TECHNICAL MANUAL

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HARRIS CORPORATION Broadcast Products Division
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MANUAL CHANGE NOTICE

PUBLICATION NO. 888 1753 001

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ITEM MSP-100 Audio Processor System MODEL 994 7967 001 SERIAL

INSTRUCTIONS: Note indicated changes to manual.
File CHANGE NOTICE in front of manual.

CHANGE NO.	DATE	AUTHORITY	REASON
1.	12/13/78	ENGINEER REQUEST	1a. Include 888 1841 001 Program Directors Guide with all copies of MSP-100(888 1753 001) Manuals.

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MANUAL CHANGE NOTICE

SHEET 2

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Change No.		Change
1.	1a.	Section VI - Parts List. Table 6-3. AM Protection Module Printed Circuit Board - 992 5148 001. Page 6-6. Change C82,C83,C85,C86, 526 0110 000, Capacitor, 47 uF 20V, Qty. 2 TO C82,C83,C85,C86, 526 0033 000 Capacitor, 47 uF, 20V, Qty. 4.

TECHNICAL MANUAL

PROGRAM DIRECTOR'S GUIDE

HARRIS CORPORATION Broadcast Products Division

T.M. No. 888 1841 001

Printed: September 1978

PROGRAM DIRECTOR'S GUIDE

Congratulations! You have purchased one of the most versatile broadcast audio processing systems available today. All important processing parameters are switch selectable, providing consistent, repeatable results. Flexibility is essential in tailoring audio processing to meet your requirements, but there is a catch! We're going to ask you to learn what audio processing equipment does and how to properly adjust your new HARRIS MSP series equipment. Versatility is best - but for every great setup there are several mediocre ones, so randomly twisting knobs will only get you confused. Instead, a good working knowledge of how processing equipment alters station audio is necessary for proper adjustment. The circuitry used in modern processing equipment is quite complex and need not be described here, however, the operating characteristics of audio processing equipment are more easily understood, and once mastered, can be a powerful competitive tool. This guide has been written especially for you, the program director. But please give this guide to anyone who makes decisions about the airsound of your station.

Harsh, mellow, crisp, bright, cosmic, and punchy are all very descriptive terms, but mean different things to different people. Bright to one Program Director may be 20% high frequency distortion to another! We're going to stay away from ambiguous terms and concentrate on what really happens to processed program audio. Read on!

WHY AUDIO PROCESSING IS NECESSARY

Human hearing has a range of about 110 dB from the threshold of recognition to the threshold of pain. Most people can hear well in a frequency band from about 20 Hz to 18 kHz. Humans also have the distinct ability to detect small changes in waveshape, or timbre. Musical signals are very complex waveforms with constantly changing timbre, amplitude, and frequency. They generally contain complex overtones, or harmonics, which may fall outside the range of human hearing. Even though these overtones cannot be heard, they contribute to the delicate timbre of the original signal. So, the
1841 purist or audiophile has quite a challenge ahead of him if he strives for perfect reproduction! Fortunately, the average listener is not a perfectionist.

Well maintained disc and tape systems have a usable dynamic range of about 50 dB, while the dynamic range of a large orchestra may exceed 80 or 90 dB. So, compression is used in making master tapes and cutting discs, since the dynamic range of some music is greater than the recording process can handle. In other words, music is processed to meet the physical constraints of disc and tape media.

The FCC imposes bandwidth constraints on all broadcast stations that translate into maximum modulation limitations. Since noise problems limit the minimum modulation possible, especially in AM broadcasting, further constraints are placed on the dynamic range of radio broadcasting by noise level and maximum modulation capability.

While there is no such thing as typical music, most contemporary records have a peak to average ratio of about 10 dB. In other words, musical peaks are 10 dB louder than the average recorded level. Your modulation monitor meter responds to pseudo peak levels and will read somewhat higher than the actual average level, while the peak flasher responds to true peak modulation levels. So, with an unprocessed typical source modulating the transmitter to 100% on peaks, the modulation monitor meter will indicate around 50%!

Most home stereo systems are capable of reproducing the full dynamic range capabilities of an AM or FM broadcast station. Car radios are a different beast, since most of them are underpowered. High background noise levels in autos and underpowered radios combine to produce worst-case signal to noise margins of 10 dB. This means that unprocessed programming will become lost in the background noise! To cover automobiles, the average modulation level of the transmitted signal must be increased, reducing the peak to average ratio of the music.

Broadcast audio processing equipment from any manufacturer alters program signals by reducing their peak to average ratio, thereby increasing average modulation. As unavoidable side effects, the timbre of the signal is altered and the distortion is increased. In poorly designed or improperly adjusted systems, additional unwanted side effects, called artifacts, are generated. "Pumping", "ducking", and "swishing" are words that have been used to describe these artifacts. Harris processing equipment does not produce any artifacts when adjusted properly.

The main tradeoff in a properly designed and adjusted processing system is average modulation (density) vs. distortion. The end goal for most broadcasters is to reach that elusive point where average modulation is as high as possible within their own acceptable limits of distortion. Very loud signals may attract listeners, but reasonable distortion levels will keep them tuned in! Harris processing equipment frees you to trade density for distortion, without worrying about the artifacts produced by inferior equipment.

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Listeners have very different distortion tolerance levels. Several studies have been conducted on distortion tolerance, but their results are inconsistent. Distortion produces listening fatigue at normal listening levels, by changing the timbre of musical waveforms, and making instruments sound unrealistic or unnatural.

HOW AUDIO PROCESSING REDUCES DYNAMIC RANGE

Modern audio processing systems consist of an AGC amplifier and peak limiter, with some type of overmodulation protection. The AGC and LIMITER must be treated as a system for optimum performance, though each one will be described separately.

THE AGC AMPLIFIER

An AGC amplifier is the most versatile piece of audio processing equipment, and must not be confused with a simple compressor, since the AGC also includes expansion circuitry (which will be described later). A compressor is used to reduce the peak to average ratio of program audio, and is simply an amplifier whose gain is determined by the amplitude of its input signal. The larger the input signal, the lower the gain, thus it produces an almost constant output level.

Compressor gain does not change instantly. The time it takes for compressor gain to decrease upon application of a signal is called the Compressor Attack Time. The time it takes compressor gain to increase after removal of a signal is called the Compressor Recovery Time. The slope of a compressor determines how much the compressor's output level will change for a given change in input level. Slope of a compressor has meaning only if the compressor has already attacked on the input signal, so a signal whose duration is shorter than compressor attack time will pass through the compressor unchanged. Signals of longer duration will cause the compressor to attack and the compressor output level is then determined by slope. A compression slope of 3:1 indicates that the compressor output will change 1 dB for every 3 dB of input level change. A 24:1 slope indicates that compressor output level will change only 1 dB for every 24 dB of input level change.

Musical signals have components that are both shorter and longer than the compressor attack time. This means that compressor gain changes to keep the average output level constant. Fast compressor attack times cause the compressor gain to decrease on shorter peaks, holding output level nearly constant. Long compressor attack times allow peaks to pass through the processor untouched, resulting in an output with large dynamic range.

So, you can see that the compressor output dynamic range is determined by compressor attack time and slope.

1841 How does compressor recovery time affect the output signal? Fast recovery times allow the compressor to closely follow the input signal, providing a dense output with very high average modulation. Slow compression recovery times keep AGC gain reduced over a longer period of time, providing an output signal that, at the expense of reduced average modulation, is more dynamic.

Unlike a simple compressor the AGC amplifier's expansion circuitry makes gain reduction almost unnoticeable. Without an expander, signals below a certain input level, called the compression threshold, will pass through the processor untouched. Average modulation on these signals would be low. The expander raises the average level of any program material whose amplitude is much lower than the compression threshold, thus increasing average modulation. As signal input to the expander is increased, the output level of the processor will increase more than the input, determined by the expander slope.

In MSP Series equipment, the expander slope is fixed at 2:1 and expansion stops when the input signal is large enough to cause about 12 dB of expansion. At this point there is a 10 dB linear range before compression begins.

Like the compressor, the expander has selectable attack and recovery times. The audible effect of the expander controls is much less pronounced than that of the compressor, yet these controls are important and must be properly set for best results. In general, expander recovery times should be set the same as compressor recovery times. Why?

The expander, besides building up low level passages, acts along with the compressor as a noise reduction system. A simple compressor will amplify program noise between songs. Depending on the recovery time, noise buildup after a song ending may be very objectionable. This effect has been called "Noise Swish Up", and is especially obnoxious when large amounts of compression are employed. When adjusted properly, the expander-compressor combination will not build up background noise. How?

With no input signal, the expander automatically reduces the AGC gain by 12 dB. As input signal increases, the expander will increase the AGC gain until the compression threshold is reached. As input signal level increases beyond the compression threshold, AGC gain will decrease. If about 12 dB of compression is used, the processor will have the same gain as with no signal When the signal is removed, the compressor and expander circuits will begin to recover. If compressor and expander recovery times are identical there will be no net gain change.

As the compressor recovers, it will increase gain, but while the expander recovers it will decrease gain. If both changes occur at the same rate there will be no net gain change and no noise swish up. 1817

Expansion attack determines how much the low level signals will be built up. Slow expansion attacks provide for very smooth operation, but let peaks pass through the AGC unexpanded. Fast expansion attacks allow the expander to build up more peaks, increasing average modulation during low level passages.

A tri band AGC splits the audio spectrum into three discrete bands, so it is actually three separate AGC units. Tri band systems have several advantages over broadband units. Less compression can be used to attain the same average modulation, or density. Extremely loud signals in one band will not affect information in other bands, as can happen in broadband systems.

The result is a cleaner overall sound. Also, by offsetting the operating parameters from band to band the tri band AGC may be used as an equalizer to emphasize any portion of the audio spectrum. This is especially important in AM broadcasting where receiver deficiencies may require equalization at the transmitter.

In summary, an AGC amplifier is the most powerful tool that can be used for dynamic range reduction. Compressor attack time, slope, recovery time and the amount of compression used determine the degree of dynamic range reduction that will take place. However, the effect of varying each parameter is different. If AGC operation is still unclear, reread this section. Keep in mind that the AGC is a dynamic amplifier whose gain is constantly changing. The speed and amount of AGC gain change directly determines the density of the output signal. Now that you're an AGC whiz, we'll move on to the limiter.

THE LIMITER

The limiter is a broadband compressor whose attack time is much faster than that of an AGC. Since limiter slope is very steep and not adjustable, its operation is much more radical than the AGC. Only a few peaks pass through the limiter, depending upon the attack time selected. The limiter is broadband and must be used with care, especially if preceded by a Tri Band AGC system, or limiter effects will dominate the AGC. Since limiters don't expand, heavy limiting (over 6 dB) will cause noise "swish up".

FM AND AM OVERMODULATION PROTECTION

Overmodulation protection would be unnecessary if limiters could be operated with extremely fast attacks, since no peaks would pass through the limiter. However, fast attack limiters cause severe intermodulation distortion on voice and other narrow band programming. Instead, placing a clipper after a moderately fast limiter will remove peaks that would otherwise overmodulate the transmitter.

FM PROTECTION

Preemphasis used in FM broadcasting dictates special processing requirements. If limited audio is fed into the transmitter without FM protection, high frequency information will severely overmodualte the transmitter. Instead, the broadband limiter output is pre-emphasized inside the audio processor, just as it is in the transmitter exciter. This pre-emphasized signal is then fed to a fast limiter and a clipper. The front panel FM MODE control determines the proportion of limited and clipped high frequency audio applied to the transmitter. High frequency clipping introduces the most distortion and preserves high frequency response, whereas high frequency limiting rolls off high frequency response but introduces very little distortion. The FM MODE control in MSP Series equipment is best thought of as a treble control.

The hard position preserves high frequency response at the expense of distortion, and the soft position reduces distortion at the expense of high frequency response. Adjusting the MODE control somewhere between hard and soft results in the best compromise of high frequency response and distortion.

AM PROTECTION

AM systems need no pre-emphasis, so processing requirements are less stringent than in FM systems. However, legal positive modulation capability extends to 125%, which results in special limiting requirements. Program audio, especially voice, is asymmetrical. In other words, the maximum positive level of the program may be larger or smaller than the maximum negative level. To use the legal 125% modulation capability to best advantage, audio must be flipped whenever the amplitude of negative going peaks exceeds that of positive going peaks. Noiseless digital zero crossing switching is used in MSP Series AM equipment to insure maximum positive modulation.

ADJUSTING YOUR AUDIO PROCESSING CHAIN

Audio Processing is a system and must be adjusted as a system. Although we've looked at each section of a processing system individually, the components must be adjusted as a system. All this discussion of attacks, recoveries, and slopes doesn't exactly tell you what you need to know. After all, you want to be as loud as possible with the least amount of distortion! That's easier said than done. General trends are to adjust processing equipment for the loudest sound that is tolerable, at best a hit and miss procedure. Now that you're familiar with the technical operation of the AGC, LIMITER, and overmodulation protection, adjustment of the processor to meet your goals will be much simpler. Adjustment of MSP series audio processing equipment should be done in two steps. First, listen to the processor on the bench with high quality source material and reproduction equipment. Second, listen to the processor on the air to determine the optimum setting for your station. Distortion in program material will be emphasized by the processing equipment. A good power amplifier and a set of matched speakers should be used to initially set up a stereo FM processing system. A Crown D60 and ACOUSTIC RESEARCH AR3A loudspeakers were used during our testing.

The remainder of this guide emphasizes the density vs distortion tradeoffs that you must make, taking into consideration market, format and competition. Setup charts for bench testing and on-air listening tips are given for the MSP-90 and MSP-100 auido processing systems.

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THE BIG TRADEOFF IS:

Average Modulation (Density)	vs.	Quality (Distortion)

There are three ways to reduce the dynamic range of program audio. The AGC, the LIMITER, or the overmodulation protection circuitry can all be used to reduce dynamic range.

The amount of dynamic range reduction performed in each stage is very important. The AGC has the greatest dynamic range reduction capability, and the limter somewhat less. The overmodulation protection circuitry is capable of some dynamic range reduction, however, it contains clippers which add severe intermodulation distortion. Protection circuitry is not designed to significantly reduce dynamic range, even though it may be used for that purpose in highly competitive markets.

Most of the dynamic range reduction should take place in the AGC, so the AGC amplifier must be adjusted keeping the density vs. distortion tradeoff in mind. AGC adjustment is dependent upon your program format and desired density. AOR, MOR, contemporary and CW music are generally very busy. There is a significant amount of fast transient information present, like percussion and fast guitar work. Rock and popular music are quite dense to begin with, due to the use of electronic instruments and moderate processing at the record mastering plant. Competition in this market is generally heavier than in most program formats. Keeping all the above factors in mind, AGC attack and especially release times can be selected. For the MOR, contemporary and CW formats, recovery times can be set fairly fast. Normally, distortion increases as recovery time shortens, but since rock and pop use electronic instruments and are dense to begin with, fast recovery times are not objectionable. Vocals are the limiting factor in adjusting AGC recovery time. Vocals become rough and harsh with very fast recoveries due to the increased distortion.

What are acceptable limits of distortion? There is no simple answer; you must decide. However, if a table radio turned up all the way sounds just fine to you, obtaining a second opinion is in order.

Listening fatigue caused by distortion in your program audio should be of great concern to you, especially since distortion caused by state of the art MSP Series equipment is directly under your control. Listeners can tune out due to listening fatigue and not know why! REMEMBER: Density vs. Distortion!

Compressor attack time and slope determine how much of the AGC output will be processed by the broadband limiter. Slow attacks and shallow slopes provide an AGC output with a large dynamic range. The limiter would have to work very hard to produce a dense sound with the AGC adjusted in this manner. Fast attacks and steep slopes provide an AGC output with little dynamic range. The limiter would have to work very little to produce a dense overall sound. It would then seem wise to use fast attacks and steep slopes when maximum density is desired, letting the limiter act only on short peaks. This is true, in general, but taken to extremes, the resulting sound has no dynamics. Adjusting AGC slopes and attacks is not as simple as it first seems!

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THE KEY TO A GOOD PROCESSED SOUND IS THE COMPROMISE BETWEEN AGC ACTION AND LIMITER ACTION.

