

# APR474



## AUTOMATIC PICTURE REJUVENATOR

INSTRUCTION MANUAL

IB 6440-01

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APR474  
TABLE OF CONTENTS

	<b>PAGE</b>
<b>1.0 FEATURES AND BENEFITS OF THE APR474</b>	<b>2</b>
<b>1.1 AUTOMATIC PICTURE RESTORATION</b>	<b>2</b>
<b>1.2 AUTOMETIC PICTURE CLARITY RESTORATION</b>	<b>3</b>
<b>1.3 COAX vs. APR474 FREQUENCY RESPONSE CURVE</b>	<b>3</b>
<b>1.4 AUTOMATIC CORRECTION FOR "HOT CAMERA LEVELS"</b>	<b>4</b>
<b>1.5 AUTOMATIC POWER LINE INTERFERENCE CANCELLATION</b>	<b>5</b>
<b>1.6 COST COMPARISON, APR474 vs FIBER OPTIC CABLE</b>	<b>5</b>
<b>1.7 TANDUM OPERATION ON COAX OVER 5000 FEET</b>	<b>6</b>
<b>2.0 SHIPPING INSPECTION</b>	<b>6</b>
<b>3.0 HOW AND WHERE TO MOUNT THE APR474</b>	<b>6</b>
<b>4.0 MODUAL CARD INSTALLATION</b>	<b>7</b>
<b>5.0 HOW TO CABLE THE APR474</b>	<b>7</b>
<b>6.0 POWER SUPPLY INSTALLATION</b>	<b>8</b>
<b>7.0 SET- UP OF THE APR474</b>	<b>8</b>
<b>8.0 OPERATION</b>	<b>8</b>
<b>9.0 FRONT PANEL INDICATORS</b>	<b>8</b>
<b>10.0 CARE AND MAINTENANCE</b>	<b>9</b>

## **1.0 FEATURES AND BENEFITS OF THE APR474**

It is now possible to transmit clear pictures over coaxial cable for up to a mile on RG59/U cable using the new APR474 AUTOMATIC PICTURE REJUVENATOR at the receiving end of the coaxial cable. This will open up many picture transmission opportunities that formerly required Fiber-Optic transmission at a far greater cost to the installer. Direct transmission using the APR474 on coaxial cable can be far more economical than the cost of Fiber-Optic transmission equipment.

The APR474 is placed at the receiving end of a cable connecting a camera to a central receiving location (often the location of the recording facility). The Automatic Picture Rejuvenator is a circuit card that plugs into a Card-Cage and contains four Rejuvenators on one card. There are four types of cards available to suit all types of installations.

1. The APR474 is for use with a 75-Ohm coaxial cable at both input and output terminals.
2. The APR474/D is also for use with a 75-Ohm output cable, with an additional video output to drive a second monitor. It has a built-in two-output distribution amplifier.

The APR474 insures that every camera connected to its input will deliver the best picture that the camera is capable of producing, no matter how long the camera cable is, up to 5000 feet for coaxial cable. Furthermore, the APR474 will continue to make these corrections to the amplitude and frequency response of the system throughout the life of the system, even while moisture is penetrating the insulation and increasing cable loss.

### **1.1 AUTOMATIC PICTURE RESTORATION**

The APR474 Automatically corrects video levels, and continues to do so, automatically, on a moment-by-moment basis. The APR474 will automatically correct all losses that the cables will induce over the life of the cable.

The APR474 always operates to correct any losses as they occur. That causes the received signal at the VCR to appear as though there were zero feet of cable between the camera and the VCR, no matter how many feet of actual cable there may be, up to 5000 feet of RG59A/U cable, or even greater distances with lower loss coaxial cable. Even at these distances, the received signal will look just as good as a back-to-back bench test.

## **1.2 AUTOMATIC PICTURE CLARITY RESTORATION**

The "clarity" of a picture is primarily determined by the frequency response of the camera and the high frequency losses incurred by the intervening coaxial cable. The frequency response of the camera is set by the number of "pixels" etched onto the "CCD" Charge Coupled Device "Chip", while the high frequency losses of the coaxial cable is determined by the length and composition of the cable itself. The pixels available on any given camera are fixed and cannot be improved upon except by changing the camera to another higher quality unit. However the primary cause of picture degradation is the cable itself. The distance a picture goes over coax will determine the degree of picture degradation that will occur, unless steps are taken to compensate for the cable loss. While the picture brightness is an obvious visible effect easily compensated for by adjusting the IRIS on the camera, the loss of frequency response is cumulative and not easily corrected.

