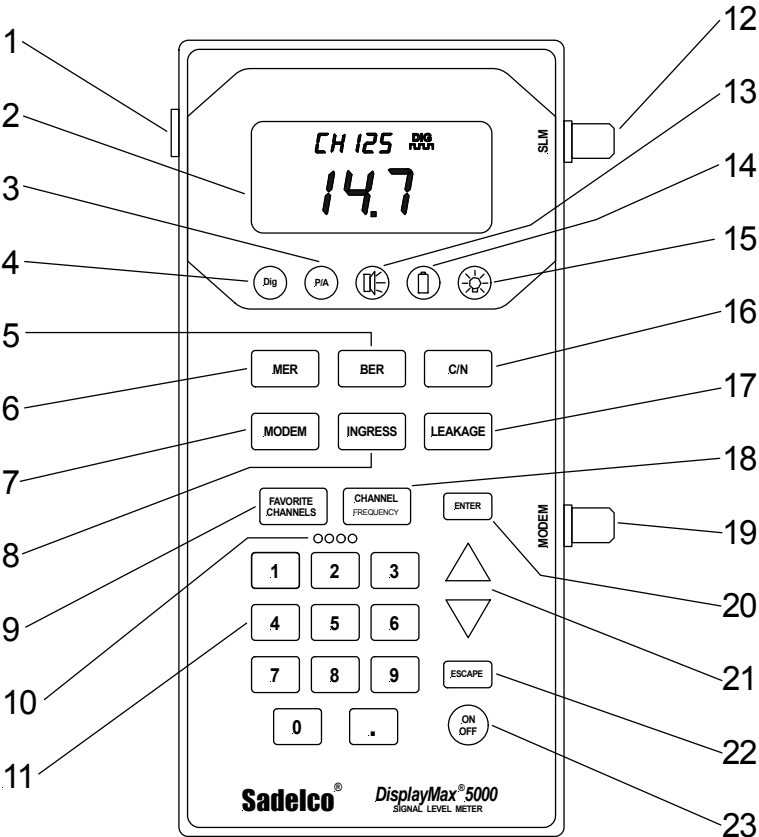
Thank you for purchasing a Sadelco meter.

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Front Panel Controls



1. **Charge Jack**
Use Sadelco T70 ac charger or CH04 car charger.
2. **LCD Display**
Channel number displayed on top, level (dBmV) on bottom.
3. **Picture / Audio**
Toggle between picture and audio carriers on analog channels.
4. **Digital**
Toggles channel between analog, digital 64 QAM and digital 256 QAM.
5. **BER**
Display Bit Error Rate of tuned digital channel.
6. **MER**
Display Modulation Error Ratio of tuned digital channel.
7. **Modem**
Display modem's return level.
8. **Ingress**
Automatic ingress scan displays frequency and level of highest ingress signal.
9. **Favorite Channel**
Program & tune up to 30 favorite channels. Automatic pass / fail of favorite channels.
10. **Speaker Holes**
11. **Numeric Keypad**
Used for entering channel or frequency.
12. **Main Input**
User replaceable F-connector .
13. **Speaker**
Adjust volume level.
14. **Battery**
Display battery voltage and accumulated on-timer.
15. **Back-Lights**
16. **Carrier to Noise**
Display C/N of tuned analog channel.
17. **Leakage**
Activates leakage detector
18. **Channel / Frequency**
Enter channel or frequency. Also toggles between channel and frequency.
19. **Modem Input**
User replaceable F-connector.
20. **Enter**
Used for channel or data entry.
21. **Up / Down**
Scroll to next channel or frequency.
22. **Escape**
Terminates keypad entry.
23. **ON/OFF - Power**

Option Packages

- New meters can be ordered with ANY combination of options.
- Field meters can be upgraded as your needs change.
- DisplayMax-Jrs can be upgraded to DisplayMax 5000s with any combination of options.

Please contact Sadelco for upgrade information – see page 35

Option-01: Ingress Detection

Detect unwanted ingress signals in the drop and home wiring. Meter automatically scans the return path and checks for ingress down to -40 dBmV. A Pass / Fail message is displayed along with the frequency and level of the highest ingress signal.

Option-02: Leakage Detection

Detect forward channels leaking from anywhere in the system, including the drop and home wiring. Leakage detection is the fastest way to find the source of Ingress; simply attach the rubber duck antenna and search for “hot spots”. Shutting down a source of Leakage shuts down a source of Ingress.

Option-03: MER, BER & C/N

Add three quality measurements with one option. MER (modulation error ratio) and BER (bit error rate) are digital channel quality tests that indicate not only the quality but also the reliability of a digital channel. C/N (carrier to noise ratio) is a similar test for analog channels.

Option-04: Modem Return Level

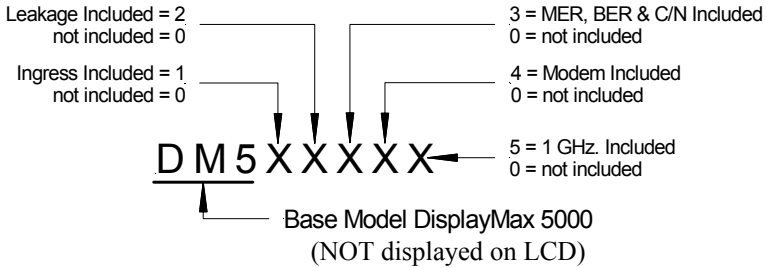
This option adds a DOCSIS modem chip-set to your meter. Qualify the return path by establishing a connection with the CMTS (cable modem termination system) and verify healthy margins by viewing the modem’s return level.

Option-05: 1 GHz. Tuning

Extend the upper tuning range from 872 MHz to 1000 MHz. (1 GHz).

Part Number System

The part number reflects the options included in your meter. To view your meter's part number, press .51 Enter (press and hold Enter for 3 seconds).



Examples:

- Displayed
- DM5 00000 : Base Meter with No Options
 - DM5 02000 : Base Meter with Leakage
 - DM5 12000 : Base Meter with Ingress & Leakage
 - DM5 00040 : Base Meter with Modem
 - DM5 00340 : Base Meter with MER / BER / C/N & Modem
 - DM5 12345 : Base Meter with ALL Options

See Appendix A on page 36 for a complete list of options and part numbers.

Specifications

SIGNAL LEVEL METER (BASE MODEL)

Frequency Range: 5 to 872 MHz

Channel Plans: EIA, HRC, IRC, AIR, PAL-BG
(custom plans on request)

Tuning Resolution: 125 KHz

Tuning Bandwidth: 280 KHz

Analog Power Range: -30 to +60 dBmV

Digital Power Range: -23 to +67 dBmV

Level Resolution: 0.1 dB

Level Units: dBmV, dBuV

Typical Accuracy: +/- 0.5 dB

Max Additional Error at 70° F: +/- 0.5 dB

Typical Accuracy from 0 to 120° F: +/- 1.0 dB

Max Additional Error from 0 to 120° F: +/- 1.0 dB

Digital Error: additional +/- 0.5 dB

INGRESS DETECTOR (OPT-01)

Frequency Range: 5 to 872 MHz.

Default Frequency Range: 5 to 40 MHz.

Return Sensitivity: -40 dBmV (5 to 40 MHz)

Forward Sensitivity: -30 dBmV (40 to 872 MHz)

Level Units: dBmV, dBuV

Tuning Resolution: 250 KHz

Tuning Bandwidth: 280 KHz

Detector Mode: Peak

Accuracy: Same as base model digital channel

LEAKAGE DETECTOR (OPT-02)

Frequency Range: 110 to 140 MHz.