Peaks that pass through the AGC will be caught by the limiter whose attack time can be set faster than the fastest AGC attack time. Since the limiter only acts on peaks, recovery time should be very fast so that its operation does not dominate the AGC. The limiter then acts only on peaks too short to be processed by the AGC. The limiter is generally not used to its maximum capabilities, since doing so would cancel out all advantages of the AGC amplifier.

Limiter attack determines how may peaks will be clipped by the protection circuitry. Fastest attacks result in little protection clipping. However, limited bandwidth material will distort if very fast attack limiting is used. Moderate limiter attacks are used to eliminate voice break up and allow slight protection clipping on peaks. Distortion on music increases as attack time is lengthened, since more peaks hit the protection clipper. Vocal distortion increases as attack time is shortened, due to the narrow band nature of voice. You will have to arrive at a compromise setting during listening tests.

Classical, jazz, and beautiful music formats are more difficult to process than popular formats. Classical music contains very delicate overtones and nuances. The instruments' timbre are well known and must be reproduced accurately to sound correct. AGC time constants and slopes must be longer and shallower to avoid audible distortion. Less AGC and Limtier gain reduction is required. This marketplace is less competitive and more quality oriented than the popular marketplace. Listeners are generally more critical and have high performance stereo systems. Less limiting and protection clipping are used in the classical, jazz, and beautiful music marketplace, primarily due to distortion caused by heavy limiter and protection operation.

If you have taken the time to read and understand the information presented so far, you will be able to properly adjust your processing equipment. To further help you, we have determined several setups for the MSP-100 and MSP-90 audio processors. These setups are broken down into two groups: AOR/POPULAR, and Classical/Jazz. The AGC time constants and slope are kept nearly constant in each group, with four different dynamic range reduction levels for the AOR/POPULAR group and two different dynamic range reduction levels for the classical/jazz group. 1817 In addition, you will find chart recorder graphs of processed audio for each setup, with percent modulation marked on each graph. The input and output audio was peak detected to properly operate the DC chart recorder pens.

A good practice is to listen to every setup, looking at the chart recorder graphs, which are an excellent example of typical program density. Listening to each setup allows you to sample the extremes of processor operation and to determine which setup fits your density and format requirements. Listening to each setup is a good way to familiarize yourself with the control locations.

The remainder of this guide contains practical information needed to put the MSP-90 or MSP-100 audio processors on the air. Setup charts and hints are given for each processor, along with useful tips for making air tests and final adjustments.

FINAL ADJUSTMENT

The setup charts given in this guide are intended as starting points to help you find a setup that is close to your needs. Using that setup as a starting point and keeping in mind the ultimate goal of maximum density and minimum distortion, determine what quality the sound is lacking. Use good, varied program material to quantify the problem. Then using your knowledge of AGC operation, vary one parameter at a time until the problem is isolated. Keep in mind the tradeoffs between AGC, LIMITER, and protection clipper operation. Watch compression level and limiting level carefully, since they will change as other processing parameters are varied.

ON THE AIR

Listening to your processed air sound should be done with several receivers. A high quality home component system should be used first if your station is Stereo FM. Listen to varied high quality program material, and take notes. Listen on several stereos if possible. Listen on high quality car stereo systems, then on a typical automobile radio. With data on this listening, determine what parameters, if any, need changing. The FM MODE control is important. If high frequency audio sounds too harsh, turn the control more toward soft. Remember that these tests are subjective. Get several different opinions. Listen to the competition and determine the good and bad qualities of their signal. Analyze, be subjective, throw away all prejudices (easier to say than do). Be ruthlessly efficient and accurate in taking notes and making observations. Vary only one parameter at a time. Go slowly and you will be successful, since audio processing cannot be adjusted overnight. Your subjectivity is critical to success, so solicit opinions and comments from technical people, audiophiles, and especially people with musical training.

Knowing how processing equipment reduces dynamic range, you will be able to adjust it for your individual circumstances. Listening is important and no one else can do that for you. The setup charts given here were derived from listening tests conducted at Harris with varied program material and several different sets of ears. They are given as a guide and starting point only.

Be analytical and fair during all listening, but above all - Good Listening!

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MSP-100 SETUP NOTES

The MSP-100 Setup charts will give you a good starting point. Be very careful to adjust limiting level control to obtain the described meter indication. Be sure to balance input levels on stereo processors when changing the amount of gain reduction. Watching the broadband FM protection LEDS will help with rough level balancing.

A tri-band AGC has more dynamic range reduction capability for a given distortion level than a wideband AGC. It is necessary in highly competitive markets where heavy processing is employed by the competition. A tri-band system allows you to choose different recoveries for each band. For instance, the high band recovery time can be set fast with slightly slower mid and low band recovery times, providing lower distortion and higher density than is possible with a wideband AGC. If distortion is high, (especially low frequency distortion), slow down recovery times one step at a time, starting with the low band. Remember, fast recoveries provide the densest sound. AGC attack times are set slow to preserve some of the original program dynamic range. Limiter attacks are set moderate to allow some protection clipping. You may have noticed that the only difference between the HEAVY and FULL TILT popular settings is the AGC DUAL/SINGLE recovery.

Dual recovery increases recovery time on the average program level. On short repetitious bursts of music recovery time is very rapid. The overall sound is much more dynamic when dual recoveries are used. Experiment with recovery mode to determine which best suits your requirements. Dual recovery does increase the overall recovery time, so faster recovery times can be used when recovery mode is dual. Expansion attacks have not been mentioned at all. Most of the time fast is sufficient. If you note any undesirable side effects, when the AGC is in the expansion region, slow down the expansion attack times. The result will be smoother action with less build up on quiet passages. If flat spectral response does not meet your needs, Book 1 of the MSP-100 manual contains the information necessary to accomplish spectral manipulation. It is simplest to vary attacks, recoveries, and slopes in each band to obtain the desired response. Limiter Auto Attack is very useful for varied programming, since it allows fast attacks for musical signals and slow attacks for limited bandwidth material. Experiment with the Limiter Auto Attack and Recovery to determine their utility in your format. The tri-band AGC turnover frequencies are switch selectable. They are preset at 230 Hz and 2180 Hz at the factory. In many applications it may be desirable to change the turnover frequencies. In AM broadcasting where narrowband receivers limit high frequency response, the high frequency turnover can be lowered and AGC parameters offset to provide higher density in the high frequency band.

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MSP-100 POPULAR FORMATS

AOR/MOR/CONTEMPORARY/CW/ADULT/VARIED

DESIRED PROCESSING LEVEL	MILD	MODERATE	HEAVY	FULL-TILT
COMPRESSION BAND Attack (L,M,H) Recovery (L,M,H) Slope (All Bands)	 5 4 3 2 2 1 3:1	 5 4 3 2 2 1 6:1	 5 4 3 2 2 1 12:1	 5 4 3 2 2 1 12:1
EXPANSION BAND Attack (L,M,H) Recovery (L,M,H)	 1 1 1 2 2 1	 1 1 1 2 2 1	 1 1 1 2 2 1	 1 1 1 2 2 1
LIMITER Attack (Manual) Recovery (Manual)	 3 1	 3 1	 5 1	 5 1
AGC RECOVERY MODE (EXPANSION AND COMPRESSION)	Single	Single	Single	Single
LIMITER RECOVERY MODE	Single	Single	Single	Single
PEAK AGC GAIN REDUCTION	<12 dB Meters should be in lower green region.	12 dB-15 dB Meters should be in mid green region.	>18 db - <24 dB Meters should be in upper green region near red region.	
PEAK LIMITING	Meter should not move into green region. <3 dB	Meter should peak in the first 1/8 of green region. >3 dB	Meter should peak in the lower 1/4 of the green region. <6 dB	

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NUMBERS 1 to 5 indicate switch positions. 1 is fully CCW, 5 is fully CW

MSP-100 CLASSICAL FORMATS

CLASSICAL/JAZZ/BEAUTIFUL MUSIC/TALK/VARIED

DESIRED PROCESSING LEVEL	MILD	MODERATE
COMPRESSION BAND Attack (L,M,H) Recovery (L,M,H) Slope (All Bands)	 5 5 5 4 4 3 3:1	 5 5 5 4 4 3 6:1
EXPANSION BAND Attack (L,M,H) Recovery (L,M,H)	 2 2 2 4 4 3	 2 2 2 4 4 3
LIMITER Attack Recovery	 AUTO 1	 AUTO 1
AGC RECOVERY MODE (EXPANSION AND COMPRESSION)	SINGLE	SINGLE
LIMITER RECOVERY MODE	SINGLE	SINGLE
PEAK AGC GAIN REDUCTION	Below the mid green region mark, <12 dB maximum.	Below the mid green region mark, <12 dB maximum.
PEAK LIMITING LEVEL	Meter should indicate on the GRN/WHT line.	Meter should not move further than the first 1/4 of the green region.

NUMBERS 1 to 5 indicate switch positions. 1 is fully CCW, 5 is fully CW.

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MSP-90 SETUP NOTES

The MSP-90 FM LIMITER boosts selectable expansion range and High Frequency Protection Turnovers, two features of interest to the QUALITY minded broadcaster. Selectable expansion range allows the expander to complement the compressor when less than 12 dB of compression is employed. Expansion range is adjustable at 3, 6, 9, or 12 dB. High Frequency Protection turnover determines the frequency at which High Frequency processing commences. Normally, the HF processing begins at 400 Hz, however, 800, 1600, 3200, and 6400 Hz are also selectable. Higher frequency protection turnovers result in significantly lower distortion and lower modulation.

FM and AM limiter attacks are preset at 40 microseconds, which is slow enough to prevent breakup on narrow band material and fast enough to allow a little protection clipping.

Be sure to balance input levels on Stereo processors when changing the amount of gain reduction. Watching the broadband FM protection LED's will help with rough level balancing. If distortion is high, slow down limiter and AGC recovery times one step at a time, starting with the limiter. Remember, fast recoveries provide the densest sound. AGC attack times are set slow to preserve some of the original program dynamic range.

If you notice any undesired side effects when the AGC is in the expansion range, slow down the expansion attack time. The result will be smoother action with slightly reduced low level build up. Dual recovery increases recovery time on the average program level. On short repetitious bursts of music recovery time is very rapid. The overall sound is much more dynamic when dual recoveries are used. Experiment with recovery mode to determine which best suits your requirements. Dual recovery does increase the overall recovery time, so faster recovery times can be used when recovery mode is dual.

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MSP-90 POPULAR FORMATS

AOR/MOR/CONTEMPORARY/CW/ADULT/VARIED

AGC AMPLIFIER ATTACKS AND RECOVERIES

COMPRESSOR		
Attack	S8-1 Closed	S8-2,S8-3 Open
Recovery	S9-3 Closed	S9-1,S9-2 Open
EXPANDER		
Attack	S5 All Closed	
Recovery	S6 All Closed	

DESIRED PROCESSING LEVEL	MILD	MODERATE	HEAVY
COMPRESSOR Slope	S7-3 Closed S7-1,S7-2 Open	S7-2 Closed S7-1,S7-3 Open	S7-3 Closed S7-1,S7-2 Open
PEAK GAIN REDUCTION	Less than 12 dB	12 dB-15 dB	18 dB-24 dB
FM LIMITER RECOVERY	S4-1 Open S4-2,S4-3 Closed	S4-1, Open S4-2,S4-3 Closed	S4-1, Open S4-2,S4-3 Closed
AM LIMITER RECOVERY	S3-1,S3-2 Closed S3-3 Open	S3-1,S3-2 Closed S3-3 Open	S3-1,S3-2 Closed S3-3 Open
PEAK LIMITING LEVEL	3 dB	6 dB	9 dB

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MSP-90 CLASSICAL FORMATS

CLASSICAL/JAZZ/BEAUTIFUL MUSIC/TALK/VARIED

AGC AMPLIFIER ATTACKS AND RECOVERIES

COMPRESSION		
Attack	S8 All Open	
Recovery	S9 All Open	
EXPANDER		
Attack	S5-3 Closed	S5-1,S5-2 Open
Recovery	S6-1 Closed	S6-2,S6-3 Open

DESIRED PROCESSING LEVEL	MILD	MODERATE
COMPRESSION Slope	S7-3 Closed S7-1,S7-2 Open	S7-2 Closed S7-1,S7-3 Open
PEAK GAIN REDUCTION	12 dB	12 dB-18 dB
FM LIMITER RECOVERY	S4-1 Open	S4-2,S4-3 Closed
AM LIMITER RECOVERY	S3-3 Open S3-1,S3-2 Closed	S3-3 Open S3-1,S3-2 Closed
PEAK LIMITING LEVEL	<3 dB	>3 dB, <9 dB

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ON THE AIR

Listening to your processed air sound should be done with several receivers. A high quality home component system should be used first if your station is Stereo FM. Listen to varied high quality program material, and take notes. Listen on several stereos if possible. Listen on high quality car stereo systems, then on a typical automobile radio. With data on this listening, determine what parameters, if any, need changing. The FM MODE control is important. If high frequency audio sounds too harsh, turn the control more toward soft. Remember that these tests are subjective. Get several different opinions. Listen to the competition and determine the good and bad qualities of their signal. Analyze, be subjective, throw away all prejudices (easier to say than do). Be ruthlessly efficient and accurate in taking notes and making observations. Vary only one parameter at a time. Go slowly and you will be successful, since audio processing cannot be adjusted overnight. Your subjectivity is critical to success, so solicit opinions and comments from technical people, audiophiles, and especially people with musical training.

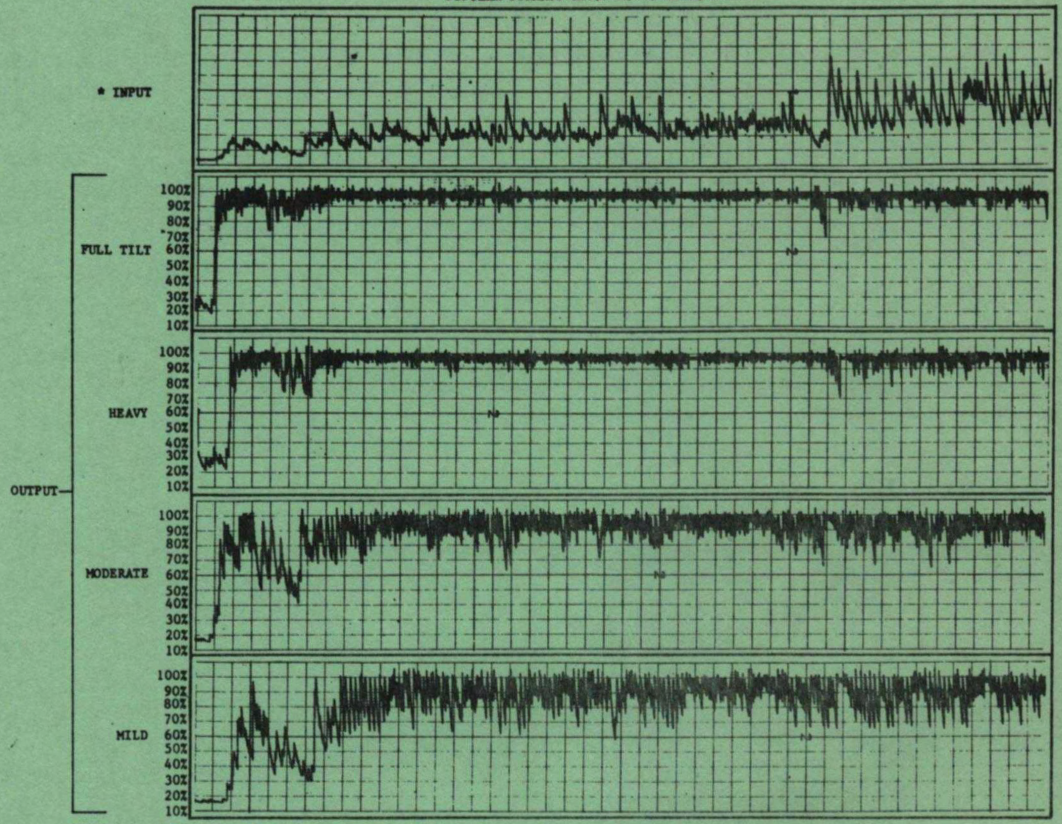
Knowing how processing equipment reduces dynamic range, you will be able to adjust it for your individual circumstances. Listening is important and no one else can do that for you. The setup charts given here were derived from listening tests conducted at Harris with varied program material and several different sets of ears. They are given as a guide and starting point only.