In order to improve the picture clarity on long cable runs, it is necessary to amplify the higher frequencies much more than the lower frequencies in proportion to the loss being incurred on the cable length. Coax cables attenuate low frequencies differently than the high frequencies so just straight amplification is not the answer. FM Systems, inc. has devised a way to correct this cable loss automatically for cable lengths up to 5000 feet long. The APR474 AUTOMATIC PICTURE REJUVENATOR will correct this high frequency cable loss in increments of about 5000 feet each. That is, a single APR474 will correct for any length of cable up to a maximum of 5000 feet, while another APR474 hooked up in tandem with it will correct for additional cable length to 10,000 feet, etc. Each cable and APR474 will produce a picture with a 70 dB signal to noise ratio, so several can be connected in tandem without decreasing the effective signal-to-noise ratio below normal.

The APR474 is capable of high quality picture transmission over distances ordinarily reserved for Fiber Optic transmissions and can compete with Fiber Optic systems in the 300 feet to 5000 feet (for a single APR474 unit) and 15000 feet for three APR474 Automatic Picture Rejuvenators operating in tandem. Below 300 feet, the CCTV cameras are usually used alone, without additional transmission equipment, although even at that distance the APR474 will improve the quality of a picture noticeably.

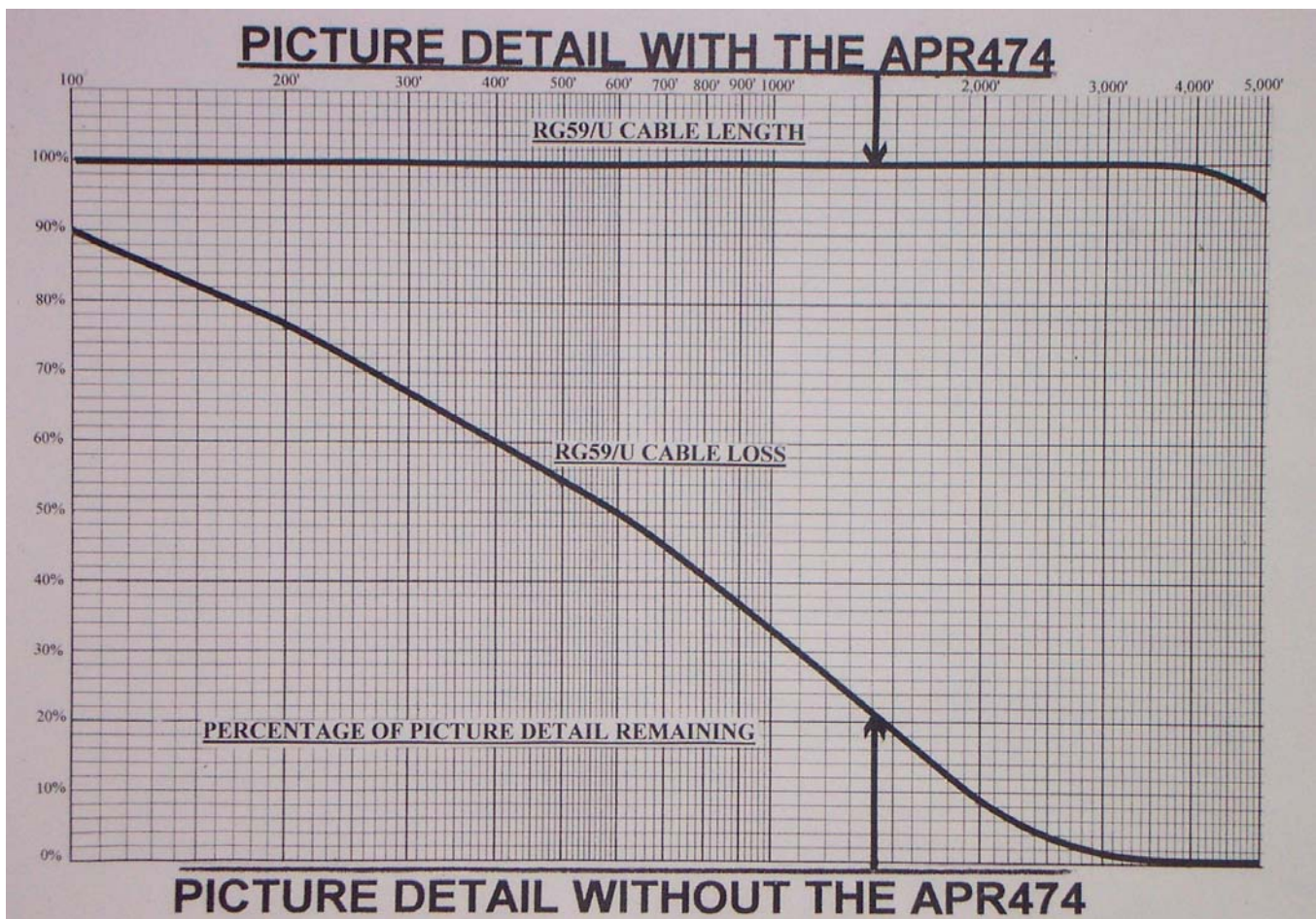
## **1.3 COAX vs. APR474 FREQUENCY RESPONSE CURVE**