Sensitivity: 2 uV/m, with duck antenna 3ft from leak

Level units: uV/m

Tuning Resolution: 125 KHz

Tuning Bandwidth: 280 KHz

Detector Mode: Peak

Responds only to video signals (rejects non-cable signals)

Audio: Outputs tone; pitch varies with level

Accuracy: Same as base model analog channel

QUALITY MEASUREMENTS (OPT-03)

Digital BER: min 10 E-9 (min input -15dBmV)

Digital MER: max 40dB (min input -15dBmV)

Analog C/N: max 48dB (min input 0dBmV)

Displayed as a function of system noise

MODEM LEVEL (OPT-04)

DOCSIS Version: 2.0

Downstream Locking Range: -15 to +20dBmV

Upstream Max Level: 58dBmV

1 GHz. Tuning (OPT-05)

Extends max tuning range from 872 MHz to 1000 MHz

All other specs same as base model

GENERAL

Battery life: 8 hrs. (5 hrs with 25% modem use)

Battery Charge: 12 hours

Audio: Water sealed speaker with volume control

Weight and Dimensions: 3 lbs, L 8.2" x W 4.0" x D 2.5"

Supplied Accessories: Nylon case (CASE007), 110V wall charger (T70), duck antenna (ANT01), Ni-MH battery (BAT09), manual

Optional Accessories: Car charger (CH04), 220V wall charger, (T70E), dipole antenna (ANT02), monopole antenna (ANT03)

Specifications subject to change without notice

Getting Started

The wrong F-Connector can DAMAGE YOUR METER!!!

Periodic inspection of the F81 input connector is recommended as dirty or spread contacts can cause intermittent or low signal level readings. To replace the F81 connector on your meter, simply loosen with a 7/16 wrench and replace with the original type connector and washers

The original Sadelco F-connector has a short barrel (0.300”) and uses two washers - one flat and one star. When the F-connector is tightened, the star washer is firmly pressed into the meter’s metal housing by the flat washer. This configuration provides good grounding between the F-connector and metal housing (required to maintain low sensitivity in the leakage mode) and also dissipates mechanical shock from the F-connector into the metal housing. This is important if the meter is dropped or takes a direct hit to the F-connector.

Longer barrel F-connectors present two problems: First, they will not tighten onto the metal housing. Instead, they bottom out in the input bushing and thus will not dissipate mechanical shock from the F-connector into the housing. If the meter is dropped or takes a direct hit to the F-connector, the mechanical shock is fully transmitted into the meter’s circuitry. Damage that may occur includes a broken input bushing, cracked surface mount components on the circuit board, and damaged standoffs used to mount the circuit board. The second problem related to a longer barrel is the loss of grounding between the F-connector and metal housing. This can reduce sensitivity in the leakage mode by as much as 10dB.

Protect your investment: use only original Sadelco F-connectors & washers.

Contact Sadelco to order your F-connector Replacement Kit. Kit includes F-connectors, flat washers and star washers. Call 800-569-6299 or go to our website at www.sadelco.com and click the Parts & Accessories tab.

Part Number: F01-20 (20pc kit), F01-50 (50pc kit), and F01-100 (100pc kit)

Battery & Charging

Battery

BAT-09: Five super-capacity A-size Nickel Metal-Hydride cells.

Charger

AC Charger: T70 – Standard charger / USA 110VAC
T70E – 220VAC European standard prong
Car Charger: CH04 – Vehicle cigarette lighter type plug

Charge Time

To charge a completely dead battery, place meter on charge for 12 hours. Charging a battery with a partial charge will require less time. Extensive over-charging can reduce battery life.

Run Time

8 hours with NO modem or backlights.
5 hours with modem on 25% of the time.

Battery Test

To test the battery, press the battery key. The LCD will display the battery voltage and an accumulated on-timer. The nominal battery voltage is 6.0V and the normal operating range is 5.0 to 7.0 volts. Since the battery voltage does not drop linearly with use, it is not a good indicator as to the remaining life of the battery. The accumulated on-timer tracks the total amount of time the meter has been operated since the timer was last reset. To reset the timer, press the decimal point, then the battery key. Use the timer in conjunction with the battery voltage to determine when the battery needs to be recharged. Remember to reset the timer each time the battery is charged.

The meter will beep and display a warning when the battery voltage is getting low. The meter will turn off automatically when the battery reaches 5.0V. The DisplayMax 5000 WILL NOT give incorrect readings due to low battery.

Automatic Shutoff

To conserve battery power, the meter is programmed to turn off after 5 minutes of non-use (no keypad entry). The timer can be set to 10 minutes by pressing .10 ENT (decimal, 1, 0, ENT) or disabled by pressing .00 ENT (decimal, 0, 0, ENT). To set back to 5 minutes, press .05 ENT (decimal, 0, 5, ENT). Note: press and HOLD enter key for approximately 2 seconds.

Power On / Off

To power the meter on, **press and hold** the ON/OFF key until the model number is displayed on the LCD. If the meter does not power on, the battery may require charging. The meter will automatically power itself down if the battery voltage is too low, or after 5 minutes of no keypad entry (see automatic shutoff).

Channel Plan

The DisplayMax 5000 comes programmed with all major plans. The most common plan, EIA (NCTA) is the default plan. To check which plan is currently selected, press .50 ENT (decimal + 5 + 0 + ENT, *Hold Enter key for 2 seconds*) To change plans, press the up or down arrow to scroll to a new plan, then press ENT. The standard plans are as follows:

- | | |
|-------------------------|-----------------------------|
| 1. EIA (Standard Cable) | 5. HRC (Non-Standard Cable) |
| 2. EIA (Standard Cable) | 6. IRC (Non-Standard Cable) |
| 3. EIA (Standard Cable) | 7. AIR (Off-Air Broadcast) |
| 4. EIA (Standard Cable) | 8. PAL BG (Europe) |

Plans can be edited in the following ways: 1. Mark digital channels. 2. Assign favorite channels.

Four copies of the most common plan (EIA) allow users to program different favorites and / or digital channels for different systems.

Make sure the correct plan is selected for your application. Contact Sadelco for custom channel plan requirements.

Channel Measurements

Level Units

Television signals are measured in decibels relative to 1 millivolt, commonly expressed as dBmV. The decibel expresses the ratio between two voltages. A positive dBmV indicates the signal is greater than 1mV, a negative dBmV indicates the signal is lower than 1mV, while a 0 dBmV signal is equal to 1mV.

DisplayMax 5000 has been preset to measure in dBmV units. However, the measurement units can be changed to the European standard of decibels relative to 1 microvolt, or dBuV. To change the units, press .99 ENT (decimal + 9 + 9 + ENT, *Hold Enter key for 2 seconds*). The display will momentarily flash “dB EUR”. To change back to dBmV, press .99 ENT again; the display will

momentarily flash “dB USA”. Note: If your meter is set to dBuV, it will read 60 dB higher than if set to dBmV.

Analog Channels

Analog Basics

Analog channels have two separate carriers, Picture and Audio. The DisplayMax 5000 can only measure one carrier at a time. Since the picture carrier is of primary interest, the meter automatically tunes to the picture carrier whenever a channel entry is made. To toggle the measurement between picture and audio carrier, press the “P/A” key. When measuring the picture carrier, the letter “P” will appear after the channel number. When measuring the audio carrier, the letter “A” will appear after the channel number. If the volume is adjusted while tuned to the audio carrier, you can monitor the audio on the speaker.

Tuning Analog Channels

- Direct Tuning: Enter desired channel number, then press the “Channel / Frequency” key or the “Enter” key.
- Sequential Tuning: Press the up / down arrows to tune to the next channel in the plan; In this mode, the channels are tuned in frequency order. Since the channel numbers are not always in frequency order, the channel numbers may jump (e.g. CH 4, 5, 6, 95, 96, 97).
- Favorite Channels: Up to 30 channels can be programmed as “Favorite Channels”. To tune to a favorite channel, enter the favorite slot, then press the “Favorite Channel” key. Once in the favorite channel mode, the up / down arrows tune to the next favorite channel. For more information, see the “Favorite Channel” section in this manual.