Be analytical and fair during all listening, but above all - Good Listening!

1817

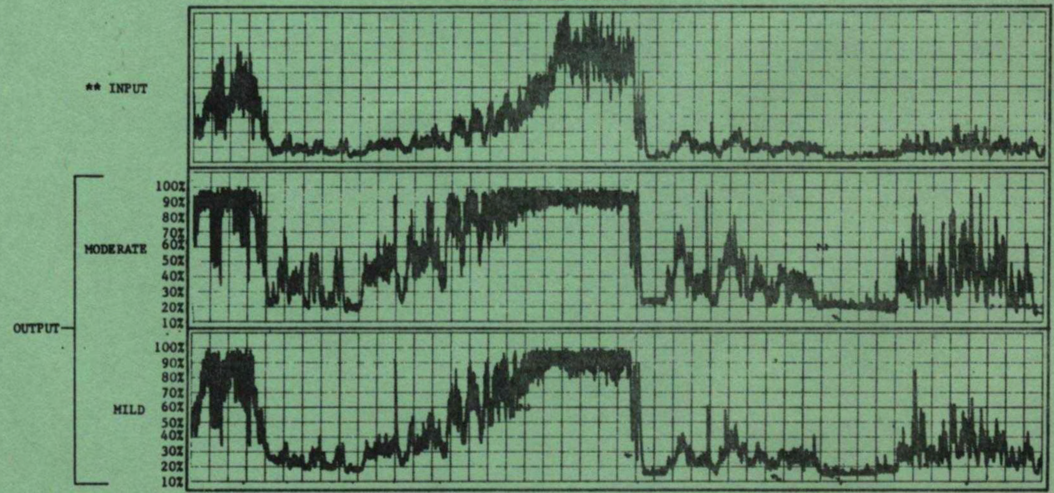
CHART RECORDER GRAPHS OF ACTUAL INPUT AND OUTPUT AUDIO. OUTPUT GRAPHS ARE SCALED IN % MODULATION

POPULAR FORMATS AOR/MOR/CW/ADULT/VARIED



* BEGINNING OF "BOOGIE NIGHTS" BY HEATWAVE

CLASSICAL FORMATS



** EXCERPT FROM "PATHETIQUE" SYMPHONY NO. 6
BY TCHAIKOVSKY

TECHNICAL MANUAL

VOLUME II

MSP 100

AUDIO PROCESSOR SYSTEM

HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1753 001

Printed: July 1977
Rev. A: March 1978
Rev. B: October 1978

FOREWORD

Volume II of this technical manual provides detailed descriptions, maintenance, troubleshooting, and spare parts information for the main frame and each module of the MSP 100 Audio Processor. The form of presentation is a complete technical manual for each module in the system.

This volume contains the following technical manuals:

MAIN FRAME
888 1753 100

TECHNICAL MANUAL

MAIN FRAME

992 4958 001

HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1753 100

Printed: July 1977
Rev. A: March 1978
Rev. B: October 1978

LIST OF EFFECTIVE PAGES

TOTAL NUMBER OF PAGES IS AS FOLLOWS: 26

PAGE NO.	ISSUE	PAGE NO.	ISSUE
Title Page	Rev.B: 10/78		
List of Effective Pages	Rev.B: 10/78		
iii through vi	Rev.B: 10/78		
1-1	Original		
1-2	Blank		
2-1	Original		
2-2	Blank		
3-1	Original		
3-2	Blank		
4-1 through 4-7	Rev. A: 3/78		
4-8	Blank		
5-1 through 5-9	Rev. A: 3/78		
5-10	Blank		
6-1 through 6-6	Rev. B:10/78		

1753 100

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WARNING: Disconnect primary power prior to servicing.

LIST OF TABLES

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LIST OF ILLUSTRATIONS

SECTION I

GENERAL DESCRIPTION

1-1. INTRODUCTION.

1-2. This portion of the manual covers the main frame of the MSP 100 Audio Processor System. Coverage includes physical and electrical characteristics, a functional description, including interconnection diagrams, and parts lists.

1-3. EQUIPMENT PURPOSE.

1-4. The main frame houses the 15 modules and power supply which comprise the audio processing system. The primary function of the main frame is to provide interconnecting paths to and from the modules and the power supply and to provide input and output connection for the audio signals. A radio frequency interference filter is also included in the audio input and output lines.

1-5. PHYSICAL DESCRIPTION.

1-6. The main frame is divided into two major components, separated vertically by an aluminum partition. The partition provides a base for mounting the five meter modules and the primary power supply transformer and filter capacitors. On the under side of the partition are mounted guides for the ten plug in modules. The motherboard, which provides interconnections for all the modules, mounts parallel to the rear of the frame and is supported at bottom and top by angle brackets. The sides of the unit are aluminum extrusions dovetailed together and secured with screws. Module locations are shown in Technical Manual 888 1753 001, MPS 100 Audio Processor System, Section I.

1-7. TECHNICAL CHARACTERISTICS.

1-8. MECHANICAL AND ENVIRONMENTAL.

1-9. Refer to Technical Manual 888 1753 001, Section I, for mechanical and environmental characteristics of the main frame.

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SECTION II

INSTALLATION

2-1. <u>GENERAL</u>.

2-2. Installation of the main frame is covered in Technical Manual 888 1753 001, MSP 100 Audio Processor System, VolumeI, Section II.

WARNING: Disconnect primary power prior to servicing.

SECTION III

OPERATION

3-1. GENERAL.

3-2. Operation of the main frame is covered in Technical Manual 888 1753 001, MSP 100 Audio Processor System, Volume I, Section III.

SECTION IV

PRINCIPLES OF OPERATION

4-1. GENERAL.

4-2. This section describes the functions of the main frame and their relationship to overall system operation. Figure 4-1 is a functional block diagram of the main frame.

4-3. The mother board performs the routing of power, signal, and control voltage between the various subsystems of the audio processor. Figure 4-1 is a representation of this distribution, including reference designators and prefix numbers. For point to point signal tracing, refer to the mother board schematic, figure 4-3 and the interconnection wiring diagram, figure 4-2. Figure 4-2 shows only cable connections, since there is a one to one correspondence between connector pins at either end of the cables.

4-4. RFI FILTERS.

4-5. The audio input and output connections to the main frame are made through radio frequency interference filters as shown in figure 5-1. The purpose of these filters is to prevent any RF signals from affecting processor performance.

4-6. PRIMARY POWER SUPPLY.

4-7. The primary power printed circuit board is mounted on the rear wall of the main frame, and transformer, 15T1, and filter capacitors, 15C1 and 15C2, are mounted on the partition separating upper and lower compartments. Primary regulators 13U1 and 13U2 are mounted on the outside rear of the main frame utilizing the frame as a heat sink. The ON/OFF switch and fuses are mounted in the program meter module.

4-8. The AC power input, switch/fuse, filter capacitor, power transformer, and DC output connections all terminate on the power supply PC module A13 (see figure 5-4). AC input power is applied through an input RFI filter consisting of capacitors 13C1, 13C2, 13C3 and 13C4 and ferrite bead RF chokes 13Z1 and 13Z2. Transformer 15T1 has two primary windings which can either be connected in parallel for 115 volt operation or in series for 230 volt operation (see T.M. 888 1753 001, Section II for proper transformer strapping). The output of the transformer, nominally 19 volts RMS feeds full wave bridge rectifier 13CR1 and filter capacitors 15C1 and 15C2. The output of the rectifier, filter combination is about 26 volts with a ripple factor of about 0.7%.

4-9. Primary regulation occurs in integrated circuit regulators 13U1 and 13U2. These regulators feature internal current limiting and thermal cutout. The inputs to these regulators are bypassed by capacitors, 13C5 and 13C6, and the outputs are bypassed by 13C7 and 13C8. The values of 13C7 and 13C8 have been chosen because of the inherent asymmetry of the two regulator devices; consequently, it is imperative that should they have to be replaced, the specified values be installed, as different values would degrade performance. The voltage divider 13R1, 13R2, 13R3 establishes the control voltage for the two chips. Pin 3 of the positive regulator is held at close to +5 volts and pin 2 of the negative regulator is held close to -2.23 volts by this divider.

4-10. The input-output differential voltage for the positive regulator is two volts. As long as the input voltage is more positive than the output voltage by at least this amount, operation will be within specified tolerances. Likewise, the negative regulator input voltage must remain at least one volt more negative than the output. Total output ripple factor of the primary supply should be less than 0.002%.

