Equalizers
Duplexers
Automatic level control
Automatic tilt control
Matching transformers
Home splitters
Tapoffs: Pressure taps, hybrid types, isolation, thruloss.

17. Accessories: housings mountings
18. Test instruments and their uses, particularly the field strength meter.
19. Servicing and installation:
    Signal probing, checking of cables, grounding, weather proofing, use of test equipment, trouble shooting by symptoms, checking defective distribution lines, preventive maintenance.
20. Specifications: Interpretation and writing.
21. Cost estimates.
22. Pole line construction.

CATV - AUXILIARY PROGRAMS

23. Basics for closed circuit (CCTV) program origination.
    a) lighting
    b) lenses
    c) types of cameras
24. Weather channel, sub-channels, microwaves

CHAIRMAN TAYLOR: Thank you very much. Does anyone want to ask Ike questions about this training program?

QUESTION: Is this training available to anyone, and on what basis?

MR. BLONDER: We have conducted seminars throughout the United States, usually in regions, conducted by our Regional Sales Manager. I must admit that we have concentrated much more on the NATV area in which we have had, in the past, a greater interest, but we are setting up a new program. If you will indicate to us your interest in participating, you will find that we will have a regional meeting in your area eventually to which you are certainly invited.

CHAIRMAN TAYLOR: Our next speaker is Mr. George Bates, Vice President of Engineering for DYNAIR Electronics, Inc. Mr. Bates will speak on the use of the sideband analyzer and its applications. Mr. Bates.

MR. GEORGE W. BATES (DYNAIR ELECTRONICS, INC.): The "sideband analyzer" is well-known to the television broadcast engineer; it's one of the basic tools of his trade. However, for some unknown reason, the average CATV engineer - who has even more need for this device - is not familiar with its application in CATV and, in many cases, doesn't even know it exists.

The purpose of this paper is to introduce the sideband analyzer to the CATV engineer and to show the many reasons why it is almost mandatory that this device be used for efficient maintenance of today's complex CATV systems. In our opinion, there is no other method which will enable a head-end to be maintained-economically-in top operating condition. This device, which replaces a multitude of expensive test equipment, enables the engineer to precisely determine the quality of his modulators, in a matter of minutes, without even removing a dust cover!

Almost anyone who has worked around a television modulator of any type is familiar with the time-consuming point-to-point method of determining over-all video and RF response. A typical test setup for this method is shown in Figure 1. The required equipment consists of a wideband oscilloscope, an RF marker generator, an RF sweep generator, a video sweep generator, a VTVM, an attenuator, detector probes, and about a dozen miscellaneous cables - roughly $8,500.00 worth of precision test equipment!

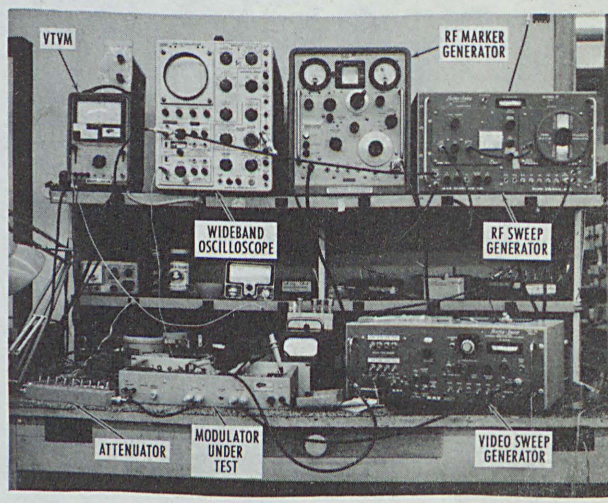
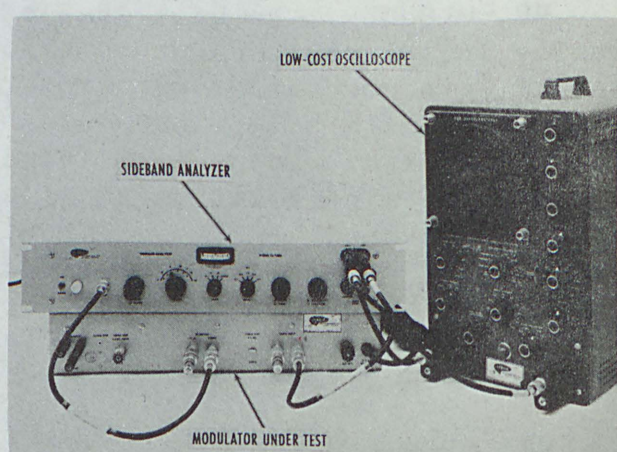