Target Analog Levels

- Picture Carrier: According to FCC specifications, the minimum picture carrier level going to the TV is 0 dBmV, and the maximum level is one that will not cause distortion in the TV tuner. Industry standards are 0 to 15 dBmV, with 10 dBmV as a good target. As you move upstream from the TV, signal level must increase to compensate for signal losses in the cable, splitters, taps, etc.
- Audio Carrier: According to FCC specifications, the audio carrier should be from 10 dB to 17 dB lower than the picture carrier.

Digital Channels

Digital Basics

Digital channels have their power spread across the full bandwidth of the channel they occupy. Standard digital channels (video and forward modem) occupy a 6MHz bandwidth (same as analog channels) and therefore fit neatly

into the existing channel plan. Tuning to a standard digital channel is the same as tuning to an analog channel. **Before making a measurement, the tuned channel must be programmed as digital.** To accurately measure digital channels that do not occupy a 6 MHz. bandwidth, see “Measuring Non-Standard Digital Channels” later in this section.

Digital Programming

Channels can be programmed as analog (AnA), Digital 64 QAM (64), or Digital 256 QAM (256). To view the channel’s programmed status, quickly press and release the “Dig” key. Subsequent presses of the “Dig” key will scroll through the other settings. To reprogram a channel’s status, scroll to the desired setting and press the “Enter” key. Pressing the “Escape” key will exit without reprogramming. If a channel is programmed as either 64 or 256 QAM, a “Dig” icon will appear to the right of the channel number. 64 vs. 256 programming only affects the meter’s BER function – it has NO affect on signal level or MER.

Automatic Digital Programming

If you are not sure whether the channel you are measuring is analog or digital, press and hold the “Dig” key for two seconds. You can release the key once the word “Auto” appears on the display. The DisplayMax 5000 will automatically determine if the tuned channel is analog or digital and program its status accordingly. Since the auto-digital function can’t distinguish between 64 & 256 QAM it will default to 256 QAM setting.

Note: The automatic programming mode cannot be turned on permanently, but rather must be done on a channel by channel basis. Also, the meter must be connected to an active cable system in order to work.

Tuning Digital Channels

Tuning to a digital channel is the same as tuning to an analog channel. Enter the channel number on the keypad followed by “Channel / Frequency” or “Enter”. When tuning to a new channel, the Displaymax 5000 will check its memory to determine whether the channel has been programmed as analog or digital.

Since compression allows several programs to be combined into a single digital channel, the set-top box may display a channel number that is not consistent with the DisplayMax 5000’s channel plan (e.g. HBO – Channel 705). In this case, you need to determine the channel number as defined by the modulator.

Digital channels are sometimes referred to by their center frequency. For example, the center of channel 125 (EIA Plan) is 801 MHz. Simply tuning to the center frequency of the digital channel will lead to large measurement errors. To accurately measure a digital channel, you must tune by channel number, then program the channel as digital.

Measuring Non-Standard Digital Channels

Non-standard digital channels do not conform to the standard channel plans, therefore, the channel must be tuned by frequency. In addition, a custom correction factor may be required based on the channels bandwidth and modulation format. To simplify the measurement, Favorite Channels can be programmed with a specific frequency and correction factor that match the digital channel. Once programmed, simply tune to the Favorite Channel and read the level displayed on the LCD. See “Programming and Recalling Favorite Channels”.

Forward Vs Return

Forward digital channels (signals that transmit from the headend to the field) are easy to measure since they transmit continuously and do not change frequency, level or modulation format. Return signals (signals that transmit from the field to the headend – typically from a modem) are difficult to measure since they do not transmit continuously (bursty), and can change frequency, modulation format and level based on instructions from the CMTS (cable modem termination system).

Target Digital Channel Level

Digital channels are typically set 6 to 10 dB lower than what an analog channel would have been. Therefore, if analog channels are measuring around 10dBmV, you would expect adjacent digital channels to measure from 0 to 4dBmV.

Measuring Off-Air ATSC (VHF / UHF)

To measure off-air ATSC channels, you must first change the channel plan to “Air” (See “Channel Plans”). Next, select the desired channel and program as digital (See “Manual Programming” and “Automatic Programming” of Digital Channels). Note: setting ATSC as 64 or 256 will give correct power readings.

When working with off-air ATSC signals, channel flatness is equally important as signal level. When reflected signals are received by the antenna slightly out of phase with the “line of sight” signal (a condition know as “Multi-Path”), the channel may have large response variations and the digital receiver may be unable to “lock-on”. By measuring several frequencies across the channel’s bandwidth (avoid band edges and carrier frequency), the flatness of the channel can be determined. (See “Favorite Channel Programming” – use offset of 6.8 dB). Adjust the antenna for the best combination of level and flatness.

Tuning by Frequency

To tune a specific frequency, enter the frequency on the keypad using a decimal point, then press the Channel / Frequency key. Once in the frequency mode, the up / down arrows will tune to the next / previous frequency in 125 KHz. increments.

It is important to use the decimal point when entering a frequency. If the decimal point is not entered, the entry will be assumed to be a channel. It is not required to add trailing zeros after the decimal point.

Keypad Entry	Action
100.000 + CH/FRQ	Tune to 100.000 MHz.
100. + CH/FRQ	Tune to 100.000 MHz.
100 + CH/FRQ	Tune to Channel 100

Favorite Channels

Favorite Channel Basics

The DisplayMax 5000 can be programmed with a maximum of 30 Favorite Channels (per channel plan). The user can program the meter to measure specific analog channels, standard digital channels, non-standard digital channels, test pilots and other signals. Once programmed, the stored channels can be easily scrolled through by entering the Favorite Channel mode, then pressing the up / down arrows.

Standard analog and digital channels (6 MHz channels that are included in the channel plan) are stored as channels. Non-standard digital channels (channels that are not included in the channel plan) and other non-standard signals are stored as frequencies. When storing a frequency, a level offset can be applied to account for bandwidth and other correction factors associated with digital channels.

To exit the Favorite Channel mode, enter a channel using the Channel / Frequency key, or press ESC. Cycling power WILL NOT exit Favorite Channel mode.

Programming Channels

To program a channel as a Favorite Channel, first tune to the desired channel. Next, press the Favorite Channel key, then select a Favorite Channel number, (1 to 30), and press Enter.

Note: The only way to store a channel's audio carrier as a Favorite Channel is by programming the audio carrier frequency. When programming a channel as a Favorite Channel, the picture carrier is automatically stored.

Note: A channel's analog / digital status can be programmed in or out of Favorite Channel mode by pressing the "Dig" key.

Programming Frequencies

Frequencies can be stored as Favorite Channels in order to measure non-standard digital channels, test pilots and other signals. When programming a

frequency, the meter will allow a level offset (used for digital channel measurement) and pass / fail parameters that will be used during Level Check mode.

To program a frequency as a Favorite Channel, first tune to the desired frequency (see “Tuning by Frequency” later in this section). Next, press the Favorite Channel key. Next, select a Favorite Channel number (1 to 30), then press Enter. An offset of 0.0 dB will appear on the LCD display. Use the up / down arrows to select an offset value, then press Enter. Next, a default value of 15 dBmV will appear as the Pass / Fail High value. Use the up / down arrows to select a new High Pass value, then press Enter. Next, a default value of 0 dBmV will appear as the Pass / Fail Low value. Use the up / down arrows to select a new Low Pass value, then press Enter.

Tuning to a Favorite Channel

To tune a Favorite Channel, first enter the Favorite Channel number (1 to 30), then press the Favorite Channel key. The LCD will display the stored channel or frequency and its level. Once in the Favorite Channel mode, the up / down arrows will tune to the next / previous Favorite Channel.