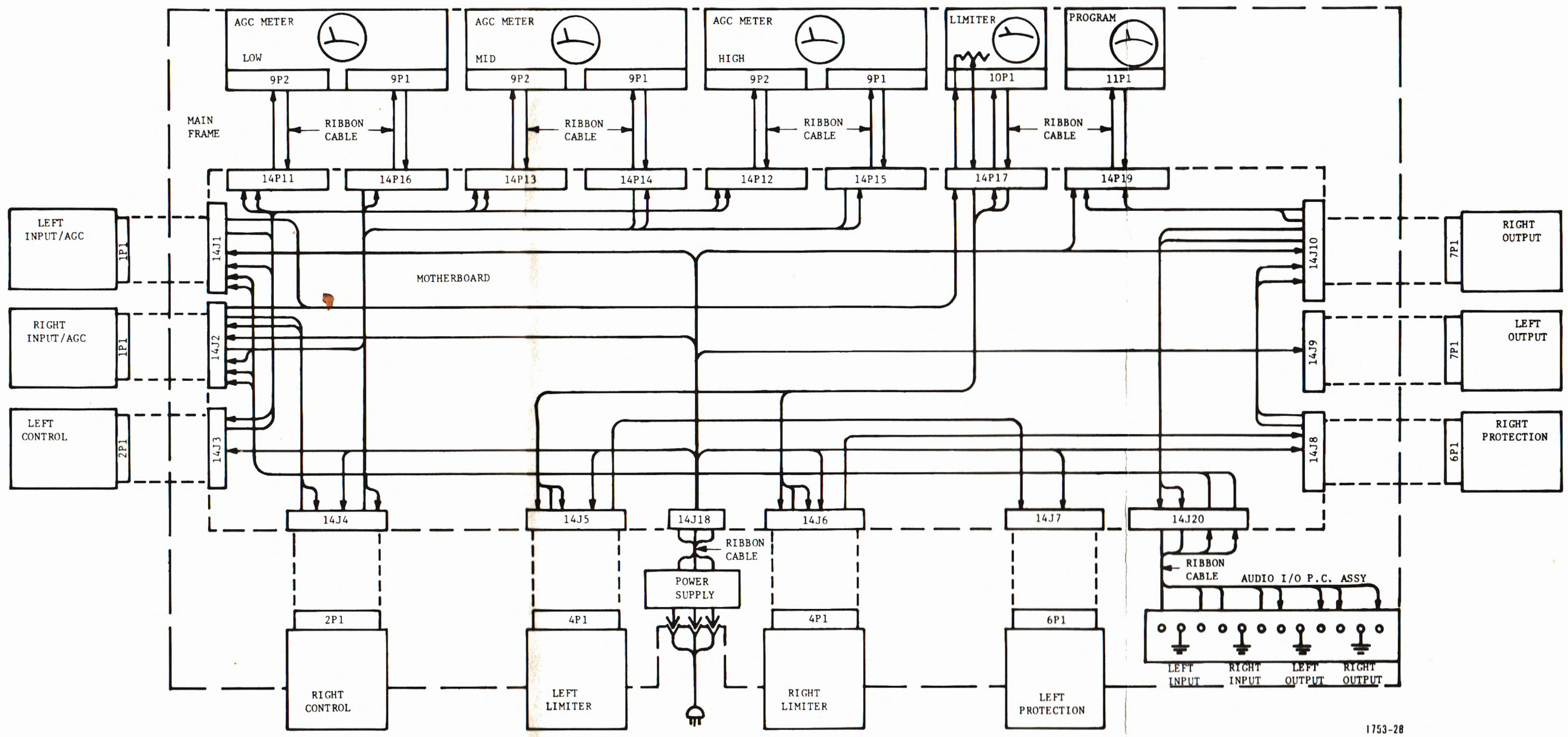

FIGURE 4-1.
MAIN FRAME FUNCTIONAL
BLOCK DIAGRAM

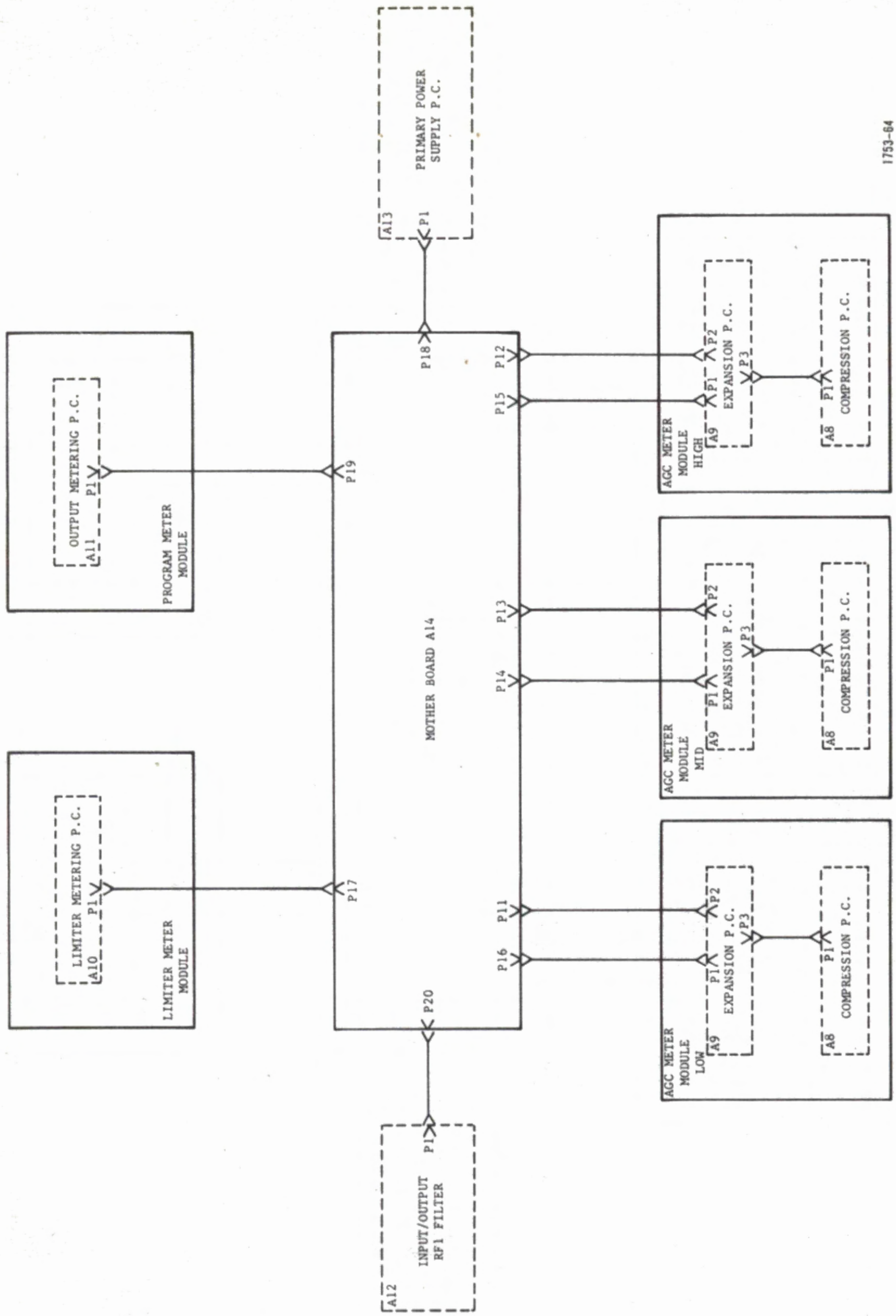

Figure 4-2. Main Frame Simplified Flow Diagram

A

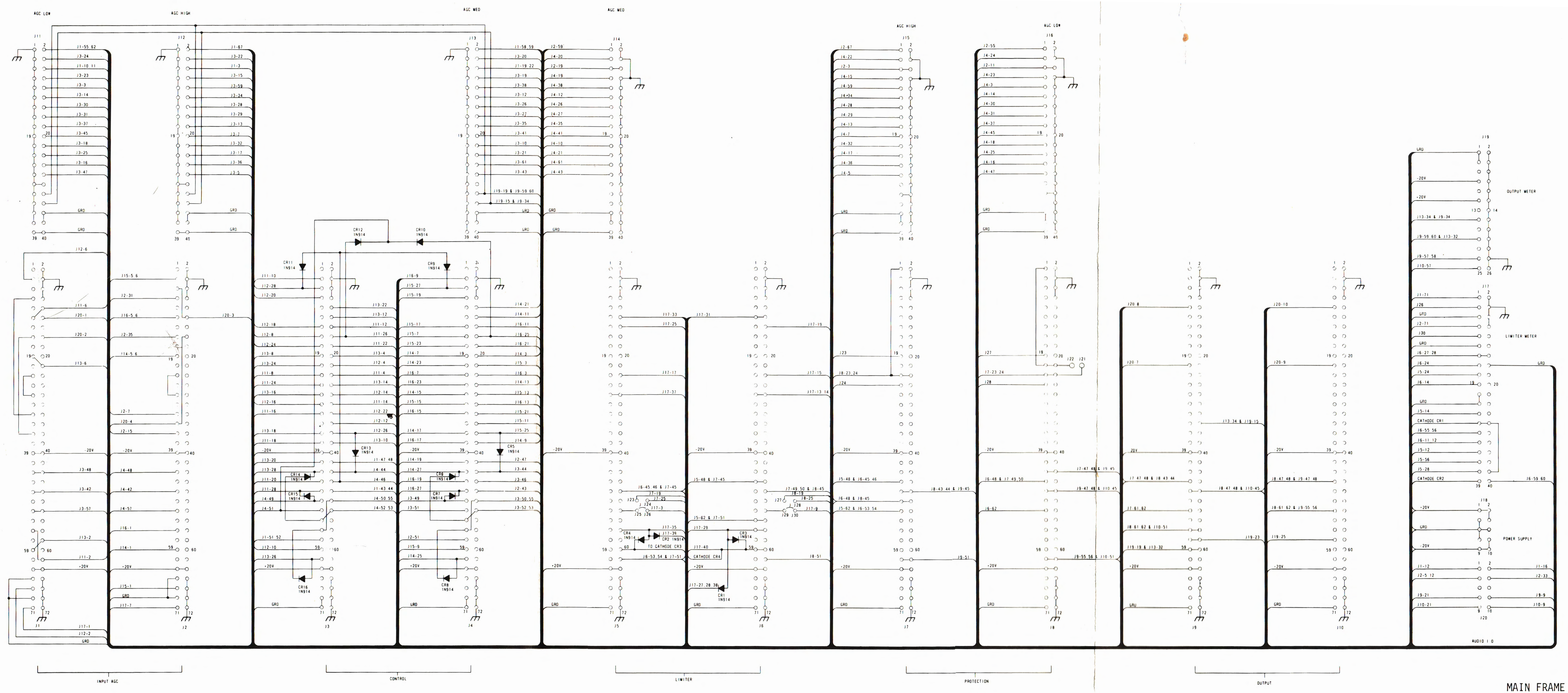

FIGURE 4-3.

MAIN FRAME MOTHER BOARD
SCHEMATIC
852 8463 001

SECTION V

MAINTENANCE AND TROUBLESHOOTING

5-1. GENERAL.

5-2. Maintenance is covered in Technical Manual 888 1753 001, MSP 100 Audio Processor System, Volume I, Section V.

5-3. TROUBLESHOOTING.

5-4. RFI FILTER.

5-5. Since the input/output RFI filter contains only inductors and capacitors, troubleshooting consists only of continuity checking with an ohmmeter. Figure 5-1 is the schematic.

5-6. PRIMARY POWER SUPPLY.

5-7. Figures 5-2 and 5-3 show the primary power supply parts locations and figure 5-4 is the schematic. If a fault is suspected in the primary power supply, figure 5-5 can be used as a guide in troubleshooting. Refer to Technical Manual 888 1753 900, Program Meter Module, Section V, for troubleshooting of the power status indicators.

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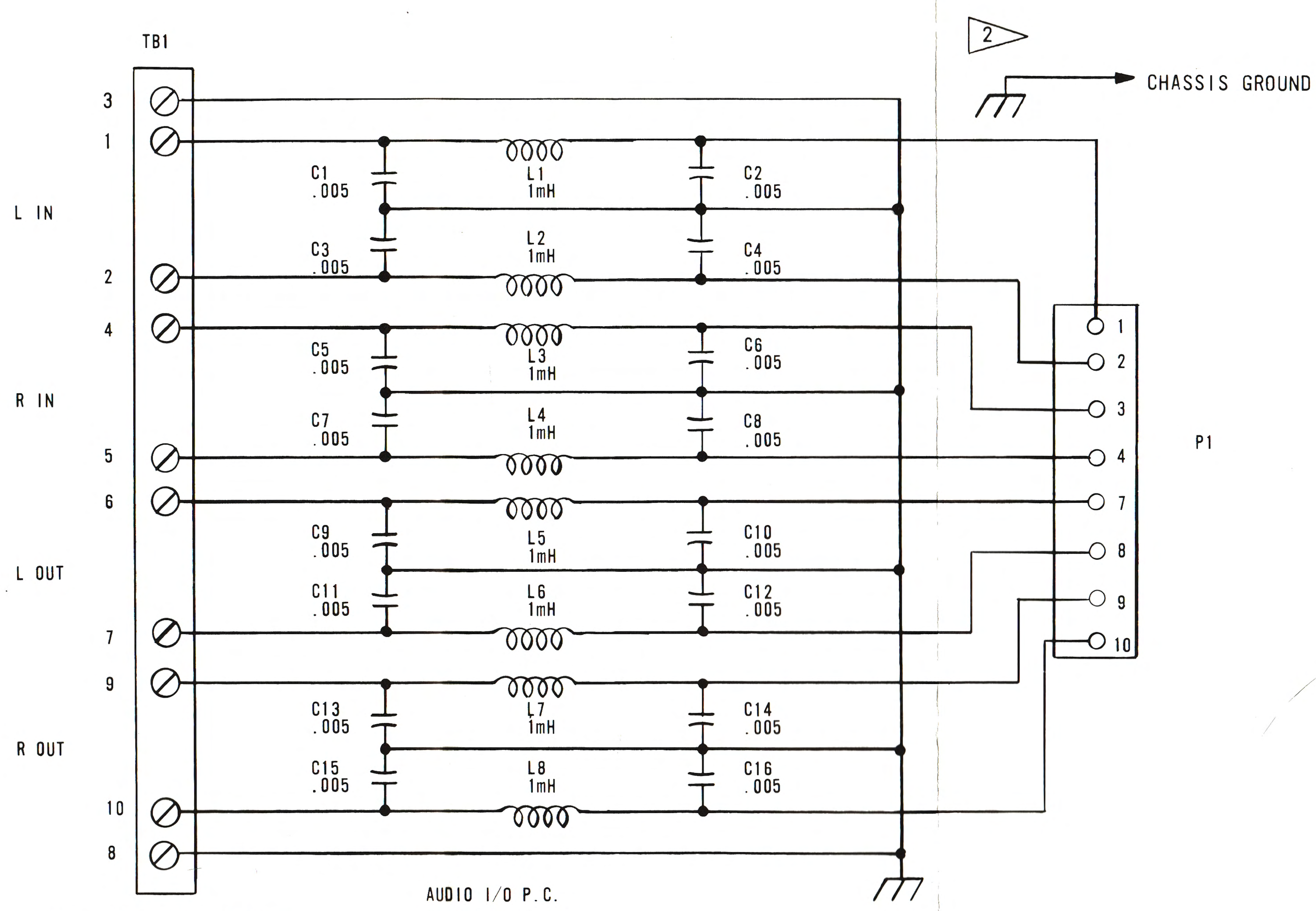
 WARNING: Disconnect primary power prior to servicing.



AUDIO I/O P.C.
MODULE PREFIX 12

2 TOP FOIL GROUND PLANE

1 ALL CAPACITORS IN uF, RATED AT 1KV.

NOTES:

FIGURE 5-1.
(SHEET 1 OF 2)
AUDIO INPUT/OUTPUT RFI FILTER
SCHEMATIC
829 2692 001

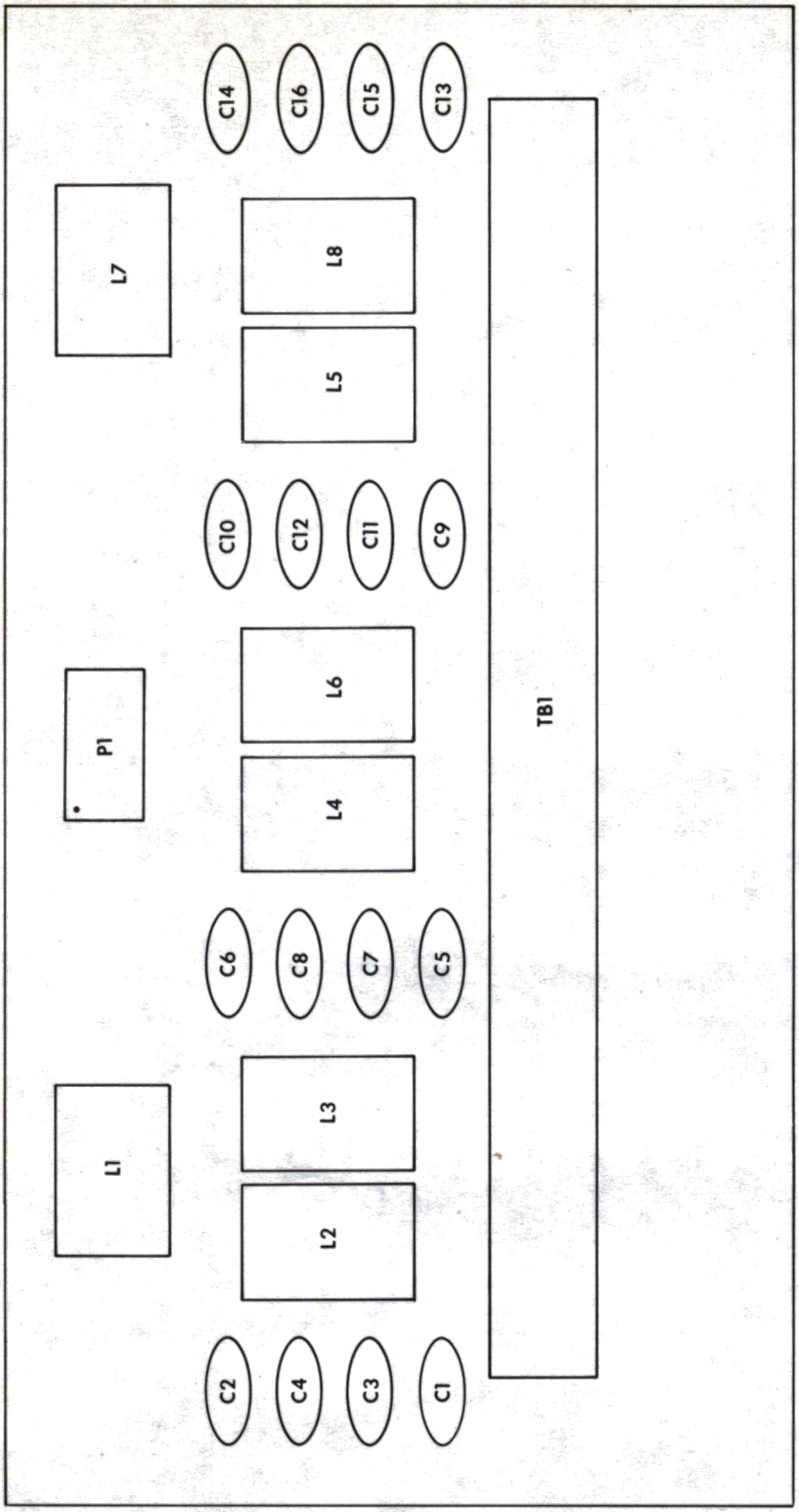


FIGURE 5-1. (SHEET 2 OF 2) AUDIO I/O BOARD
COMPONENT LOCATION - 843 2213 001

 WARNING: Disconnect primary power prior to servicing.

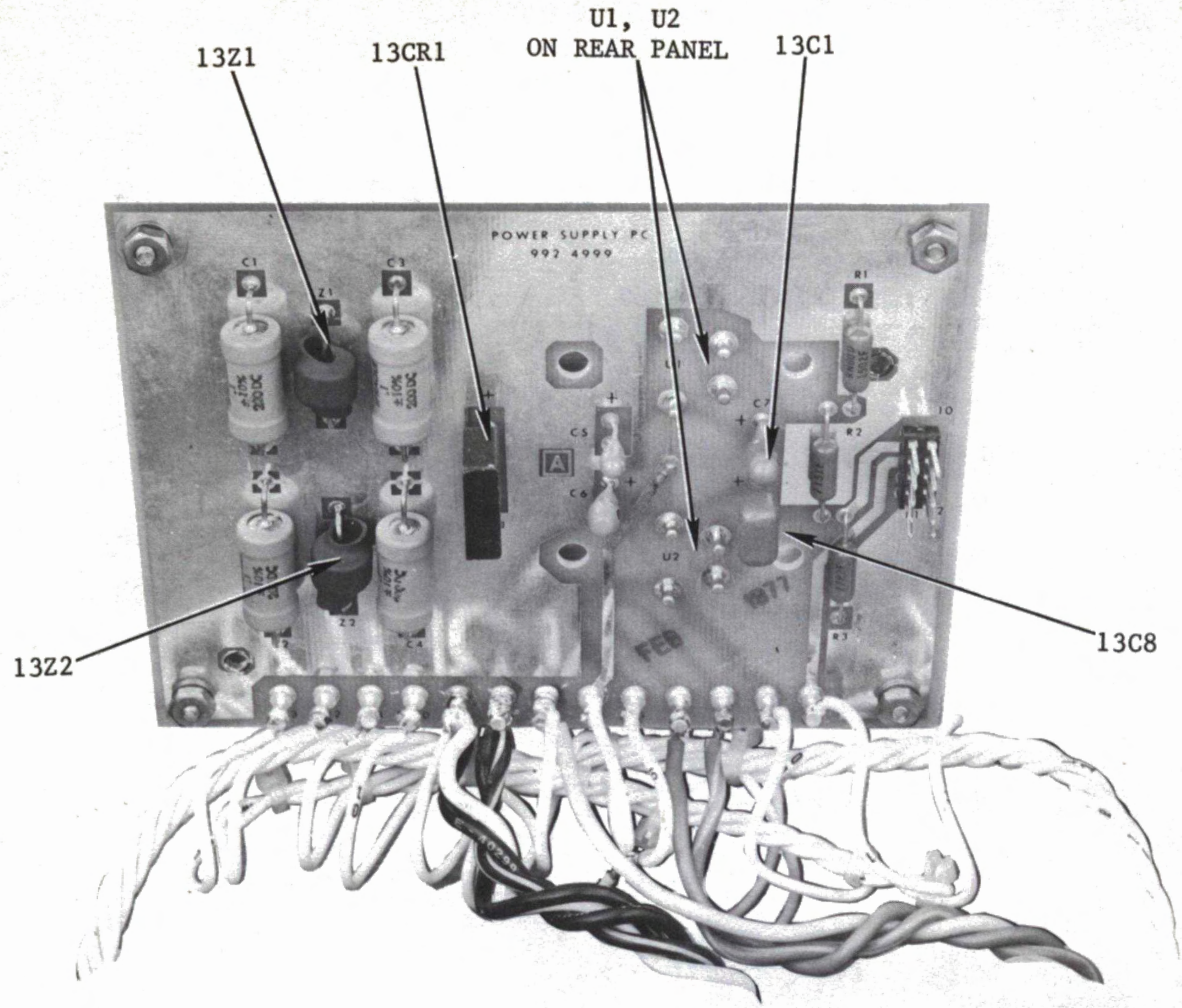


Figure 5-2. Power Supply Board Parts Layout

1753 100

WARNING: Disconnect primary power prior to servicing.