Figure 2 illustrates a test setup for performing the same function, with the same accuracy, only using a sideband analyzer, an inexpensive oscilloscope and four miscellaneous cables - total cost of equipment here: roughly $1,150.00. (Sideband analyzer - three popular models are available - range in price from $950.00 to $3,500.00, with a low-cost oscilloscope costing about $200.00.)

The test as performed with the sideband analyzer will only take a few minutes and, if desired, can be performed with the modulator mounted in a rack. However, the point-to-point method shown in Figure 1 requires, from start to finish, usually a minimum of 2 hours, and is much more involved, consisting of: (1) removing the modulator from the rack, (2) removing the dust covers, (3) clipping into certain parts of the circuitry, (4) sweeping the video amplifier, (5) sweeping the RF amplifiers, and (6) reassembling the modulator and reinstalling it in the rack.

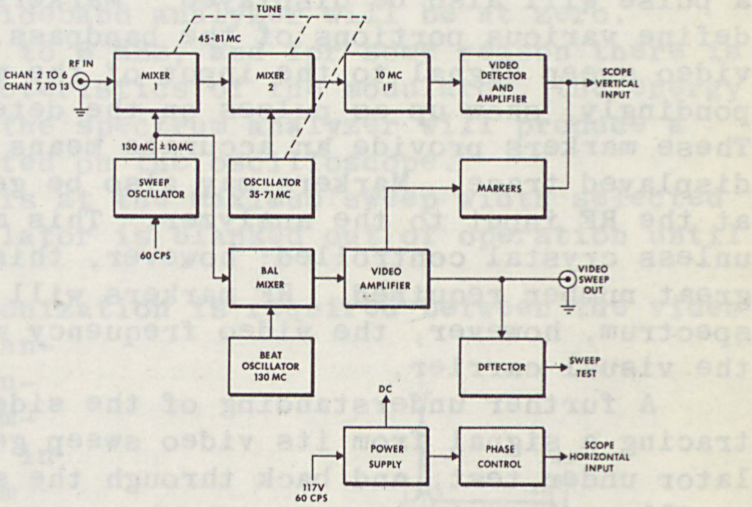


Problems are also involved which further decrease the desirability of the point-to-point method. The RF input coupling is, in most cases, extremely critical, with improper coupling producing inferior and uncertain results. Even when properly performed, the point-to-point method will not assure a quality picture when the modulator is returned to the system.

On the other hand, the sideband analyzer checks the modulator as it actually operates in the system, assuring a precise evaluation. Any spurious frequencies present are seen, and the test gives a true evaluation of the quality of picture the modulator will produce.

Other rather obvious advantages of using the sideband analyzer are: (1) less space is required for test equipment, (2) it is extremely simple to operate, and (3) none of the ground-loop problems involved in most sweep techniques are encountered.

When using the sideband analyzer, an internally generated sweep signal is applied to the modulator input. The RF output of the modulator is connected to the RF input of the sideband analyzer. Separate horizontal and vertical oscilloscope outputs are provided on the sideband analyzer which are cabled to their respective oscilloscope inputs. The sideband analyzer is then tuned for maximum vertical deflection at the modulator's operating frequency (operating channel). With power applied to the units, and controls set for normal operating, the oscilloscope will display the bandwidth characteristics of both the video and the RF stages. (See Figure 3) Markers are provided to establish various pertinent points throughout the video bandpass.



As indicated by the previous test setup description, operation of the sideband analyzer is relatively simple. However, it should be noted that what is actually occuring is most complex in nature. In other words, the operation is simple, but the sophisticated circuitry involved in generating the oscilloscope display requires more of an explanation.