Erasing Favorite Channels

Individual favorite channels can be reprogrammed with a new channel or frequency, but cannot be erased. To erase ALL favorite channels, enter the following key sequence: 0, Favorite Channel, decimal, Escape.

Auto-Check of Favorite Channels

Auto-Check Basics

Auto-Check allows a quick pass / fail test of all Favorite Channels. The acceptable range for analog channels is from 0 dBmV to 15 dBmV at the input of the television, with standard digital channels being from 6 to 10 dB lower than analog channels. Auto-Check is activated by pressing and holding the Favorite Channel key for 2 seconds.

Auto-Check Operation

The Level Check mode compares all Favorite Channels against stored pass / fail parameters. If all Favorite channels are within pass / fail parameters, the LCD will display a Pass message. If an individual channel is not within pass / fail parameters, the LCD will display a Fail message along with the failed channel and level.

If a channel fails, press the Up Arrow key to continue testing. When all Favorite Channels have been tested, the LCD will display Scan End. To enter a new mode, first press the Escape key.

Auto-Check Setup

Analog and digital pass / fail parameters can be viewed and edited by pressing .70 + ENT, *Hold ENT for 2 seconds*. First, the LCD will display the Analog Channel High Pass Limit. Use the Up / Down arrow to change the value, press Enter to accept the displayed value and advance to the next parameter. Continue for Analog Low, Digital High and Digital Low.

Single frequency pass / fail parameters are entered while storing the Favorite Channel. Unlike analog and digital channels, each Favorite frequency can have its own pass / fail parameter.

Shielding Qualification

The shielding on a coax cable is necessary in providing quality service to the customer. Proper shielding serves two purposes:

1. Prevent off-air signals from entering the coax; the environment is filled with all kinds of electromagnetic interfering signals from many different sources. Poor shielding allows these signals into the coax where they can interfere with the desired cable signals. These interfering signals are known as Ingress.
2. Prevent cable signals from escaping the coax; cable signals must be properly contained within the cable system so as to not interfere with legitimate off-air broadcast signals. In particular, the FCC requires that cable systems monitor, report and fix Signal Leakage in the aeronautical band.

Although a defect in a cable's shielding causes both Ingress and Leakage, it is important to run both tests. Based on the type of shielding defect, the forward levels, the nature of the ingress signal (if present at all), you may find the problem only by performing an Ingress Check or only by performing a Leakage Check. For example, if you only perform an Ingress Check and it passes, it is possible that there is still a defect in the shielding but there were no interfering signals at the exact moment you performed the Ingress Scan. If you only perform a Leakage Check, it is possible that the radiation pattern of the leak produced a dead zone where the leakage measurement was made. The bottom line is that you improve your chances of finding and fixing a problem if you routinely perform both tests at each install.

Ingress Check

Ingress Basics

The cable's shielding is designed to prevent signals that are "in the air" from getting to the center conductor of the cable. If there is a defect in the shielding, unwanted signals will be picked up by the center conductor, a condition referred to as Ingress. Ingress signals that are picked up in the home wiring, or at the

drop, will continue upstream to the local node and then on to the CMTS. If the ingress signal is large enough, it can disrupt data flow from the individual home, and possibly for the entire node.

To check for ingress on the return path, disconnect at the ground block and measure what is coming out of the house. To test the drop cable, disconnect at the tap and measure what is coming back from the drop. It is important to fully tighten the cable to the meter before pressing the Ingress Check key.

Ingress signals can come from many sources. As such, ingress signals are very unpredictable. They can occur for a period of time, then go away. They can be at a single frequency or across the full return bandwidth at the same time. They can also vary in level. If you made 10 ingress reading on a defective drop cable, you may get a different reading each time. Take any failed reading seriously; a borderline reading may give a much worse reading at a later time.

Ingress Operation

The Ingress Check mode compares readings at each frequency between user defined start / stop frequencies (default 5 to 40 MHz) against a user defined pass/fail parameter (default -35 dBmV). If all frequencies pass, the LCD will display a PASS message in addition to the highest reading and the frequency at which it occurred. If one or more frequencies are above the pass/fail parameter, the LCD will display a FAIL message in addition to the highest reading and the frequency at which it occurred. If there was no ingress signals to be measured at any frequency, the LCD will display a constant PASS message since there is no level or frequency to report.

Ingress Setup

To enter a new start frequency: First tune to the desired frequency (See Tuning by Frequency), then enter the following keys: `.72 + Enter` (decimal, 7, 2, Enter), *Hold the enter key for 2 seconds*. After holding the Enter key for 2 seconds, the LCD will display the original start frequency value. Press Enter again (quick press) to continue. If you do not want to change to a new start frequency, press Escape. If you press Enter, the LCD will flash the new start frequency value. Press Enter one more time to program the new start frequency.

To enter a new stop frequency: Follow the same procedure as entering a start frequency, except use input code `.73 + Enter`.

To enter a new pass / fail value, enter the following keys: `.74 + Enter` (decimal, 7, 4, Enter). *Hold the enter key for 2 seconds*. After holding the enter key for 2 seconds, the current pass/fail value will display. If you do not want to enter a new value, press Escape. To change the current value, use the up / down arrows to select a new value, then press Enter (quick press).

Ingress Troubleshooting

To measure ingress, you must disconnect the cable you are testing from the active plant. If you are testing for ingress in the home wiring, the best place to measure is at the ground block. To avoid false ingress readings, turn off modems and set top boxes inside of the home, or avoid scanning the bandwidth used by those devices. Disconnect the drop from the ground block, then measure what is coming out of the house. If Ingress Check fails at the ground block, then find the first splitter, disconnect its outputs and run the test on each leg separately. Use this technique to isolate the problem to an individual cable or component.

The level of ingress depends on the nature of the defect and also the nature of the interfering signal. Some types of ingress may be fairly stable while others may be quite intermittent. If you measure ingress at point A, then measure no ingress at point B, go back to point A and see if the ingress is still present before assuming the problem is in-between A and B.

MAKE SURE ALL CONNECTIONS ARE TIGHT! A loose connection will cause the cable to act as an antenna, creating both ingress and leakage. If you measure ingress at point A, then measure no ingress at point B, then measure no ingress back at point A, you may have unknowingly fixed the problem by tightening a loose connection, or you may be dealing with an intermittent ingress source.

The Leakage Check can also be used to determine the location of a shielding problem (See Leakage Check). Use the duck antenna to find where leakage signals are radiating from. Most likely this is where ingress is getting into the system. Leakage Check is very helpful, especially when dealing with intermittent types of ingress that are not always present.

Leakage Check

Leakage Basics

The cable's shielding is designed to prevent signals that are carried on the center conductor of the coax from radiating into the air. Signals that escape from the cable are known as leakage signals. The FCC requires that cable operators regularly monitor their systems for leakage. This is because channels in the 110 to 140 MHz range will interfere with aircraft communications. As such, cable operators normally have special crews that deal specifically with leakage issues. A secondary problem associated with leakage is ingress. The same defect that causes leakage will also allow unwanted off-air signals to enter the cable system (See Ingress Check). Since ingress causes major problems in the return path, many installers are required to find and fix leaks in order to also fix sources of ingress.

Leakage signals are measured using an antenna that is connected directly to the meter or through a short length of coax cable (several feet). Leakage signals are

strongest at the location of the cable fault. As you move away from the leakage source, the signal level will drop as a function of distance. From a distance of 10 feet from the leak, the signal level is reduced one half each time the distance is doubled. For example, if you were measuring 50 uV/m at 10 feet, you would measure 25 uV/m at 20 feet, and 12.5 uV/m at 40 feet. Consequently, leakage readings are only meaningful if made at a specific distance. The FCC requires leakage readings be made 10 feet from the source of the leak.