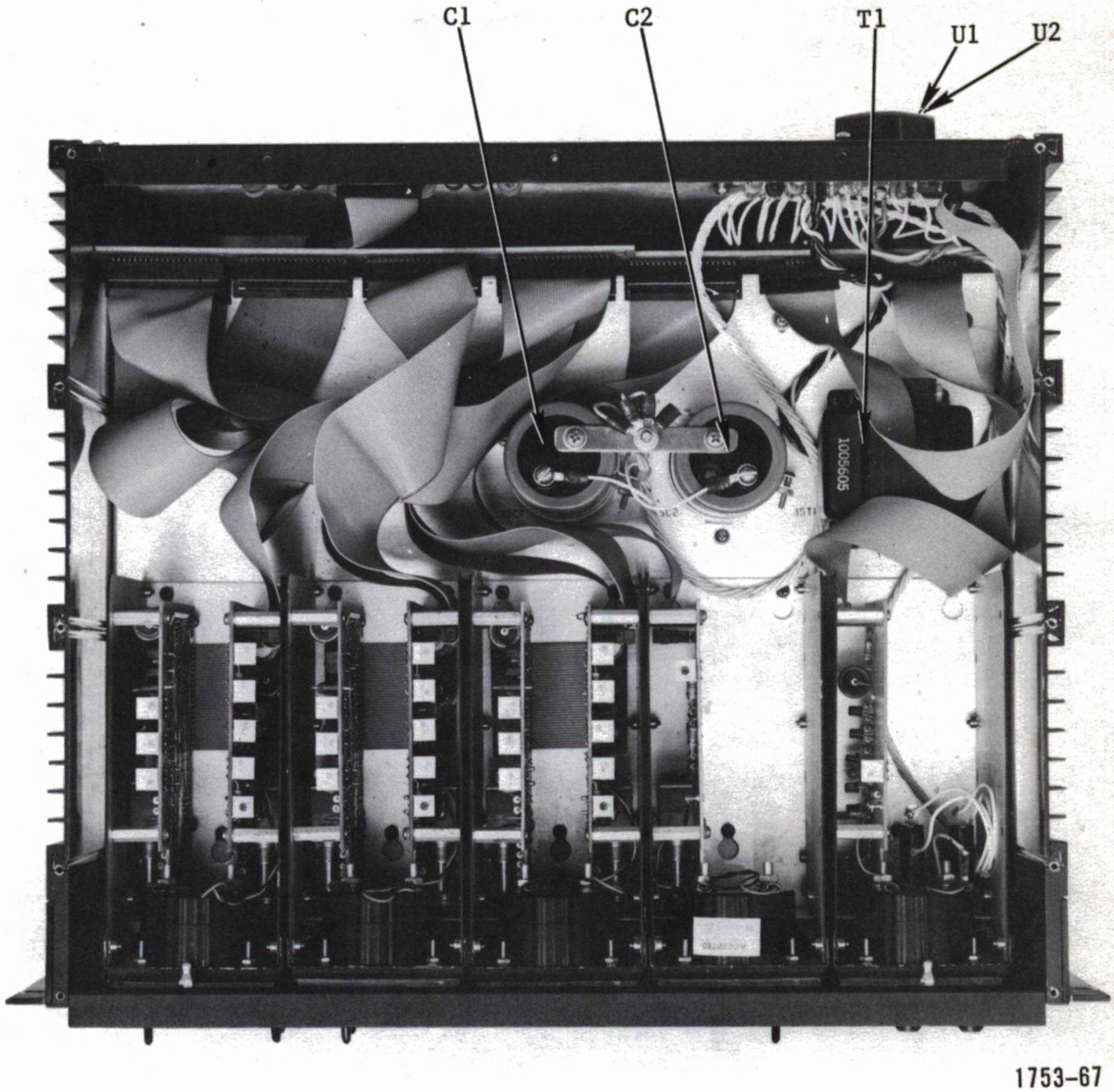
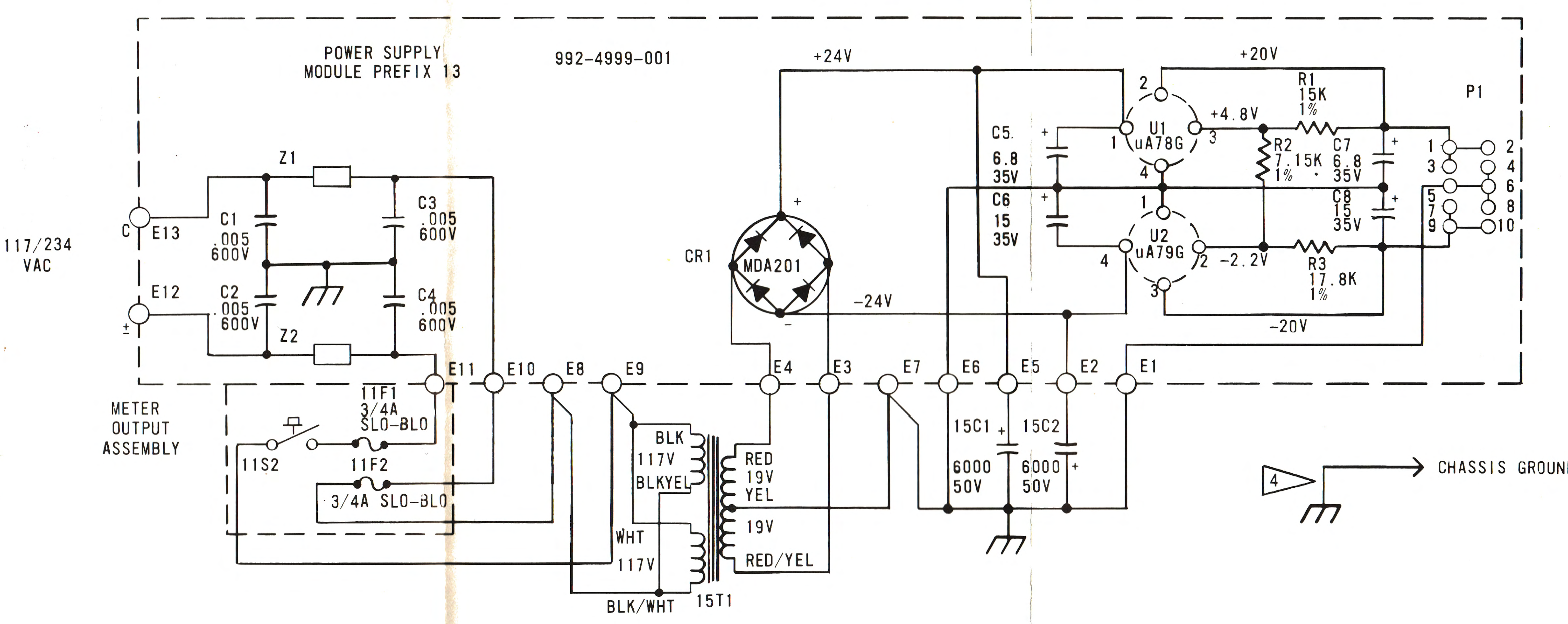


Figure 5-3. Chassis Power Supply Parts Locations



4 TOP FOIL GROUND PLANE

3. ALL CAPACITANCE IN uF.

2. ALL RESISTANCE IN OHMS.

1. ALL RESISTORS ARE 1/4WATT, 1%.

UNLESS OTHERWISE SPECIFIED:

NOTES:

FIGURE 5-4.
(SHEET 1 OF 2)
PRIMARY POWER SUPPLY
SCHEMATIC
839 3501 001

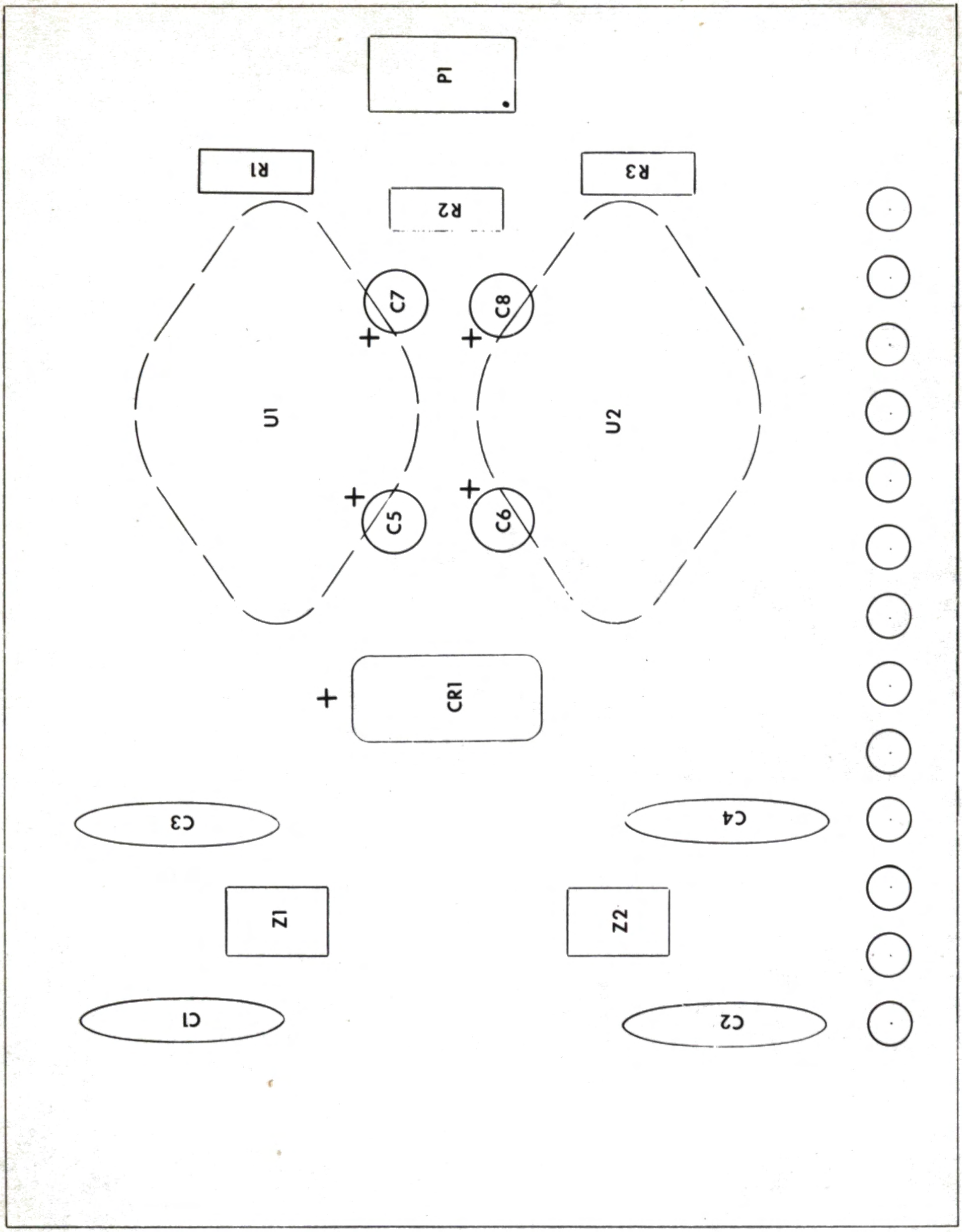


FIGURE 5-4. (SHEET 2 OF 2) POWER SUPPLY
COMPONENT LOCATION - 843 2212 001

 WARNING: Disconnect primary power prior to servicing.

SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This section provides a description, reference designator, and order number for replaceable electrical parts, assemblies, and selected mechanical parts necessary for proper maintenance of the main frame. Table 6-1 lists the assemblies having replaceable parts, and the number of the table listing the parts.

6-3. REPLACEABLE PARTS SERVICE.

6-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Service Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

6-5. TECHNICAL ASSISTANCE.

6-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Department during normal working hours. Emergency technical service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

Table 6-1. Replaceable Parts List Index

Table 6-2. Main Chassis Power Supply - 992 4958 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
2A1A1	992 4998 001	PC Board, Audio Input/Output	1
2A1A2	992 4999 001	PC Board, Power Supply	1
2A1A3	992 5071 001	PC Board, Mother	1
2A1A4	992 4955 001	AGC Meter Module	3
2A1A5	992 4956 001	Limiter Meter Module	1
2A1A6	992 4957 001	Program Meter Module	1
C1,C2	524 0150 000	Capacitor, 6000 uF, 50V	2
P1	610 0752 000	Socket, AC Power	1
T1	472 1143 000	Transformer, Power	1
U1	382 0524 000	Regulator, 78GKC	1
U2	382 0525 000	Regulator, 79GKC	1
XCV1,XCV2	358 1750 000	Protective Cover	2

Table 6-3. Power Supply Printed Circuit Assembly - 992 4999 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1,C2,C3,C4	508 0079 000	Capacitor, 0.005 uF, 600V	4
C5	526 0049 000	Capacitor, 6.8 uF, 35V	1
C6	526 0093 000	Capacitor, 15 uF, 35V	1
C7	526 0049 000	Capacitor, 6.8 uF, 35V	1
C8	526 0093 000	Capacitor, 15 uF, 35V	1
CR1	384 0665 000	Diode, MDA 201	1
P1	610 0741 000	10 Post Header Assembly	1
R1	548 0340 000	Resistor, 15k ohm, 1%	1
R2	548 1420 000	Resistor, 7.15k ohm, 1%	
R3	548 1400 000	Resistor, 17.8k ohm, 1%	1
Z1,Z2	414 0212 000	Ferrite Bead	2
	939 3119 001	Printed Circuit Board	1

1735 100

Table 6-4. Audio I/O Printed Circuit Assembly - 992 4998 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1 thru C16	516 0074 000	Capacitor, .005 uF, 1kV	16
L1 thru L8	494 0419 000	Choke, 1 MHy	8
J1	610 0741 000	Post Assembly, 10 Terminals	1
TB1	614 0711 000	Barrier Block, 10 Terminal	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-5. Motherboard Printed Circuit Assembly - 992 5071 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
CR1 thru CR16	384 0205 000	Diode, 1N914	16
J1 thru J10	612 0887 000	Edge Connector, 72 Pin	10
J11 thru J17	610 0748 000	Cable Connector, 40 Pin	7
J18	610 0741 000	Cable Connector, 10 Pin	1
J19	610 0747 000	Cable Connector, 26 Pin	1
J20	610 0741 000	Cable Connector, 10 Pin	1
J21,J22	612 0775 000	Jack	2
	852 8334 001	Printed Circuit Board	1