The frequency response of a coaxial cable like the RG59/U cable that is used most frequently by the CCTV installers, can be plotted with the length of the cable plotted against the amount of detail remaining after traversing that given distance. In this plot, the percent of picture detail remaining in the picture is taken to be when the highest frequency (4.2 MHz) is reduced in power at that distance by 50% of the original signal power at the camera.

As can be seen from the RG59/U curve on the "picture detail loss plot", even at a distance of 100 feet, about 10% of the detail has been lost, by 600 feet, about 50% of the original detail has been lost, and the picture is now much fuzzier than the picture at the camera. This is why many CCTV installers try to keep cable lengths down to a few hundred feet. The picture gets fuzzy because of the high frequency loss on the coaxial cable. In addition to the fuzzier picture, the picture brightness is also reduced by long cables. While it is possible to create a brighter picture by increasing the receiving amplifier gain back to normal levels, the loss in picture detail cannot be corrected in this way.

This is where the APR474 comes in to save the day. The Automatic Picture Rejuvenator restores the original picture brightness automatically back to the original brightness at the camera and also automatically corrects the cable induced loss of picture detail. The picture is viewed as though there was no cable present between the camera and the VCR up to 4000 feet and only an imperceptible loss of 5% of the picture detail at 5000 feet. The APR474 does all this automatically, without any attention required on the part of the CCTV installer, and furthermore will continue to apply this correction even, when cables age, or are lengthened or replaced for any reason.

This ability of the APR474 to compensate for the losses otherwise present in the coaxial cable picture transmission enables the CCTV camera to traverse up to a mile of cable, while still providing a picture equal in quality to the same camera with only 100 feet of connecting cable. At cable lengths of 4000 feet or less, there is no loss at all, just as though the test was being performed on a test bench with zero length cables. No adjustment of any kind are required to maintain the cable at zero effective length.



#### 1.4 AUTOMATIC CORRECTION FOR "HOT CAMERA LEVELS"

Some camera manufacturers produce cameras that output pictures with excess video voltage levels on their automatic iris cameras in the hope that this will enable a CCTV operator to transmit a picture further with their camera than a competitor's camera. We refer to these cameras as "hot cameras". Unfortunately, they only increase the video voltage level and do not increase the high frequency response so the loss in definition is just the same as a standard output level camera. This results in a brighter picture with reduced detail and poor contrast.

This excess video signal level can, however, cause a problem with the DVR (Digital Video Recorder) at the receiving end of the transmission system particularly with short cable runs. Many DVR's will actually stop working when excess video levels occur. They either show a blank screen refusing to recognize the input video signal or they "freeze-frame" and display only the last frame of video that was not over loaded. The APR474 detects this excess video level condition by lighting a red LED whenever a hot camera is installed on a CCTV system, enabling the operator to set the video level at the APR474 output to the correct level with a front panel control to correct this condition.

After the camera is installed the installer adjusts the output level control counter-clockwise until the red LED just barely turns off. This adjustment will set the output level to just exactly the correct level so that all pictures will be the same brightness and none will be at the edge of overload. Once the front panel control is set, the unit will automatically control all received levels and output a standard video signal.

## **1.5 AUTOMATIC POWER LINE INTERFERENCE CANCELLATION**

The APR474 completely cancels 60-Hertz Power Line interference that is injected by the power industry into every common ground. Unfortunately, there is only one "ground" and the Power Industry and the CCTV industry both use the same ground. This results in 60 cycle Power Industry energy cross-talking into CCTV video signals. Whenever a system is grounded in more than one location (i.e. at the camera case and the video recording system), a 60Hz current can flow in the cable. This 60 Hz AC power line voltage may even exceed the video voltage of 1 V p-p. When this induced voltage exceeds approximately 10% of the video voltage (i.e., about 0.1 Volts), then "60 cycle bars" may appear in the picture, and as the interference increases, the picture can be completely wiped out. The level of cross-talk from the Power Industry will change from time to time, depending on the degree of load unbalance existing in the power system at the time (i.e. as lights are turned on and off, etc.