In the leakage menu, the distance can be set to 3, 10 or 20 feet. Measurements are always normalized to 10 feet. Therefore, the meter will always display what the leakage value is at a distance of 10 feet from the leak, even though the measurement was made at a different distance. For accurate leakage measurements, it is necessary for the antenna to be 3, 10 or 20 feet from the leakage source, as per the menu setting. The default distance is 3 feet. To change the distance in the menu, see the section on Leakage Setup. If you are only interested finding and fixing leaks and measurement accuracy is not important, then you do not have to worry about the distance setting.

Leakage signals are measured in units called “microvolts per meter”, abbreviated “uV/m”. This represents the voltage, in microvolts, that would be developed across a single length of wire, 1 meter in length, held parallel to the leakage source. In the real world, leakage measurements are made with antennas, not lengths of wire. The DisplayMax 5000 comes with a rubber duck type antenna. This is a general-purpose antenna. Optional antennas include a dipole and magnetic mount monopole. The dipole antenna has more gain and is more directional than the rubber duck, which means you can measure lower level leaks and better pinpoint their location. The FCC requires the dipole be used for all leakage reading that are used in the official CLI report (CLI stands for Cumulative Leakage Index and represents the total leakage value for the system.) The magnetic mount monopole antenna is placed on the roof of a vehicle so that the system can be monitored while driving. The monopole antenna can receive signal from all directions which makes it ideal for searching for the presence of a leakage signal while driving, but it is not ideal for precisely locating the source of the leak. If you use either the dipole or monopole, you must select the correct antenna type in the leakage setup menu.

When checking for leakage, the antenna may pickup non-cable signals such as electrical noise and radio transmissions. To prevent false leakage readings, the Displaymax 5000 automatically rejects all non-video signals. This feature can be disabled in the leakage setup menu in order to measure unmodulated test carriers or other CW type signals.

The Displaymax 5000 represents the amplitude of the leakage signal in two ways. First, the level is displayed in uV/m units in numeric form on the LCD display. Second, a tone is generated that increases in pitch as the signal level

increases. The volume level can be adjusted by pressing the speaker key under the LCD.

Some systems use a “tagging” method on a channel used for leakage monitoring. Tagging is a special modulation that allows the technician to verify the leakage signal being received is from his cable plant. This is useful in overbuild situations where two systems can potentially generate a leak. It is also useful in discerning between cable leaks and non-cable signals. Tagging systems can employ either AM or FM modulation although AM systems tend to be more prevalent. Sadelco does not supply a tagging system, however the Displaymax 5000 will detect the AM tagging signal in its audio - the normally flat tone will have a fast warble in it.

The Displaymax 5000 has a tuning range of 110 MHz to 140 MHz in the leakage mode. The default frequency is 133.250 MHz (channel 16). To tune a different frequency, you must enter a new frequency into the leakage setup menu. The Displaymax 5000 uses a wide IF bandwidth for leakage measurement, as such the meter tunes in 125 KHz steps and can accurately measure channels with standard aeronautical frequency offsets. Simply enter the desired frequency and the meter will automatically select the closest 125 KHz tuning increment. There are NO errors due to these frequency offsets.

Leakage Operation

When the Leakage key is pressed, the meter activates the leakage circuitry and tunes to the frequency that has been preset into the leakage setup menu. If the video gating is enabled (factory default setting), then only video signals that are present on the antenna will be detected and measured. The LCD display will activate a Leakage Check icon, display the tuned frequency and the uV/m value if a leak is detected. In addition to the numeric value, a tone will be generated on the speaker. The pitch of the tone will increase as the leakage level increases.

Leakage Setup

To enter a new leakage frequency: First tune to the desired frequency (See Tuning by Frequency), then enter the following keys: **.75 + Enter** (decimal, 7, 5, Enter), **Hold the Enter key for 2 seconds**. After holding the Enter key for 2 seconds, the LCD will display the original leakage frequency. Press Enter again (quick press) to continue. If you do not want to change to a new leakage frequency, press Escape. If you pressed Enter, the LCD will flash the new leakage frequency. Press Enter again to program the new leakage frequency.

All other parameters are edited by entering a single code, then scrolling through the menu items. To access the main leakage setup menu, enter the following keys: **.76 + Enter** (decimal, 7, 6, Enter), **Hold the Enter key for 2 seconds**. The menu items are as follows:

- a) Distance: The current distance will initially be displayed. Press the up arrow to scroll through the choices of 3 ft, 10 ft, and 20 ft. Once you select the proper distance, press the Enter key to update the menu and proceed to the next menu item. Pressing Escape will exit the menu without any changes being made.
- b) Antenna type: After exiting distance, the current antenna type will be displayed. Press the up arrow to scroll through the choices of Ant-1 (rubber duck – supplied with meter), Ant-2 (magnetic mount monopole), and Ant-3 (dipole). Once you select the proper antenna, press Enter to update the menu and proceed to the next menu item. Pressing Escape will exit the menu without changes to the antenna type.
- c) Gate: After exiting antenna type, the current Video Gate status will be displayed. Press the up arrow to toggle between the two choices of EnA (Enable – only video signals will be detected), and diS (Disabled – all signals will be detected). Once you select the desired setting, press the Enter key to update the menu and proceed to the next menu item. Pressing Escape will exit the menu without any changes to the gate status.
- d) Level units: After exiting gate status, the current level units will be displayed. The two choices are uV/m and dBmV. Press the up arrow to toggle between the two. When the display reads “Sho dB diS” (show dB – disabled), the level units will be uV/m which is the standard units for measuring leakage. When the display reads “Sho dB EnA” (show dB – enabled), the level units will be dBmV. Use dBmV only for special test purposes, like checking calibration against a standard signal generator. (Note: If measuring the output of a signal generator, make sure to disable the gate feature.) Once you select the level units, press the Enter key to update the menu and proceed to the next menu item. Pressing Escape will exit the menu without changes to the level units.
- e) Calibration offset: After exiting level units, the current calibration offset will be displayed. To change the calibration offset, use the up / down arrows to scroll to a new offset. The offset is made in dBs and has a max range of +/- 3 dB. Once you select the desired offset value, press the Enter key to update the menu and exit out of the leakage menu. Pressing Escape will exit from the menu without changes to the cal offset.

Note: If you only want to view the menu items, enter the code and continue pressing the Enter key.

Leakage Measurement Techniques

Prior to making leakage measurements, make sure the meter is setup properly for your system. Read the full section on leakage in this manual.

Unlike measuring signal directly from the coax, making leakage measurements requires skill and practice. The first step is to try and detect a leakage signal. Do this by pressing the Leakage Check key, attaching the antenna and slowly moving the antenna about.

If a leakage signal is detected, the next step is to determine the location of the leak. The maximum readings will be obtained when the antenna element is held parallel to the source of the leak. The lowest reading will be obtained when the antenna is pointing at the source of leakage. (DO NOT HOLD THE ANTENNA ELEMENT). Keep in mind that the antenna has a donut shape pickup pattern. It is possible that the leak may be coming from several directions. The best way to determine if a suspected cable or component is the source is to move the antenna closer and see if the reading increases. If the reading continues to increase as you move the antenna closer, chances are the cable or component is bad. Making measurements inside of a home is especially difficult since RF signals pass through walls and reflect off of metallic surfaces.

Once the source of the leak is found and fixed, it is good practice to again measure for leakage. First, you want to make sure the fix was good and second, there might be smaller leaks coming from other sources. Smaller leaks can't be measured until the larger ones are fixed.

Leakage Troubleshooting

If you suspect a cable is leaking, check that the connections on either end of the cable are tight. A loose connection can remove the ground connection for the shield, making the cable act as an antenna. Also, check for staples or nails that may have pierced through the cable's jacket and shielding.