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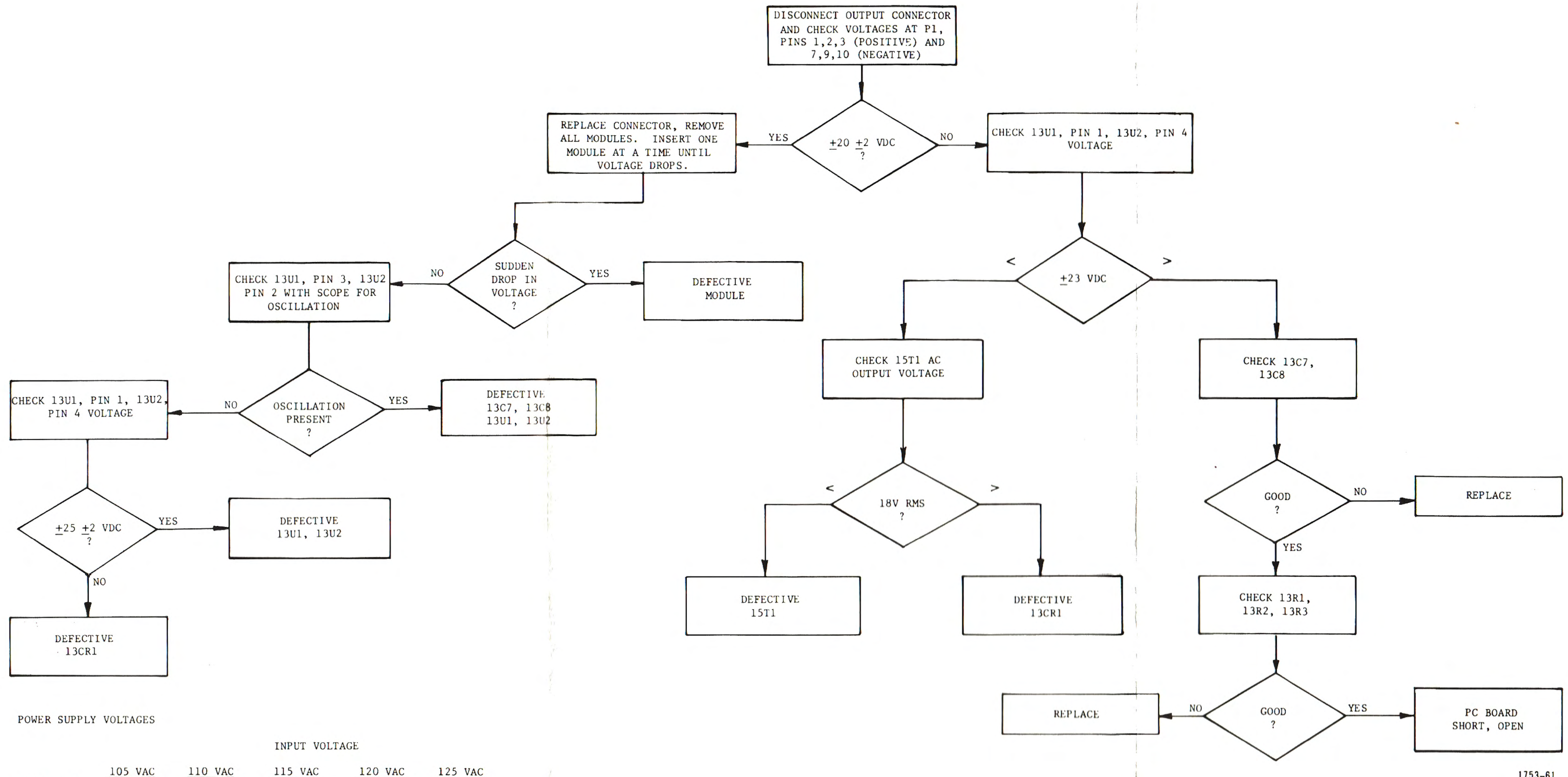

POWER SUPPLY VOLTAGES

INPUT VOLTAGE

	105 VAC	110 VAC	115 VAC	120 VAC	125 VAC
13CR1 (AC)	16.4 VAC	17.2 VAC	18 VAC	18.8 VAC	19.6 VAC
15C1 (+)	+21.2 VDC	+22.3 VDC	+23.4 VDC	+25.5 VDC	+26.6 VDC
15C2 (-)	-21.2 VDC	-22.3 VDC	-23.4 VDC	-25.5 VDC	-26.6 VDC
13U1 PIN 2	+18.2 VDC	+19.3 VDC	+20.1 VDC	+20.1 VDC	+20.1 VDC
13U2 PIN 3	+ 4.5 VDC	+ 4.8 VDC	+ 5.0 VDC	+ 5.0 VDC	+ 5.0 VDC
13U1 PIN 3	-19.0 VDC	-20.2 VDC	-20.2 VDC	-20.2 VDC	-20.2 VDC
13U2 PIN 2	- 2.1 VDC	- 2.23 VDC	- 2.23 VDC	- 2.23 VDC	- 2.23 VDC

FIGURE 5-5.
PRIMARY POWER SUPPLY
TROUBLESHOOTING CHART

INPUT/AGC MODULE
888 1753 200

TECHNICAL MANUAL

INPUT/AGC MODULE

994 7971 001

HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1753 200

Printed: July 1977
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WARNING: Disconnect primary power prior to servicing.

LIST OF TABLES

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LIST OF ILLUSTRATIONS

 WARNING: Disconnect primary power prior to servicing.

SECTION I

GENERAL DESCRIPTION

1-1. GENERAL.

1-2. There are two input/AGC modules (left and right channels) in the Audio Processor System which are identical. The purpose of the module is to match the system input to a 600-ohm balanced line and to split the signal into three bands, high frequency, mid band, and low frequency. Inputs to this module include the signal input which feeds a balanced instrumentation amplifier connected for differential input-single ended output, and the DC control voltage inputs. The DC control voltages are used to control the gain of three four-quadrant multipliers, one for each frequency bnad. Four outputs are routed to the compression expansion circuitry, the three frequency band signals, and a fourth in which the three bands are combined.

1-3. TECHNICAL CHARACTERISTICS.

1-4. Table 1-1 gives the electrical characteristics of the module.

1753 200

Table 1-1. Electrical Characteristics

FUNCTION	CHARACTERISTIC
Input audio signal	Audio from console, +20 dBm maximum. Signal clipped at 17.5 volts peak. Signal may be balanced or unbalanced 600 ohms.
Power Requirement	+20 $\pm$3 vdc and -20 $\pm$3 vdc supplied from primary power supply.
Input Impedance	600 ohms, balanced or unbalanced.
Input Signal Level and Gain	From -25 dBm to +15 dBm with two switch-selected gain settings (0 dBM and -20 dBM) and a vairable attenuator with 20 dB range.
Frequency Bands	Three (low, mid, and high frequency) with switch-selectable crossover frequencies: Low crossover frequencies: 75, 95, 105, 135, 160, 230, and 320 Hz. High crossover frequencies: 1680, 2180, 2450, 3060, 3700, 5300, and 7200 Hz.
Frequency Response	Broadband: 20 Hz to 20 kHz, $\pm$0.25 dB at +10 dBm output. Low, mid, and high frequency bands: 6 dB/octave rolloff at crossover frequencies.
Total Harmonic Distortion	0.25% or less 20 Hz to 20 kHz at +10 dBm output with control functions disabled.
Intermoulation Distortion	0.5% or less, 50 Hz and 7 kHz mixed 4:1 at +10 dBm output with control function disabled.
Noise	65 dB or greater below +10 dBm output, 20 Hz to 20 kHz bandwidth for 0 dBm input with control functions disabled.

SECTION II

INSTALLATION

2-1. GENERAL.

2-2. Installation of the input/AGC module is covered in Technical Manual 888 1753 001, MSP 100 Audio Processor, Volume I, Section II, Installation.

WARNING: Disconnect primary power prior to servicing.

SECTION III

CONTROLS AND INDICATORS

3-1. GENERAL.

3-2. Figure 3-1 shows all of the user controls and indicators provided on the input/AGC module, and Table 3-1 describes the function of each and its affect on module operation.

1753 200

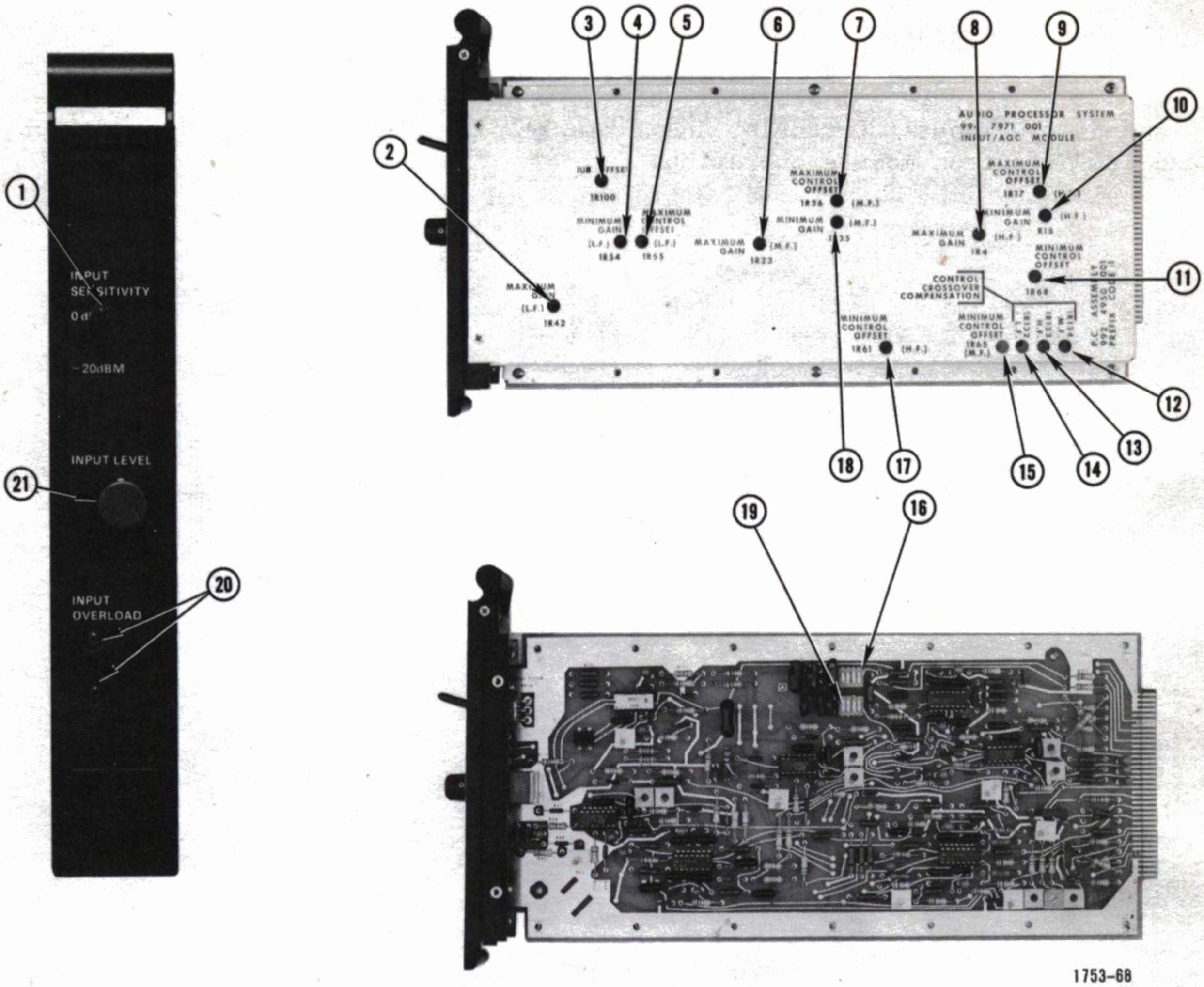

Figure 3-1. Input/AGC Module Controls and Indicators

1753 200

WARNING: Disconnect primary power prior to servicing.

Table 3-1. Input/AGC Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	INPUT SENSITIVITY 0 dBm/-20 dBm, 1S1	Selects input sensitivity. Two fixed gain settings for the input instrumentation amplifier.
2	MAXIMUM GAIN (L.F.), 1R42	Adjusts maximum gain of the low frequency 4-quadrant multiplier.
3	1U8 OFFSET, 1R100	Controls dc output offset of the input amplifier.
4	MINIMUM GAIN (L.F.), 1R54	Trims low frequency band 4-quadrant multiplier gain with 0.625 vdc control voltage input.
5	MAXIMUM CONTROL OFFSET (L.F.), 1R55	Controls dc output offset of the low frequency 4-quadrant multiplier with 10 vdc control voltage input.
6	MAXIMUM GAIN (M.F.), 1R23	Adjusts maximum gain of the mid frequency 4-quadrant multiplier.
7	MAXIMUM CONTROL OFFSET (M.F.), 1R36	Adjusts dc output offset of the mid frequency 4-quadrant multiplier with 10 vdc control voltage input.
8	MAXIMUM GAIN (H.F.), 1R4	Adjusts maximum gain of the high frequency 4-quadrant multiplier.
9	MAXIMUM CONTROL OFFSET (H.F.), 1R17	Adjusts dc output offset of the high frequency 4-quadrant multiplier with 10 vdc control voltage input.
10	MINIMUM GAIN (H.F.), 1R16	Trims high frequency 4-quadrant multiplier gain with 0.625 vdc control voltage input.
11	MINIMUM CONTROL OFFSET (L.F.), 1R68	Adjusts dc output offset of low frequency multiplier buffer to zero with 0 vdc control voltage input.
12	CONTROL CROSSOVER COMPENSATION M.F., 1R134	Adjusts peaks in mid band response near crossover frequencies by injecting broadband signal.
13	H.F., 1R133	Adjusts peaks in high band response near crossover frequency by injecting broadband signal.

Warning, disconnect primary power prior to servicing.

Table 3-1. Input/AGC Module Controls and Indicators (Continued)

<table>
<tr><th>REF.</th><th>CONTROL/INDICATOR</th><th>FUNCTION</th></tr>
<tr><td>14</td><td>L.F., 1R132</td><td>Adjusts peaks in low band response near crossover frequency by injecting broad-band signal.</td></tr>
<tr><td>15</td><td>MINIMUM CONTROL OFFSET (M.F.), 1R65</td><td>Adjusts dc output offset of the mid frequency multiplier buffer to zero with 0 vdc control voltage input.</td></tr>
<tr><td>16</td><td>LOW FREQUENCY CROSSOVER, 1S3</td><td>Selects the upper limit of the low frequency band and the lower limit of the mid frequency band simultaneously as follows:
<table>
<tr><th>FREQUENCY (HZ)</th><th colspan="4">1S3 SECTION</th></tr>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>0</td><td>Closed</td><td>Either</td><td>Either</td><td>Either</td></tr>
<tr><td>75</td><td>Open</td><td>Closed</td><td>Closed</td><td>Closed</td></tr>
<tr><td>95</td><td>Open</td><td>Closed</td><td>Closed</td><td>Open</td></tr>
<tr><td>105</td><td>Open</td><td>Closed</td><td>Open</td><td>Closed</td></tr>
<tr><td>135</td><td>Open</td><td>Open</td><td>Closed</td><td>Closed</td></tr>
<tr><td>160</td><td>Open</td><td>Closed</td><td>Open</td><td>Open</td></tr>
<tr><td>230</td><td>Open</td><td>Open</td><td>Closed</td><td>Open</td></tr>
<tr><td>320</td><td>Open</td><td>Open</td><td>Open</td><td>Closed</td></tr>
</table></td></tr>
<tr><td>17</td><td>MINIMUM CONTROL OFFSET (H.F.), 1R61</td><td>Adjusts the dc output offset of the high frequency multiplier buffer to zero with 0 vdc control voltage input.</td></tr>
<tr><td>18</td><td>MINIMUM GAIN (M.F.), 1R23</td><td>Adjusts minimum gain of the mid frequency 4-quadrant multiplier.</td></tr>
<tr><td>19</td><td>HIGH FREQUENCY CROSSOVER, 1S2</td><td>Selects the upper limit of the mid frequency band and the lower limit of the high frequency band simultaneously as follows:
<table>
<tr><th>FREQUENCY (HZ)</th><th colspan="4">1S3 SECTION</th></tr>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>1680</td><td>Open</td><td>Closed</td><td>Closed</td><td>Closed</td></tr>
<tr><td>2180</td><td>Open</td><td>Open</td><td>Closed</td><td>Closed</td></tr>
<tr><td>2450</td><td>Open</td><td>Closed</td><td>Open</td><td>Closed</td></tr>
<tr><td>3060</td><td>Open</td><td>Closed</td><td>Closed</td><td>Open</td></tr>
<tr><td>3700</td><td>Open</td><td>Open</td><td>Open</td><td>Closed</td></tr>
<tr><td>5300</td><td>Open</td><td>Open</td><td>Closed</td><td>Open</td></tr>
<tr><td>7200</td><td>Open</td><td>Closed</td><td>Open</td><td>Open</td></tr>
<tr><td>∞</td><td>Closed</td><td>Either</td><td>Either</td><td>Either</td></tr>
</table></td></tr>
</table>

Table 3-1. Input/AGC Module Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
20	INPUT OVERLOAD, 1DS1	LED (upper) flashes when negative input signal peaks are clipped.
	1DS2	LED (lower) flashes when positive input signal peaks are clipped.
21	INPUT LEVEL, 1R104	Adjusts output level of the input amplifier over a 20 dB range.

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SECTION IV

PRINCIPLES OF OPERATION

4-1. CIRCUIT DESCRIPTION.

4-2. The input/AGC module consists of three basic circuits as shown in figure 4-1. The signal enters the input/filter section through a differential input-single ended output instrumentation amplifier where it is split into three bands, low, medium, and high frequency. Each of these three signals is fed its own gain control circuit. The three circuits are then summed in the output summing amplifier where four outputs are available, the three frequency band signals and a fourth which is a composite of the three. To simplify the following discussion, power supply connections and decoupling networks are not shown.