The sideband analyzer is essentially a combination of two separate test devices: a spectrum analyzer and a video sweep generator. The spectrum analyzer sweeps continuously through the bandwidth range of the modulator under test, measuring the sidebands and any spurious emmissions of the output signal. Since the spectrum analyzer tracks perfectly with the sweep signal supplied to the modulator by the sweep section of the sideband analyzer, the oscilloscope will trace the sideband generated in the modulator by the video sweep. (This precise tracking function is very essential and is best accomplished with a swept oscillator that is common to both the spectrum analyzer and the video sweep generator portions of the sideband analyzer.)

The basic principle of the device can be compared very closely to a tuneable voltmeter; a voltmeter with an input which is sensitive only to a specific pre-selected narrow frequency range. The sideband analyzer also generates a sweep signal which is applied to the modulator under test, which must be precisely synchronous with the frequency of the tuneable voltmeter input.

If the frequency response of the modulator under test is perfectly flat, and the frequency sensitive voltmeter is tracking at exactly the frequency of the modulator output, the oscilloscope trace will be a perfectly flat line. As the outer skirts of the modulator output begin to roll off (due to the band-limiting characteristics of the modulator), the output of the tuneable voltmeter will roll off correspondingly, causing a similar indication of roll off to appear on the oscilloscope trace.

A pulse will appear on the oscilloscope trace at the visual carrier. If the aural carrier is on at the point the video sweeps through 4.5 MHz, a pulse will also be displayed. Markers are included which may be used to define various portions of the bandpass. The markers are applied with the video sweep signal to the input of the modulator under test and, correspondingly, show up as pulses on the detected sideband analyzer output. These markers provide an accurate means of determining frequencies on the displayed trace. Markers may also be generated at RF frequencies and mixed at the RF input to the analyzer. This method is generally very unstable unless crystal controlled; however, this becomes impractical due to the great number required. RF markers will appear at only one point in the spectrum, however, the video frequency markers appear both above and below the visual carrier.

A further understanding of the sideband analyzer can be gained by tracing a signal from its video sweep generator section, through the modulator under test, and back through the spectrum analyzer section to the oscilloscope outputs.

The video sweep signal generated by the sideband analyzer starts at 8 to 10 MHz, the exact frequency being determined by the adjustment of the video sweep width. As the signal sweeps from 8 to 10 MHz to zero MHz and back to 8 or 10 MHz, the tuned input of the spectrum analyzer is sweeping from 8 or 10 MHz below the visual carrier, through the carrier, and then to 8 or 10 MHz above the carrier.

As the video sweep signal lowers to approximately 1.25 to 1.5 MHz, the response of the modulator under test should be extremely low; this is the lower adjacent aural carrier in the spectrum, and the sideband is attenuated greatly in the modulator. Correspondingly, the detected output of the sideband analyzer will be very low. As the video sweep signal lowers further to .5 MHz, which is .5 MHz below the visual carrier, the modulator response should be reasonably high. At the exact time the video sweep signal reaches zero MHz, the spectrum analyzer section is responding to the visual carrier.

As the video sweep signal returns to 1 MHz, it amplitudes-modulates the visual carrier in the modulator, causing sidebands to occur at 1 MHz above and below the visual carrier frequency. At precisely this time the spectrum analyzer portion of the sideband analyzer is responding to 1 MHz above the visual carrier.

As the video sweep signal proceeds to 2 MHz, the sidebands also move to 2 MHz above and below the visual carrier, and the spectrum analyzer is now responding to this frequency. If the modulator response is still flat, the detected output of the sideband analyzer will be identical to that of the 1 MHz signal.