If you detect a leakage signal, but can't find the source, it is possible that the signal is coming from outside of the home. To verify, disconnect the cable at the ground block and repeat the measurement inside of the home. To reduce false leaks, make sure the gating feature is enabled in the leakage menu.

Quality Measurements

The quality of a given channel is as important as its signal level. It is possible to have sufficient signal level, yet still have poor quality due to impairments such as system noise. Poor signal quality can cause snowy analog channels and tiling in digital channels. The DisplayMax 5000 offers the following quality tests: MER, BER and C/N.

MER (Digital Channel Test)

Modulation Error Ratio (MER) is the magnitude of the desired digital signal, divided by the magnitude of impairments, expressed as a dB power ratio. Similar to C/N, a higher MER indicates lower levels of impairment and therefore higher quality; lower MER readings indicate higher levels of impairment and therefore lower quality

High MER = High Quality

Highest Instrument Reading = 40dB

Target MER for 256 QAM = 31dB or higher

Target MER for 64 QAM = 27dB or higher

Lowest Instrument Reading = 24dB

Low MER = Low Quality

Although a digital channel can have many possible impairments, system noise is typically the major contributor to a channel's MER value. The DisplayMax 5000 uses system noise as the basis for its MER measurement. In cases of extreme phase noise (typically a headend impairment), or extreme response ripple, reflections and group delay that go beyond the adaptive equalizers ability to correct, the actual MER may be lower than reported.

To measure MER, a channel must first be programmed as digital. See *Digital Programming* on page 14. Press the MER key to initiate test. The LCD will display "MER" on the top row and MER value on the bottom row. It may take up to 60 seconds to acquire the measurement.

BER (Digital Channel Test)

Bit Error Rate (BER) displays the number of data bits that have been received in error, typically as a result of impairments during transmission of the digital signal. If a data bit is transmitted as a 0 but was received as a 1, then it is an "errored" bit. The formula for BER is very simple: errored bits divided by the total number of bits. Because BER is typically very small it is expressed in scientific notation.

Example 1:

1 errored bit out of 100,000,000 (100 million) transmitted bits
= $1 / 100,000,000$
= 0.00000001
= 1×10^{-8}
= 1 E -8 (*Displayed on LCD*)

Example 2:

3 errored bits out of 1,000,000 (1 million) transmitted bits
= $3 / 1,000,000$
= 0.000003
= 3×10^{-6}
= 3 E -6 (*Displayed on LCD*)

Note that example 1 has a lower BER than example 2, only 1 in 100M vs. 3 in 1M; example 2 has 300 X more errors than example 1.

Low BER = High Signal Quality (low impairments)

MIN BER = $1 \text{ E } -9$ (as measured by DisplayMax 5000)

This is also the target or ideal BER for any QAM, Pre or Post FEC.

Max BER = $9 \text{ E } -4$ (as measured by DisplayMax 5000)

High BER = Low Signal Quality (high impairments)

Although a digital channel can have many possible impairments, system noise is typically the major contributor to a channel's BER value. The DisplayMax 5000 uses system noise as the basis for its BER measurement. In cases of extreme phase noise (typically a headend impairment), or extreme response ripple, reflections and group delay that go beyond the adaptive equalizers ability to correct, the actual BER may be higher than reported.

Forward Error Correction (FEC) is a system that allows a digital receiver to detect and correct errors - within limits. BER is normally much lower after FEC. BER can be displayed as either Pre or Post FEC.

To measure BER, a channel must first be programmed as digital. *See Digital Programming* on page 14. Press the BER key to initiate test. The LCD will display "BER" on the bottom row and the BER value on the top row. It may take up to 60 seconds to acquire the measurement. The first BER value displayed is Post-FEC; the letter "b" will be displayed on the top left of the LCD. A second press of the BER key will toggle to the Pre-BER reading; the letter "A" will be displayed on the top left of the LCD. Subsequent presses of the BER key will continue to toggle between the Post & Pre BER values.

C/N (Analog Channel Test)

Carrier to Noise Ratio (C/N) is the power level of an analog channel's picture carrier divided by the average noise power over the video bandwidth, expressed as a dB power ratio. A high C/N ratio indicates low system noise and therefore a high quality analog signal. A low C/N ratio indicates high system noise and therefore a low quality analog signal.

High C/N = High Quality

Highest Instrument Reading = 48dB

Target C/N = 43dB or higher at TV

Lowest Instrument Reading = 24dB

Low C/N = Low Quality

To measure C/N, a channel must first be programmed as analog. Press the C/N key to initiate test. The LCD will display “C-N” on the top row and the C/N value on the bottom row. It may take up to 60 seconds to acquire the measurement. A flashing LCD indicates the C/N is greater than the displayed value.

Return Testing

Cable modems use the return path (5 to 40MHz.) to upload data to the Cable Modem Termination System (CMTS) located in the headend. Per DOCSIS specifications, the CMTS determines the cable modem’s output level, frequency, modulation format and time slot for transmitting data. The level of an individual cable modem in the field is set so that its transmitted signal is received at the CMTS within a dB or two of all other modems. If there is excessive loss in the drop or home wiring, the cable modem may not have the ability to hit its target level at the CMTS. In this case, the modem will experience slow speeds, connection problems or connection loss. The recommended upstream signal levels are 35 to 52dBmV.

Problems at the subscriber’s premises include damaged cable or connectors, a splitter or coupler that is defective or installed backwards, an over-split cable running to the modem, a high-pass filter that is still in the line or even a bad faceplate in the tap (basically anything the signal passes through). Some of these problems will affect only the upstream levels, while others will affect both upstream and downstream levels. For example, a high-pass filter will have no affect on the downstream but will have a major affect on the upstream. The relationship between cable loss and upstream / downstream levels is as follows: cable loss will decrease downstream levels and increase upstream transmit levels.

Modem Test (Return Levels)

For maximum performance of your MODEM function, it is necessary to program the DOWNSTREAM DOCSIS FREQUENCY into your meter

(see Modem Setup on page 28)

Please note that this requirement is for all meters with Rev 2.9 or higher; if your meter is Rev 2.8, please contact Sadelco for a software upgrade. To view the software revision of your meter, enter .80 (decimal, 8, 0) into the keypad, then press and hold the Enter key for 2 seconds. The rev will be displayed on the bottom of the LCD.

Modem Basics

DisplayMax 5000s with the DOCSIS modem option have a 2nd F-connector port on the right side of the meter used exclusively for the modem function. After programming the downstream DOCSIS frequency (see Modem Setup) connect the coax cable to the modem port and press the MODEM key on the meter's panel. The internal DOCSIS modem will automatically connect with the CMTS and display the return level. To conserve battery life, the modem will power down once the level is displayed.

Modem Operation

When the modem function is activated, a single segment will start scrolling on the LCD display to indicate the modem test is in progress. The internal DOCSIS modem will then tune to the programmed downstream DOCSIS frequency (see Modem Setup) and will be guided by the CMTS through the upstream leveling process. Once the upstream signal has reached its target level, the value will be displayed on the LCD screen.

Modem Setup

When to program your meter:

1. All NEW meters must be programmed before use.
2. All meters previously used on a different system.
3. If the cable system has CHANGED its downstream DOCSIS channel.

Programming instructions:

1. Enter the following code into the keypad: .66 (decimal, 6, 6) then PRESS & HOLD the Enter key for 2 seconds until "Tun" is displayed on the LCD.
2. Enter the downstream DOCSIS modem frequency into the keypad followed by the Enter key.
3. Use meter at least once with downstream channel power levels at 0 to +5dBmV (or higher). The meter should display the return level in less than 2 minutes. This is an important step in programming the firmware; please don't skip it.