4-3. INPUT SECTION.

4-4. The input instrumentation amplifier (1U8) can accpet balanced or single ended input signals. Resistors 1R136 and 1R137 balance the inputs to ground. If one input is grounded, the difference between the other input and ground will be amplified. If both inputs are floating, a true differential amplifier is formed and the difference of the two inputs is amplified. Resistors 1R128 and 1R140 determine the gain of the amplifier as selected by SENSITIVITY switch 1S1. In the 0 dB position signals in the range of -5 dBm to +15 dBm can be accepted. In the -20 dB position, signals from -5 dBm to -25 dBm will be accepted.

4-5. Input overload indication is provided by diode bridge 1CR4 and LED indicators 1DS1 and 1DS2. Should the input signal (positive peak) exceed the positive supply voltage by more than 2.5 volts, diode A in bridge 1CR4 will be forward biased, forward biasing 1DS2 and causing it to glow by drawing current through the signal source. Likewise, if the input signal (negative peak) become more negative than the negative supply voltage by more than 2.5 volts, diode C in bridge 1CR4 and 1DS1 will conduct and 1DS1 will glow. For all other input signal conditions, diodes A, B, C, D, and 1DS1 and 1DS2 are all reverse biased and have very high impedances. DC output offset of the amplifier is set to zero with OFFSET control 1R100.

4-6. The instrumentation amplifier output is fed through isolation resistor 1R102 to the INPUT LEVEL attenuator 1R104 and 1R119. An output signal test point is also provided through isolation resistor 1R103. INPUT LEVEL control 1R104 controls the level of signal which is ultimately routed to the compression, expansion, and limiting circuits over a 20 dB range. Operational amplifier 1U9A is a voltage follower buffer which feeds the audio signal to the band splitting filter circuits. The nominal gain of instrumentation amplifier-circuit is 20 dB.

WARNING: Disconnect primary power prior to servicing.

4-7. BAND SPLITTING FILTER SECTION.

4-8. The signal from buffer 1U9A is split into three separate paths (frequency bands). Crossover frequencies for these bands are selected by operating the printed circuit switches 1S2 and 1S3 as shown in tables 4-1 and 4-2.

4-9. A combination of capacitors (1C67, 1C68, and 1C69 selected by 1S2) and resistor 1R108 at the input of operational amplifier 1U9B form a high pass filter fed from 1U9A. Cutoff frequency may be determined by operating switch 1S2 as shown in table 4-1. A low pass filter is formed by a combination of capacitors 1C75, 1C76, and 1C77, and resistor 1R122 at the input of 1U9D. The filter cutoff frequency may be determined from table 2-2.

4-10. Operational amplifier 1U9C is connected as a summing amplifier. The high frequency signal from 1U9B and the low frequency signal from 1U9D are summed through resistors 1R116 and 1R117. An attenuator consisting of 1R114 and 1R115 extracts a portion of the broadband signal and routes it to the noninverting input of 1U9C. Therefore, the output of 1U9C is the mid band signal derived by substracting the broadband signal from the sum of the high and low band signals.

4-11. GAIN CONTROL SECTION.

4-12. The gain control sections for the three frequency bands are identical; therefore, only the low band circuit will be discussed. Input signal from 1U9D is applied to the Y input (pin 4) of four-quadrant multiplier 1U3 (MC1495L) through voltage divider 1R39, 1R40 and attenuated to a nominal level of 60 mV. The dc control signal is applied to the X input (pin 9) through voltage controlled current source 1U4C. Output current of 1U4C is directly proportional to the voltage at the noninverting input. The quiescent dc control voltage (with no compression or expansion) is +10 volts. To avoid overdriving the X input of 1U3, a voltage divider, 1R49, 1R50, is included in the 1U4C input attenuating the control voltage by a factor of 0.0762. Any change in voltage at the input of 1U4C will result in a proportional change in the gain of 1U3. The inherent offset errors of the multiplier are nulled out with potentiometers 1R54, 1R55, and 1R68. 1R54 (MINIMUM GAIN (L.F.)) trims the minimum gain of the circuit (control voltage of 0.625 Vdc); 1R55 (MAXUMUM CONTROL OFFSET (L.F.)) adjusts the output dc offset with no audio signal and +10 Vdc control voltage. 1R68 (MINIMUM CONTROL OFFSET (L.F.)) adjusts the output of buffer 1U5C to zero with 0 Vdc control voltage. Scale factor resistors 1R42 and 1R43 establish the maximum gain of the circuit which can be trimmed by MAXIMUM GAIN (L.F.) potentiometer 1R42. Resistors 1R47 and 1R48 are load resistors which develop the input signal for buffer 1U5C.

4-13. SUMMING AMPLIFIER SECTION.

4-14. The audio from the gain control section is applied to attenuator 1R87, 1R88 and fed to the summing junction of 1U5D through resistor 1R77. The high frequency and mid band signals are applied to 1U5D through summing

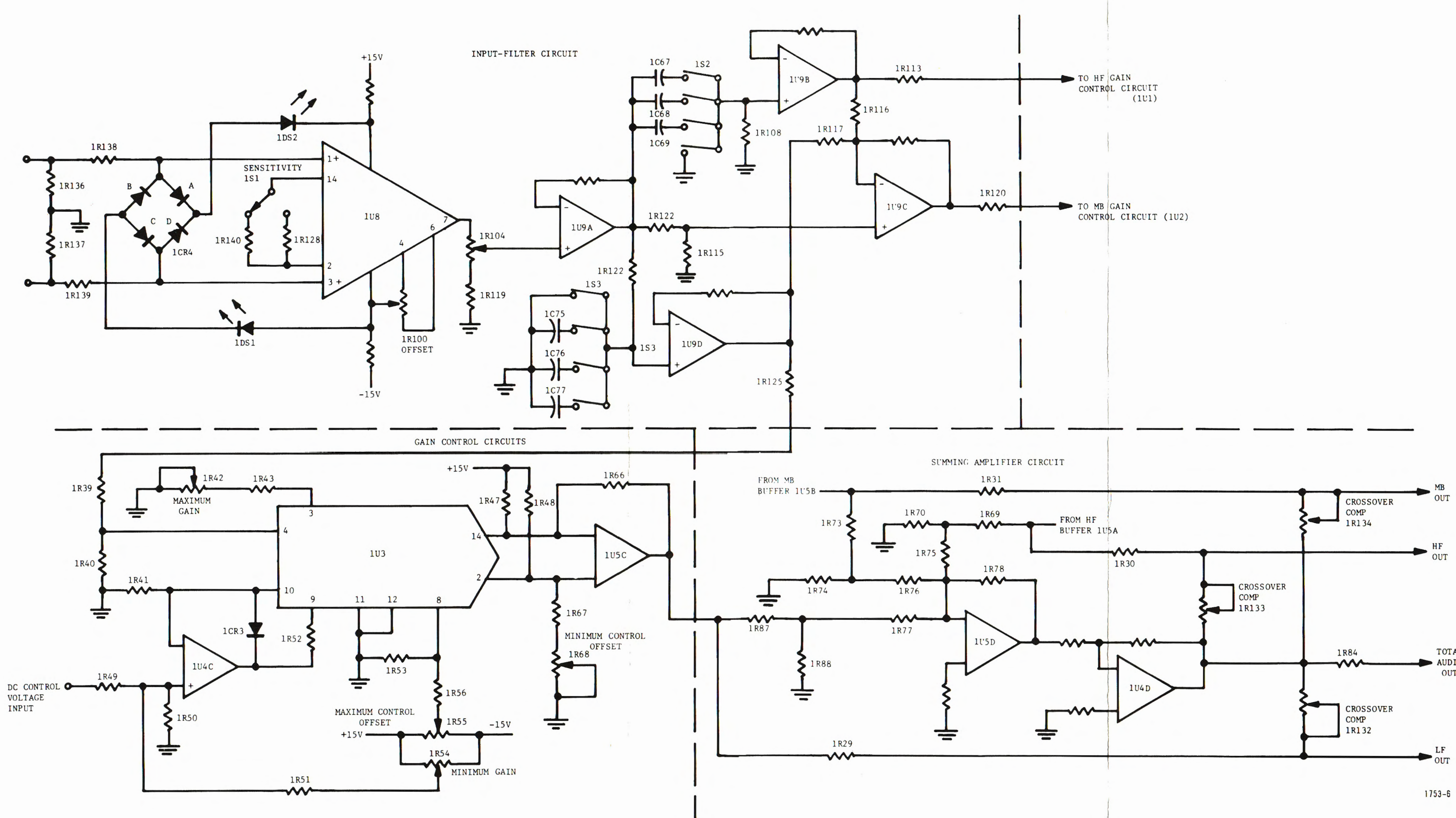

FIGURE 4-1.
INPUT/AGC MODULE
BLOCK DIAGRAM

Table 4-1. High Crossover Frequency Selection

Switch 1S2 Element				Crossover Frequency (H_2)
1	2	3	4	
Closed	Either	Either	Either	NOTE
Open	Closed	Closed	Closed	1680
Open	Open	Closed	Closed	2180
Open	Closed	Open	Closed	2450
Open	Closed	Closed	Open	3060
Open	Open	Open	Closed	3700
Open	Open	Closed	Open	5300
Open	Closed	Open	Open	7200

NOTE: In this position, the high band is disabled and all high frequency components appear in the mid band.

Table 4-2. Low Crossover Frequency Selection

Switch 1S3 Element				Crossover Frequency (H_2)
1	2	3	4	
Closed	Either	Either	Either	NOTE
Open	Open	Open	Closed	320
Open	Open	Closed	Open	230
Open	Closed	Open	Open	160
Open	Open	Closed	Closed	135
Open	Closed	Open	Closed	105
Open	Closed	Closed	Open	95
Open	Closed	Closed	Closed	75

NOTE: In this position, the low frequency band is disabled and all low frequency components appear in the mid band.

WARNING: Disconnect primary power prior to servicing.

resistors 1R75 and 1R76, respectively. The output of 1U5D is therefore the sum of the three bands. The signal is inverted by 1U4D to make the polarity identical to the input.

4-15. The ac (audio) control signal contains dips at the crossover frequencies which in turn cause the dc control voltage to rise increasing multiplier gain and causing response peaks. Connected from the output of 1U4D to each of the three frequency band outputs are three CROSSOVER COMPENSATION potentiometers. Their purpose is to inject a small amount of broadband signal into each band to reduce these response peaks near the crossover frequencies.

4-16. The output of the module consists of a high frequency signal, a mid band signal, a low frequency signal, and a fourth signal which is a composite of the three bands. These four signals are isolated by resistors 1R30, 1R31, 1R29, and 1R84 respectively.

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SECTION V

MAINTENANCE AND TROUBLESHOOTING

5-1. GENERAL.

5-2. This section describes the maintenance and troubleshooting procedures for the Input/AGC module. As shown in figure 5-1, reference designators are printed on the printed circuit board. In addition, certain parts, significant to the procedures which follow are flagged. In the text and on the schematic (figure 5-2), the reference designators shown on the printed circuit board are prefixed with the number "1". If the module does not perform properly, figures 5-3 through 5-5 may be used as guides in locating the fault. For general repairs and cleaning techniques, refer to Technical Manual 888 1731 001, Volume I, Section V.

5-3. TEST EQUIPMENT.

5-4. Refer to Technical Manual 888 1753 001, Section V, Maintenance for a list of recommended test equipment.

5-5. MODULE ALIGNMENT PROCEDURES.

5-6. The Input/AGC modules are properly aligned at the factory before shipment. Any minor adjustments which become necessary during use can be made through the access holes in the module cover unless parts have been replaced or the crossover frequencies are to be changed, by using an extender card. When using an extender card, care should be taken that the module is properly supported on the front panel end and is inserted straight into the extender card edge connector. If any parts are replaced and it becomes necessary to make measurements on the board, the module cover must be removed by removing eight cross-recessed screws. The front panel and rear cover may be removed by removing the INPUT LEVEL potentiometer knob at the front panel and sliding the front panel and rear cover forward.

5-7. ADJUSTMENT PROCEDURES.

5-8. The module internal controls are factory adjusted before shipment, and should rarely, if ever, require readjustment. If adjustment is required, such as following troubleshooting and parts replacement, the following procedures must be used.

5-9. INPUT AMPLIFIER OFFSET. Disconnect all inputs to the MSP 100 other than ac power. Connect an accurate dc voltmeter, preferably digital, between ground and pin 7 of 1U8. It is recommended that the ground side of 1R119 (towards the edge connector) to be used as the voltmeter ground. Adjust 1U8 OFFSET control, 1R100 for 0.000 $\pm$0.001 vdc at pin 7.

5-10. CONTROL CROSSOVER COMPENSATION. Controls 1R132, 1R134, and 1R133 are factory adjusted before shipment and should not be readjusted in the field. Should they be accidentally adjusted or fail, they should be adjusted for maximum resistance.

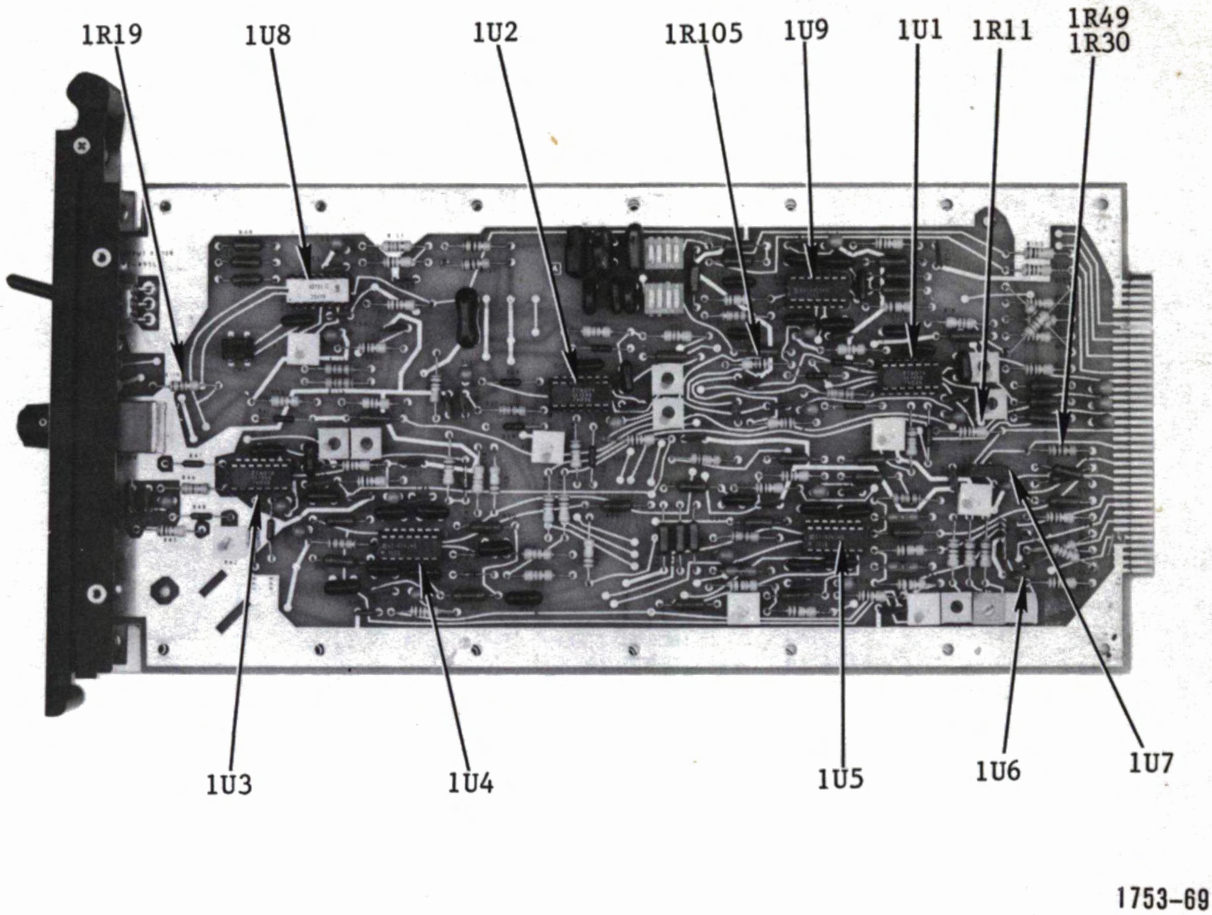

Figure 5-1. Input/AGC Module Parts Layout

WARNING: Disconnect primary power prior to servicing.