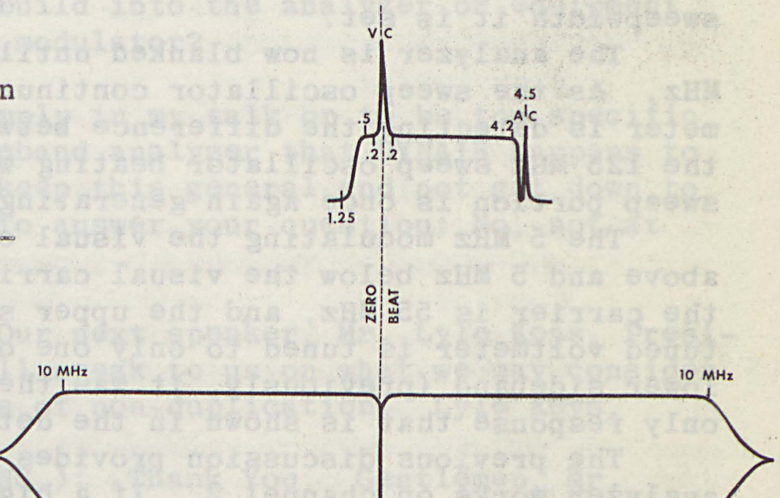
As the video sweep signal proceeds to, for example, 4.3 MHz, where the modulator output should begin to roll off, the video sweep signal is still modulating the visual carrier at 4.3 MHz and the spectrum analyzer is still measuring the amplitude of the sideband; however, because the modulator output is rolled off, the sideband displayed on the oscilloscope will be down several DB at this point.

When the video sweep signal rises to 4.5 MHz, and if the aural carrier of the modulator is being generated, a large pulse will appear on the detected output of the sideband analyzer. As the sweep signal moves to 5 MHz, if there is no response in the modulator, there will be no sideband, and the detected out put of the sideband analyzer will be at zero.

As the sweep signal proceeds to 6 MHz, and for some reason there is a slight rise in the bandpass characteristics of the modulator, the energy level will rise accordingly, and the spectrum analyzer will produce a small output which will be presented on the oscilloscope.

When the video sweep signal is at the maximum sweep width selected (8 to 10 MHz), the sweeping oscillator is blanked out of operation until it returns to the starting point.

Obviously, very close synchronization is required between the video sweep generator and the spectrum analyzer portions of the sideband analyzer. The methods used in accomplishing this can be seen in part in Figure 4, which is a block diagram of a typical sideband analyzer.



As seen in the diagram, the heart of the device is the sweep oscillator. The sweep oscillator deviates above and below its center frequency (usually 120 to 130 MHz) by the amount of sweep width required (usually 8 to 10 MHz). The output of this sweep oscillator is applied to both mixer No. 1 and the balanced mixer.

In developing the sweep signal, assuming, for example, that the sweep oscillator is at 120 MHz, it beats against a fixed 130 MHz signal produced by the beat oscillator, resulting in a 10 MHz output of the balanced mixer. As the sweep oscillator deviates to 130 MHz, the difference signal is zero MHz, and as the sweep oscillator continue to 140 MHz the difference is again 10 MHz.

In developing the spectrum-analyzed output, the sweep oscillator is applied to mixer No. 1, an untuned mixer, where it is beat against the incoming sidebands of the modulator under test. In this case, the difference output of the two signals becomes the first IF (tuneable IF) of the spectrum analyzer. For example, Channel 2, with the visual carrier in the neighborhood of 55 MHz, would produce a difference signal of 75 MHz (130-55 = 75). This would become the tuneable IF output of the first mixer. This signal would then be applied to mixer No. 2, where it is beat against the output of the fixed tuning oscillator. This is the actual tuning oscillator which is used to select the desired channel.

In the case in question, the 75 MHz output of mixer No. 1 must be heterodyned down to a lower IF frequency, which is normally in the area of 10 to 20 MHz. If a 10 MHz IF is used, the beat oscillator must produce a 65 MHz signal to produce a 10 MHz difference signal, which is then applied to the next stage, a fixed IF amplifier.

The fixed IF amplifier is a relatively narrow-band device, with the bandpass being down about 20 DB at the 100 KC bandwidth points. This assures resaonably good selectivity in viewing the modulator RF output plus any spurious emissions it might contain.

When the sweep oscillator proceeds to 135 MHz, the output of the first mixer remains at 75 MHz, and the difference between the 135 and 75 MHz is 60 MHz. Since the sweep oscillator is now at 135 MHz and is beating with the fixed oscillator of 130 MHz in the video sweep portion, the difference signal being generated is exactly 5 MHz. The tuneable voltmeter is now measuring 60 MHz and the modulator is producing a sideband of the visual carrier which is approximately 55 MHz plus the 5 MHz of video which is again 60 MHz. The sweep oscillator continues on out to 138 MHz, or to whatever sweepwidth it is set.