The APR474 is equipped with circuitry that senses these changes automatically and will clear the picture of this type of interference, even if the 60-cycle interference exceeds many volts. This 60 cycle interference can change in amplitude over a very wide range as the "load" on the 60 cycle line varies over time. So, just because the interference measures low at one time, that is no reason to believe that it will remain low in the future. The only insurance against this type of interference is positive protection provided by the APR474 Automatic Picture Rejuvenator.

## **1.6 COST COMPARISON APR474 vs. FIBER-OPTIC CABLE**

Fiber Optic transmission equipment has traditionally been used when CCTV distances are over 500 to 1000 feet long. This was done to improve the video picture quality on the long runs of cable. However the cost of Fiber Optic equipment is significant and the fiber run it-self presents special problems in cutting, trimming, and connector terminations. Also the need to put Fiber Optic transmitter equipment in the field out at the cameras location usually requires extra enclosures and additional power at the site. There is a lower cost and easier way to make these mid-range CCTV runs without the need for Fiber Optic equipment and with no additional equipment in the field.

receivers per channel, and in addition, the APR474 need only be installed at the common receiving location. An exact comparison between a camera equipped with an APR474 Automatic Picture Rejuvenator will vary somewhat depending on the exact model chosen for the Fiber Optic equipment as a comparison. By contrast the Fiber Optic transmitter must also be installed at the camera location, often imposing additional costs for power and enclosures for housing the Fiber Optic equipment. Fiber Optic transmission equipment is often chosen because of the picture definition lost on long coaxial cables. This loss does not occur when the APR474 is installed at the end of the coaxial cable, so expensive Fiber Optic equipment need not be purchased for these applications.

## **1.7 TANDUM OPERATION ON COAX OVER 5000 FEET**

When it is desirable to operate for distances in excess of 5000 feet, one or more sections of cable, each roughly evenly spaced, can be connected in tandem for any distance up to three miles. Each section of cable will automatically deliver a full quality picture at the terminus of each section eliminating the need to employ Fiber Optic equipment and cable, and at a much lower price. Now a standard CCTV coaxial cable can deliver high quality pictures over distances previously reserved for Fiber Optic transmission, and at a much lower cost.

## **2.0 SHIPPING INSPECTION**

Remove from shipping container and inspect for shipping damage. The APR474 is a Slide-in Card that fits into the RMS-400 Mainframe and Power Supply. The card is supplied with a retaining screw (attached to the PC Board), a Front Label Designator and this instruction book. If an RMS-400 Mainframe and Power Supply was purchased with a APR474 Card, the Card will be installed at the factory into the Mainframe with labels attached and the retaining screw engaged and locked.

## **3.0 HOW AND WHERE TO MOUNT THE UNIT**

Select a position for the RMS-400 that is near the video recorder, monitor or other equipment that needs video control. The placement is not critical. Then install the APR474 PC CARD in any unused CARD SLOT that is empty. Follow the instructions for PC card installation. Be sure to remove the retaining screw on the front of the card and not to apply excessive force to the card during installation.

## **4.0 MODULE CARD INSTALLATION**

1. Select one of the un-used nine positions to be occupied by the new circuit board module.
2. Remove the blank label in that position by peeling it off of the front panel. Peel the label slowly to remove all of the label and adhesive. Any remaining adhesive may be removed by rubbing the surface with your thumb. **WARNING: DO NOT USE SOLVENTS TO REMOVE THE LABEL ADHESIVE.** The solvent could damage the equipment cards or cause a fire.

## **4.0 MODULE CARD INSTALLATION (cont.)**

3. Peel the backing off of the new label and apply it to the front panel of the RMS-400 rack in

the position of the new card. Align the new label with the screw head in the hole in the lower right hand corner of the label, then align the center thumbscrew with the clearance hole in the front panel. This should cause the label to be straight and vertical. When the label is in place press firmly to secure the label.