If NO frequency has been programmed, the default value of 00.000 will be displayed when the .66 code is entered. This will trigger an automatic scan for the downstream DOCSIS channel when the modem key is pressed. The automatic scan could add significant delay to the reading, especially if the downstream DOCSIS channel is low. It is therefore recommended to program the downstream frequency as instructed above.

Modem Troubleshooting

Ideal return levels are 35 to 52dBmV. If actual levels are too high, or if the meter does not report a level (unable to lock*) check levels at the tap. If tap levels are good, then work downstream one splitter or component at a time until the bad component is found. ** If modem does not lock, make sure the correct downstream DOCSIS frequency is programmed into the meter.*

Ingress Testing

Unwanted Ingress on the return path can also slow down a modem or cause a connection problem, even though return levels may be good. Even if the modem is connected to the first two-way splitter, Ingress anywhere else in the home will eventually be combined with the modem's return signal. Ingress and Leakage are two tests that effectively qualify the shielding and allow an installer to quickly find and fix any shielding problems in the home. See page 18 for more information on Shielding Qualification.

Return Path Tester (RT100 - Optional Accessory)

The Return Path Tester (model RT100) is a portable oscillator that outputs a +45dBmV signal at 8, 34 and 60MHz. The RT100 is used in conjunction with any signal level meter to quickly determine the gain or loss of cables, splitters, amplifiers, ground blocks or any other component in the return path as well as the forward path. RT100 does NOT display return levels – it DOES allow installers to quickly identify and replace defective components. Please contact Sadelco for pricing.

User Setup

General

Individual input codes allow the user to view or edit specific menu items. **All input codes are preceded with a decimal point and are terminated by pressing and holding the Enter key for two seconds.** All setup items have been preset by Sadelco to match the needs of the typical user. It is advisable to review all setup items and make sure they make sense for your specific system or application.

Input codes will have one of the following actions: a) View only: Certain items are not editable, such as model type or serial number. b) Set: Sets a specific value. c) Toggle: Toggles between two values each time code is entered. d) Scroll: Once code is entered, the displayed value is changed using the up / down arrows. e) Keypad: Data is entered via numeric keypad. f) Trigger: Triggers a one-time event, such as resetting factory defaults.

To prevent accidental or unauthorized editing, the menu system can be set to view-only. In the view-only mode, input codes allow the user to view the current setting, but will not allow any changes. To set the view-only mode, enter the following keys: 201.99 + ENT, **Hold enter for two seconds.** The LCD will display “Loc” (lock) on the top row and either “Ena” (enable) or “diS” (disable) on the bottom row. This input code toggles between enable and disable each time it is entered.

User Setup Table (enter code, then press ENTER for 2 seconds)

Code	Setup Item	Factory Default Setting
.00	Auto Shutoff disabled	
.05	Auto Shutoff set to 5 min	Default setting
.10	Auto Shutoff set to 10 min	
.50	Select Channel Plan	Plan 1 – EIA (standard)
.51	Display Part Number	
.61	User C/N Offset	0 dBmV
.62	User MER Offset	0 dBmV
.63	User BER Offset	Contact Sadelco
.66	DOCSIS Downstream Freq.	00.000 (MUST PROGRAM)
.70	Level Check P/F Loop	
.70A	Analog High	15 dBmV
.70B	Analog Low	0 dBmV
.70C	Digital High	7dBmV
.70D	Digital Low	-8dBmV
.72	Ingress Start Frequency	5.000 MHz
.73	Ingress Stop Frequency	40.000 MHz
.74	Ingress P/F	-35dBmV
.75	Leakage Frequency	133.250 MHz
.76	Leakage Setup Loop	
.76A	Distance	3ft
.76B	Antenna	1 (rubber duck)
.76C	Gating (rejects false leaks)	Enabled
.76D	Level Units	uV/m
.76E	Leakage Calibration Offset	0dBmV
.77	Auto-Cal during Level Check	Enabled
.80	Display Software Revision	
.81	Display Serial Number	
.82	Display Calibration Date	
.83	Self-Test (software only)	
.84	Display Tuning Range	
.92	Keypad Beep	Enabled
.93	Digital Calibration Offset	0dBmV
.94	Display Favorite Offsets	
.95	Reset to Factory Defaults	
.96	Tenths dB Digit On/Off	On
.97	Calibration Offset	0
.99	dB Units (dBmV or dBuV)	dBmV
201.99	Setup Lock (Enable/Disable)	Disable

Description of Setup Items

The following section provides a detailed description of what each menu item does and how the menu system works. To simplify the descriptions, common rules were omitted: a) After selecting a new value or setting, you must press the Enter key to program the value / setting into memory. b) When entering a loop, continue to press Enter to view items without making changes. c) If a value is changed and you decide to not program it into memory, press Escape. d) If you are in the middle of a loop and press Escape, prior loop entries are still saved.

<u>Code</u>	<u>Description</u>
.00	Auto Shutoff Off: Disables automatic shutoff. Meter will only turn off with use of on / off key.
.05	Auto Shutoff 5min: Sets automatic shutoff to 5 minutes. Meter will turn off after 5 minutes without a key being pressed.
.10	Auto Shutoff 10min: Sets automatic shutoff to 10 minutes. Meter will turn off after 10 minutes without a key being pressed.
.50	Select Channel Plan: View current plan or use up / down arrows to select new plan.
.51	Display Part Number: View part number to determine which features are enabled on your meter – see Appendix A, pg 34
.61	C/N Offset: View current value for C/N offset. Use up / down arrow to select new value.
.62	MER Offset: View current MER offset. Use up / down arrow to select new value.
.63	BER Offset: Contact Sadelco for support.
.66	Modem's downstream DOCSIS frequency. (see modem setup)
.70	Level Check Pass / Fail (Loop): Enters loop allowing viewing and editing of 4 parameters associated with Level Check. The 4 menu items are .70A through .70D.
.70A	Analog High Pass / Fail: View current value for the maximum analog channel level during Level Check mode. Use up / down arrow to select new value.
.70B	Analog Low Pass / Fail: View current value for the minimum analog channel level during Level Check mode. Use up / down arrow to select new value.
.70C	Digital High Pass / Fail: View current value for the maximum digital channel level during Level Check mode. Use up / down arrow to select new value.
.70D	Digital Low Pass / Fail: View current value for the minimum digital channel level during Level Check mode. Use up / down arrow to select new value.
.72	Ingress Start Frequency: To enter a new start frequency for Ingress Check mode, first tune to the desired frequency (see Tuning by Frequency). Next, enter .72 + Enter. The LCD will initially display the current frequency. Pressing Enter will display the new

<u>Code</u>	<u>Description</u>
	frequency and the LCD will start to flash. Pressing Enter again will program the new frequency into the menu.
.73	Ingress Stop Frequency: To enter a new stop frequency for Ingress Check mode, first tune to the desired frequency (see Tuning by Frequency). Next, enter .73 + Enter. The LCD will initially display the current frequency. Pressing Enter will display the new frequency and the LCD will start to flash. Pressing Enter again will program the new frequency into the menu.
.74	Ingress Pass / Fail Threshold: Displays the current pass / fail threshold for the Ingress Check mode. Use the up / down arrow to select a new value.
.75	Leakage Frequency: To enter a new frequency (110 – 140 MHz) for Leakage Check mode, first tune to the desired frequency (See Tuning by Frequency). Next, enter .75 + Enter. The LCD will initially display the current frequency. Pressing Enter again will display the new frequency and the LCD will start to flash. Pressing Enter again will program the new frequency into the menu.
.76	Leakage (Loop): Enters loop allowing viewing and editing of 5 leakage parameters associated with leakage. The 5 menu items are .76A through .76E.
.76A	Distance: View current leakage distance. Use up / down arrows to scroll between 3 possible distances: 3ft., 10ft. and 20ft.
.76B	Antenna Select: View current leakage antenna. Use up / down arrow to scroll between 3 possible antennas: Ant-1 Duck, Ant-2 Monopole and Ant-3 Dipole.
.76C	Gate On / Off: Display current status of leakage gating: Enabled (EnA) rejects false leaks. Disabled (diS) allows meter to respond to any type of signal. Use up / down arrow to select.
.76D	Level Units: View current status of level units. “Sho dB / EnA” enables the showing of dB units. In this setting the displayed units are dBmV. “Sho dB / diS” disables the showing of dB units. In this setting the displayed units are uV/m – the standard units for leakage measurements.
.76E	Cal Offset: View current value for leakage calibration offset. Use up / down arrow to select new value.
.77	Autocal During Level Check: Allow faster Level Check by disabling autocal during Level Check mode. Entering code toggles between Enable (EnA) and Disable (diS). Disabling autocal adds .5 dB to the specs at room temperature and 1 dB
.80	Software Rev: View current software revision.
.81	Serial Number: View current serial number.
.82	Cal Date: View factory calibration date.
.83	Self Test: Initiates a self test of the microprocessor / logic circuits.
.84	Tuning Range: View tuning range of meter.