The analyzer is now blanked until the sweep oscillator returns to 122 MHz. As the sweep oscillator continues upwards to 125 MHz, the tuned voltmeter is detecting the difference between 75 and 125 MHz, or 50 MHz, and the 125 MHz sweep oscillator beating with the 130 MHz fixed in the video sweep portion is once again generating 5 MHz.

The 5 MHz modulating the visual carrier is causing sidebands 5 MHz above and 5 MHz below the visual carrier. The lower sideband is 50 MHz, the carrier is 55 MHz, and the upper sideband is 60 MHz. However, the tuned voltmeter is tuned to only one of these, which in this case is the lower sideband (previously, it was the upper sideband), so this is the only response that is shown in the detected output of the sideband analyzer.

The previous discussion provides a general idea of how the sideband analyzer works on channel 2. If a higher channel modulator were tested, say, for example, one with a carrier of about 80 MHz, the difference between the 130 MHz and the 80 MHz would be 50 MHz. In order to convert this 50 MHz into a fixed IF of 10 MHz, an oscillator frequency of 40 MHz must be generated by the tuning oscillator. Past this point in the circuitry, the signal would be processed in exactly the same manner as described for channel 2.

If a highband modulator were tested, say for example one operating on 180 MHz, the difference between the 180 MHz and the 130 MHz would be 50 MHz. In this case, the RF carrier is actually above the 130 MHz sweep oscillator, where on the low channels the RF was below the sweep oscillator. This 50 MHz difference is again converted into the 10 MHz IF with a 40 MHz signal generated by the tuning oscillator, providing the same tuned oscillator, frequency as generated with the 80 MHz channel. Because of this, both a highband and a lowband modulator should never be simultaneously connected to the input of the sideband analyzer.

Another useful feature of the sideband analyzer is that, as previously stated, the device is actually made up of two sections: a video sweep portion and a spectrum analyzer portion. These can, if desired, be used independently. The quality video sweep signal produced may be used as any normal video sweep generator, by simply disregarding the spectrum analyzer portion of the sideband analyzer. The same thing applies to the spectrum analyzer portion of the device. In other words, you might feed a multiburst or some other test signal or, if desired, an actual video signal into the modulator under test and observe the sidebands generated with the spectrum analyzer without using the video sweep section. Therefore, the versatile device actually serves as three useful test devices: a sideband analyzer, a video sweep generator, and a spectrum analyzer, providing, in one small package, most of the tools required for maintenance of your head-end modulators.

This paper is based primarily on the sideband analyzer manufactured by DYNAIR Electronics, Inc. and is similar to the other devices now on the market.

CHAIRMAN TAYLOR: Thank you very much Mr. Bates. Do we have any questions on the sideband analyzer?

QUESTION: Is there a plan to build into the analyzer or equipment for checking the audio portion of a modulator?

MR. BATES: I didn't mean to imply in my talk or to be too specific in referring necessarily to the sideband analyzer that DYNAIR happens to be manufacturing. I was trying to keep this general and not get down to specifics on our particular unit. To answer your question: No, not at this time.

CHAIRMAN TAYLOR: Thank You. Our next speaker, Mr. Lyle Keys, President of TeleMation Incorporated, will speak to us on what we may consider a dirty word, the technical problems of non-duplication. Lyle Keys.

MR. LYLE O. KEYS (TELEMATION INC.): Thank You. Gentlemen, Mr. Chairman: My paper is entitled "Design Considerations for CATV Non-duplication Equipment". There are copies of this paper on the table at the rear of the room.

The subject of CATV non-duplication can be divided into four areas:

1) requirements for program deletion
2) choice of substitute programming
3) method of switching
4) method of switcher programming

Non-duplication arrangements are not necessarily limited to the rules set forth in the FCC's Second Report and Order. CATV operators are free to negotiate different agreements with protected stations. For example,