4. Then remove the thumbscrew retainer from the product card, it is located at the front of the card and is removed by rotating the knob counter-clock-wise.
5. Select any and all product options on the specific card.
6. Next slide the card into the card guides at the rear of the RMS-400. Be sure that the notch in the circuit card is facing forward and down. Push the card all the way to the front of the rack until it stops. **DO NOT APPLY EXCESSIVE FORCE TO THE CARD.**
7. Insert the thumbscrew that was removed in step 4 while rotating it in a clock-wise direction. When it begins to thread into the card, continue until it is finger tight. **CAUTION TIGHTEN BY HAND ONLY DO NOT USE TOOLS TO TIGHTEN THE THUMB-SCREW. OVER TIGHTENING WILL DAMAGE THE CIRCUIT CARD.**
8. Attach any cables or wires necessary for operation.

Most circuit board modules have several adjustments that are carefully factory set with precision instruments for optimum performance. **WARNING: DO NOT** adjust any controls, some controls when miss-adjusted produce little change under normal operating conditions, but can seriously reduce the ability of the unit to function correctly under other conditions that may be encountered.

## **5.0 HOW TO CABLE THE UNIT**

The unit has four independent channels. All input, output, and controls are marked with the suffix "A", "B", "C", or "D" depending on the channel you are working with. This manual will describe the connection and operation of the "A" channel. The other channels are connected and operated exactly the same as the "A" channel.

Connect a cable from your source video to the "VIDEO INPUT A" of the APR474 PC Card. The "VIDEO INPUT" is internally terminated by a precision 75 Ohm termination to match standard coaxial video cable.

Next connect a cable from the VIDEO OUTPUT connector on the APR474 to the equipment you wish to have controlled video supplied to. There may be two separate video outputs on each channel if the "D" (D.A.) option was ordered so that two video circuits may be driven at once with the same video signal. The "VIDEO OUTPUTS" of the APR474 have 75 Ohm output impedance to match standard video cable. Be sure the equipment being driven is properly terminated with a precision 75 Ohm termination to insure correct video level. Failure to terminate the output cables with an accurate 75 Ohm termination is the leading cause of incorrect video output voltages.

## **6.0 POWER SUPPLY INSTALLATION**

Power for the APR474 is supplied by the RMS-400 Mainframe. It supplies the card with +/-



12 VDC to power the card.

## **7.0 SET-UP OF THE APR474**

There is only one control that may be set from the front panel. This control is a video output trim control to set an exact level to match all the other levels in your system. After all video cables have been connected rotate the "LEVEL" control fully clock-wise (this should light the red LED when a camera is connected to the channel), then rotate the control counter clock-wise until the red front panel LED just goes out. This control need only be adjusted one time at set-up for a particular camera and then the video level will be maintained automatically at that level for all input variations as long as that particular camera remains connected into the system.

## **8.0 OPERATION**

The APR474 is an Adaptive Picture Rejuvenator for use in all CCTV video installations to improve the quality of your video images. It has the ability to extend the use of Coax Cable up to 5,000 feet without the need for equipment on the sending end. This single ended solution will automatically remove distortion and sharpen your video images from color and B/W cameras. It is especially useful in systems that switch cameras with different lengths of cable. Each card has four independent control systems to regulate four video channels.

This product will replace expensive fiber-optic equipment on short haul (1000 to 5000 foot runs) allowing you to use standard coaxial cable at a substantial dollar savings and it is less trouble because all the equipment is at the "head-end" (DVR end) of the system with no need for fiber optic transmitters in the field.

The adaptive level control will watch over your video to prevent DVR overload that blanks out the video image, this occurs when the incoming video level exceeds the maximum level allowed by the DVR. Any low level signals caused by old or damaged cables will be automatically corrected and troublesome water soaked or leaky direct bury cables will have their pictures restored to original sharpness and level.

Coax cables degrade with time and are exposed to the elements that cause a slow but inevitable reduction of picture quality due to increasing cable loss. The picture rejuvenator will automatically correct the level and keep up with the loss over time.

Some of your customers require a second video output to drive the signal to another monitor or switcher in the system. The APR474 can be ordered with an optional secondary video D.A. output to drive another device.

## **9.0 FRONT PANEL INDICATORS**

A green "VIDEO ON" indicator for each channel shows that a video signal is present at that input to identify signal continuity. A red "LEVEL" LED indicates the correct level output for matching video levels in your system when the red LED is just barely lit. Once your level is set the automatic control will keep the level correct.

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PAGE 8 OF 9

## **10.0 CARE AND MAINTENANCE**

Care should be taken not to subject the APR474 to extreme moisture or temperatures

outside normal operating range. There are no periodic maintenance adjustments to be made on the APR474. If the unit does not function properly it should be returned to the factory for repair. There are no field adjustable controls beyond the front panel.



APR474 with the "D" suffix with dual video outputs