<u>Code</u>	<u>Description</u>
.92	Disable Beep: Toggles between beep Enabled (EnA) and beep Disabled (diS). When beep is enabled, the speaker emits a beep everytime a key is pressed.
.93	Digital Cal Offset: View current setting for digital channel calibration offset. Use up / down arrow to select to value. Entered value is applied only to digital channel.
.94	Display Favorite Offsets: Favorite Channels programmed as frequencies have the option of level offsets. Use up / down arrows to scroll through all Favorite Channels and view offsets. Offsets can only be viewed.
.95	Reset User Defaults: Resets all menu items to factory defaults. Also sets all channels to analog and clears all Favorite Channels. When this code is entered, the LCD will display “Erase”. Press Enter again to initiate the reset, or press Escape to abort reset.
.96	Tenths dB Digit On / Off: Enables (EnA) or disables (diS) the digit to the right of the decimal point on the dB readout. Use up / down arrows to select.
.97	User Cal Offset: View current calibration offset. This value is added to all signal level readings; including analog channels, digital channels and frequency. (does NOT apply to leakage – see .76E for leakage cal offset)
.99	dB Select: Selects either dBmV (USA Standard) or dBuV (European Standard). When code is entered, the units will automatically toggle from one unit to the next and will display the new unit on the LCD. When going into dBmV, the LCD will flash “dB USA”. When going into dBuV, the LCD will flash “dB Eur”. Note: dBuV reads 60 dB higher than dBmV.
201.99	Lock user’s ability to make changes to meter setup.

Auto-Calibration

Each DisplayMax 5000 is individually calibrated using a proprietary computer-controlled calibration process. Ultra-precision signal generators are referenced over the entire frequency and power range to produce calibration data for the full measurement window of the instrument. The process is then repeated with the meter in a temperature chamber, guaranteeing accurate readings at any frequency, at any power level, and at any temperature. To maintain accuracy over time, each meter has a precision white-noise calibration reference that is used to “Auto-Calibrate” at power-on, at regular intervals while the meter is in use, and every time a new channel is tuned. Auto-Calibration detects and corrects errors in accuracy resulting from the short-term ‘warm-up’ of components when the instrument is first turned on as well as the long-term affects of aging components and daily field abuse. This unique calibration method eliminates the need for periodic factory calibration.

Warranty / Service

Sadelco warrants all instruments against defects in material and workmanship for a period of twelve months after shipment. Sadelco will repair or replace any assembly or component (except batteries) found to be defective under normal use during this period. Sadelco's obligation under this warranty is limited solely to repairing any instrument which, in Sadelco's opinion, 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 purchaser. Return transportation via UPS surface will be provided by Sadelco. Should the customer request an alternate shipping method, the customer will be solely responsible for any charges in excess of UPS surface rates.

This warranty does not apply to any products repaired or altered by any persons not authorized by Sadelco, or not in accordance with instructions furnished by Sadelco. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions of operation, the warranty will become void. In doubtful cases, we will contact the purchaser for non-warranty repair authorization. Please notify us if an estimate is required.

Sadelco assumes no responsibility for its products being used in a hazardous manner either alone or in conjunction with other equipment. Sadelco assumes no liability for secondary damages and, in any event, Sadelco's liability for breach of warranty under any contract or otherwise shall not exceed the purchase price of the specific product shipped and against which a claim is made.

An RMA number is not required to return warranty or non-warranty repairs to Sadelco. However, an RMA number IS required on all upgrades. Sadelco assumes no liability for any product in transit to Sadelco. Please make sure to include a description of the problem or symptom along with your company name, address, telephone, fax, email, and contact person.

For Warranty or Repair Service return to:

Sadelco, Inc., 75 West Forest Ave. Englewood, NJ 07631 USA

Tel: 800-569-6299 (USA Only) Tel: 201-569-3323 Fax: 201-569-6285

e-mail: service@sadelco.com Website: www.sadelco.com

Troubleshooting Guide

Battery will not hold a charge:

- Make sure you're using a "T70" charger.
- Make sure charger is not defective & outlet is active.
- If using CH04 car charger, check for blown fuse.
- Charge for 12 hours.

Signal level is incorrect:

- Make sure correct channel plan is selected.
- Make sure channel is programmed correctly (Analog vs. Digital)
- Check F-connector for dirty or open contacts.
- If measuring leakage, make sure correct antenna and distance are entered into the menu.

Modem does not lock:

- Verify the downstream DOCSIS frequency is correct.
- Make sure downstream DOCSIS channel power is $> -15\text{dBmV}$.

Display Codes:

- Ur – Under Range (signal level is below measurement range)
- Or – Over Range (signal level is above measurement range)
- Error 1 – Channel type not compatible with test (example: attempting to measure MER or BER on an analog channel, or C/N on a digital channel)
- Error 2 – Signal level out of tolerance for test (example: attempting to measure MER or BER on a digital channel below -15dBmV , or C/N on an analog channel below -5dBmV)
- Error 3 – Meter must be returned to Sadelco for service.
- FAIL – Meter must be returned to Sadelco for service.
- Error 5uP – Meter must be returned to Sadelco for service.

Contacting Sadelco

Sadelco Inc. 75 West Forest Avenue Englewood, NJ 07631
Tel: 201-569-3323 Tel: 800-569-6299 Fax: 201-569-6285
Website: www.sadelco.com Email: sales@sadelco.com

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APPENDIX A - Sadelco Part Number vs. Feature Table

Part Number	Opt 1	Opt 2	Opt 3	Opt 4	Opt 5
Displayed	Ingress	Leakage	MER/BER	Modem	1 GHz.
DM5 00000					
DM5 10000	X				
DM5 02000		X			
DM5 12000	X	X			
DM5 00300			X		
DM5 10300	X		X		
DM5 02300		X	X		
DM5 12300	X	X	X		
DM5 00040				X	
DM5 10040	X			X	
DM5 02040		X		X	
DM5 12040	X	X		X	
DM5 00340			X	X	
DM5 10340	X		X	X	
DM5 02340		X	X	X	
DM5 12340	X	X	X	X	
DM5 00005					X
DM5 10005	X				X
DM5 02005		X			X
DM5 12005	X	X			X
DM5 00305			X		X
DM5 10305	X		X		X
DM5 02305		X	X		X
DM5 12305	X	X	X		X
DM5 00045				X	X
DM5 10045	X			X	X
DM5 02045		X		X	X
DM5 12045	X	X		X	X
DM5 00345			X	X	X
DM5 10345	X		X	X	X
DM5 02345		X	X	X	X
DM5 12345	X	X	X	X	X

X = Enabled Feature