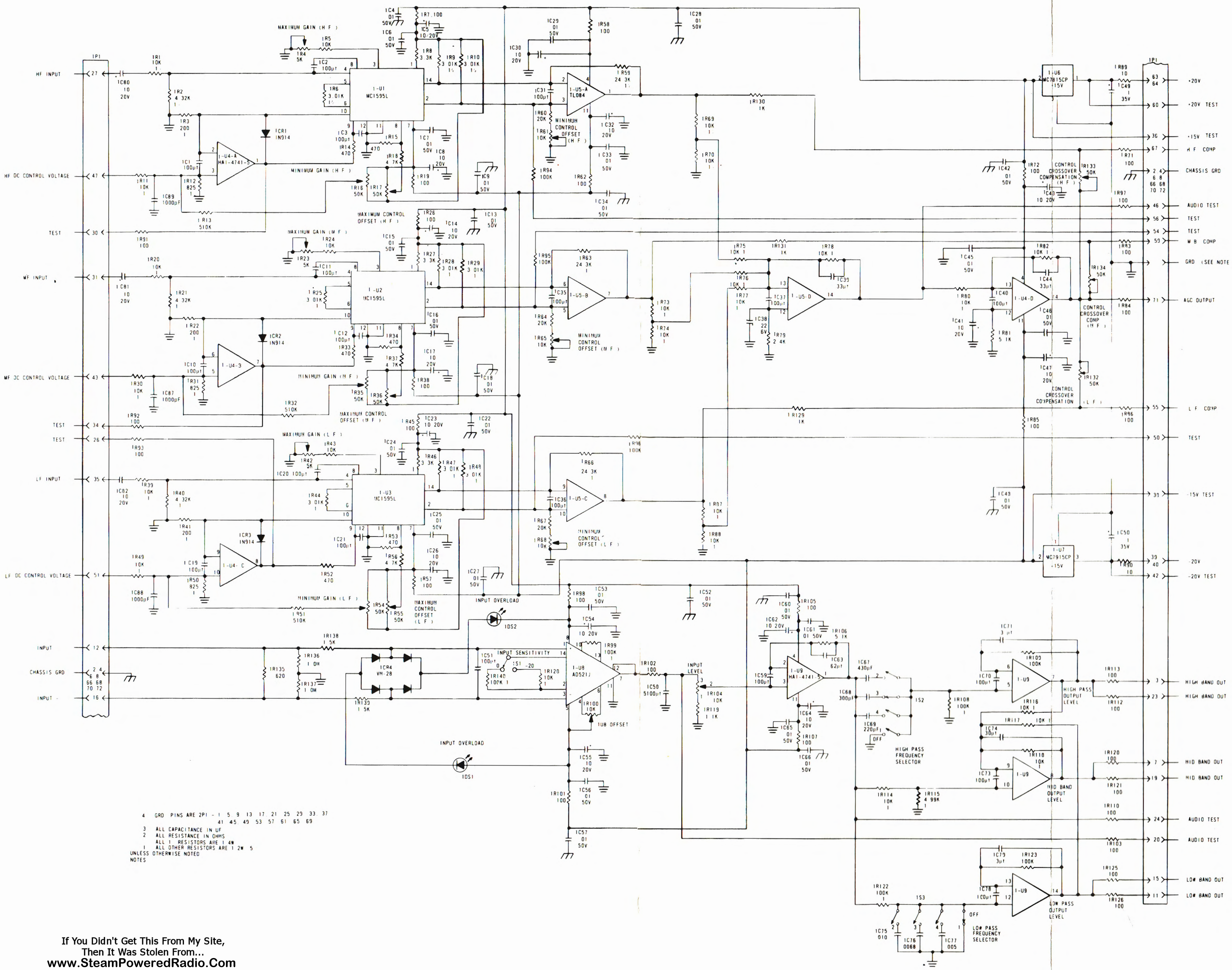

FIGURE 5-2.
(SHEET 1 OF 2)
INPUT/AGC MODULE
SCHEMATIC
852 8341 001

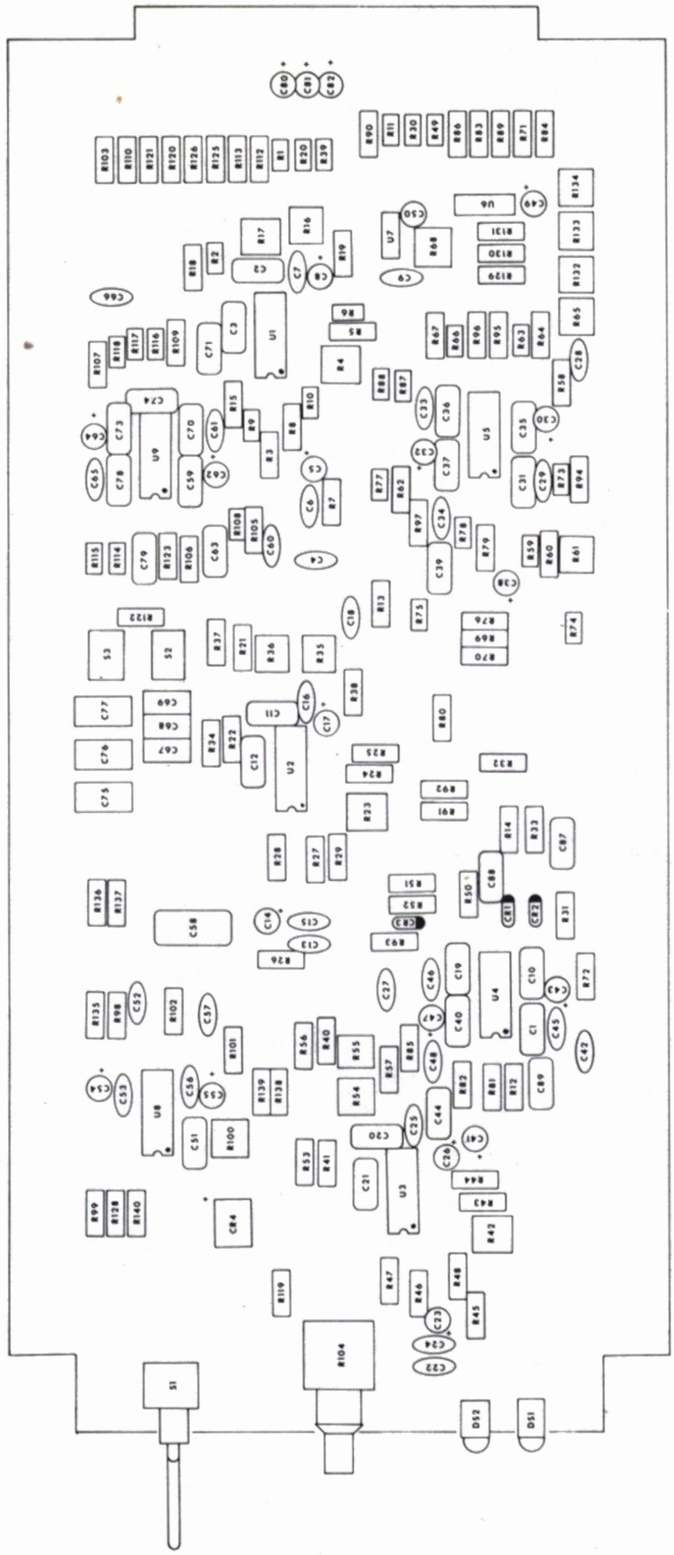

FIGURE 5-2. (SHEET 2 OF 2) INPUT/AGC
COMPONENT LOCATION - 843 2189 001

WARNING: Disconnect primary power prior to servicing.

5-11. MULTIPLIER ALIGNMENT PROCEDURE. The multiplier trim controls, MINIMUM GAIN, MAXIMUM GAIH, MINIMUM CONTROL OFFSET, and MAXIMUM CONTROL OFFSET, in each band calibrate the multiplier gain controller in that band. These controls must be adjusted as a system, since each control to some degree interacts with the others. However, if no gain errors are suspected, it is usually permissable to adjust only the offset controls when an offset error is encountered. Use sine wave frequencies of 20 Hz for the low band, 700 Hz for the mid band, and 20 kHz for the high band, in the following procedure.

NOTE

Reference designators enclosed in parentheses in the following procedure refer to low band, mid band, and high band components, respectively.

a. Set operational controls in each band as follows:

Control Module

EXPANSION FUNCTION	OFF
COMPRESSION FUNCTION	ON
RECOVERY MODE/EXPANSION	SINGLE
RECOVERY MODE/COMPRESSION	SINGLE

AGC Meter Module

COMPRESSION ATTACK TIME	Position 3 (mid)
COMPRESSION RECOVERY TIME	Position 3
COMPRESSION SLOPE	Position 4 (fully CW)

Input/AGC Module

INPUT SENSITIVITY	-20 dBm
INPUT LEVEL	Fully CW

b. If multiplier (1U3, 1U2, 1U1) has been replaced, adjust MAXIMUM GAIN (1R42, 1R23, 1R4), MAXIMUM CONTROL OFFSET (1R55, 1R36, 1R17), MINIMUM GAIN (1R54, 1R35, 1R16), and MINIMUM CONTROL OFFSET (1R68, 1R65, 1R61) to mid position; otherwise, do not adjust.

c. With no audio input, measure the dc voltage at the end of (1R49, 1R30, 1R11) toward the edge connector. It should be +10 $\pm$0.5 vdc. If it is not, refer to the multiplier alignment for the control module (T.M. 888 1753 300).

d. Remove the control module from the main frame and adjust MINIMUM CONTROL OFFSET (1R68, 1R65, 1R61) control for 0.0 vdc at pin (8, 7, 1) of 1U5.

WARNING: Disconnect primary power prior to servicing.

e. Insert the control module and adjust MAXIMUM CONTROL OFFSET (1R55, 1R36, 1R17) control for 0.0 vdc at pin (8, 7, 1) of U5.

f. Repeat d. and e. until 0.0 vdc offset is achieved under both conditions.

g. Remove the control module and jumper a 240k resistor from the +15 volt supply to the end of (1R49, 1R30, 1R11) toward the edge connector. (A convenient connection point for the +15 volts is the end of 1R105 toward the front panel.) Adjust MINIMUM CONTROL OFFSET (1R68, 1R65, 1R61) control for 0.0 vdc at pin (8, 7, 1) of 1U5.

h. Repeat e. and g. until the offset voltage at pin (8, 7, 1) of 1U5 is 0.0 vdc under both conditions.

i. Apply a sine wave (see paragraph 5-11 for frequency) to the MSP 100 input terminals at -40 dBm level and adjust MINIMUM GAIN (1R54, 1R35, 1R16) control for 3 dB gain from pin 4 of (1U3, 1U2, 1U1) to pin (8, 7, 1) of 1U5.

j. Remove the 240k resistor. Replace the control module and adjust the signal generator output to below the compression threshold. Adjust MAXIMUM GAIN (1R42, 1R23, 1R4) for 27 dB gain from pin 4 of (1U3, 1U2, 1U1) to pin (8, 7, 1) of 1U5.

k. Repeat e., g., i., and j. until gain tracking and output offsets are optimum.

5-12. TROUBLESHOOTING.

5-13. When the system does not perform properly and the fault has been traced to the Input/AGC module, figures 5-3 through 5-5 may be used as guides for locating the fault within the module. A thorough visual inspection should always be performed first. Discolored or charred parts indicate heat damage. Feeling a component (while power is on) can detect excessive heat dissipation. Finally, look for broken conductors and whiskers on the PC board with the aid of a magnifying glass; these defects are sometimes too small to be detected with the naked eye.

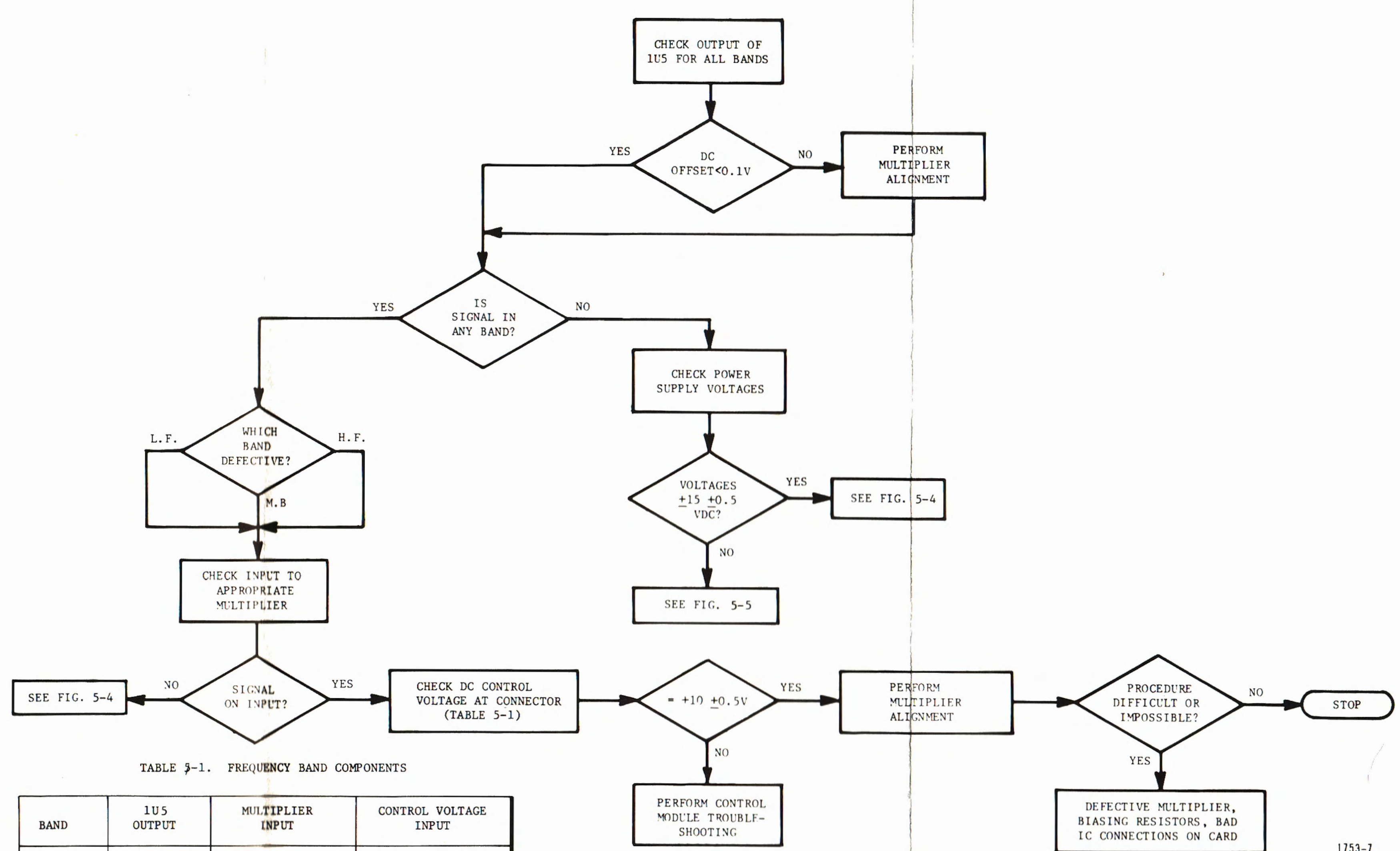

TABLE 5-1. FREQUENCY BAND COMPONENTS

BAND	1U5 OUTPUT	MULTIPLIER INPUT	CONTROL VOLTAGE INPUT
L.F.	PIN 8	1U3, PIN 4	1P1, PIN 51
M.F.	PIN 7	1U2, PIN 4	1P1, PIN 43
H.F.	PIN 1	1U1, PIN 4	1P1, PIN 47

FIGURE 5-3.
AGC TROUBLESHOOTING CHART

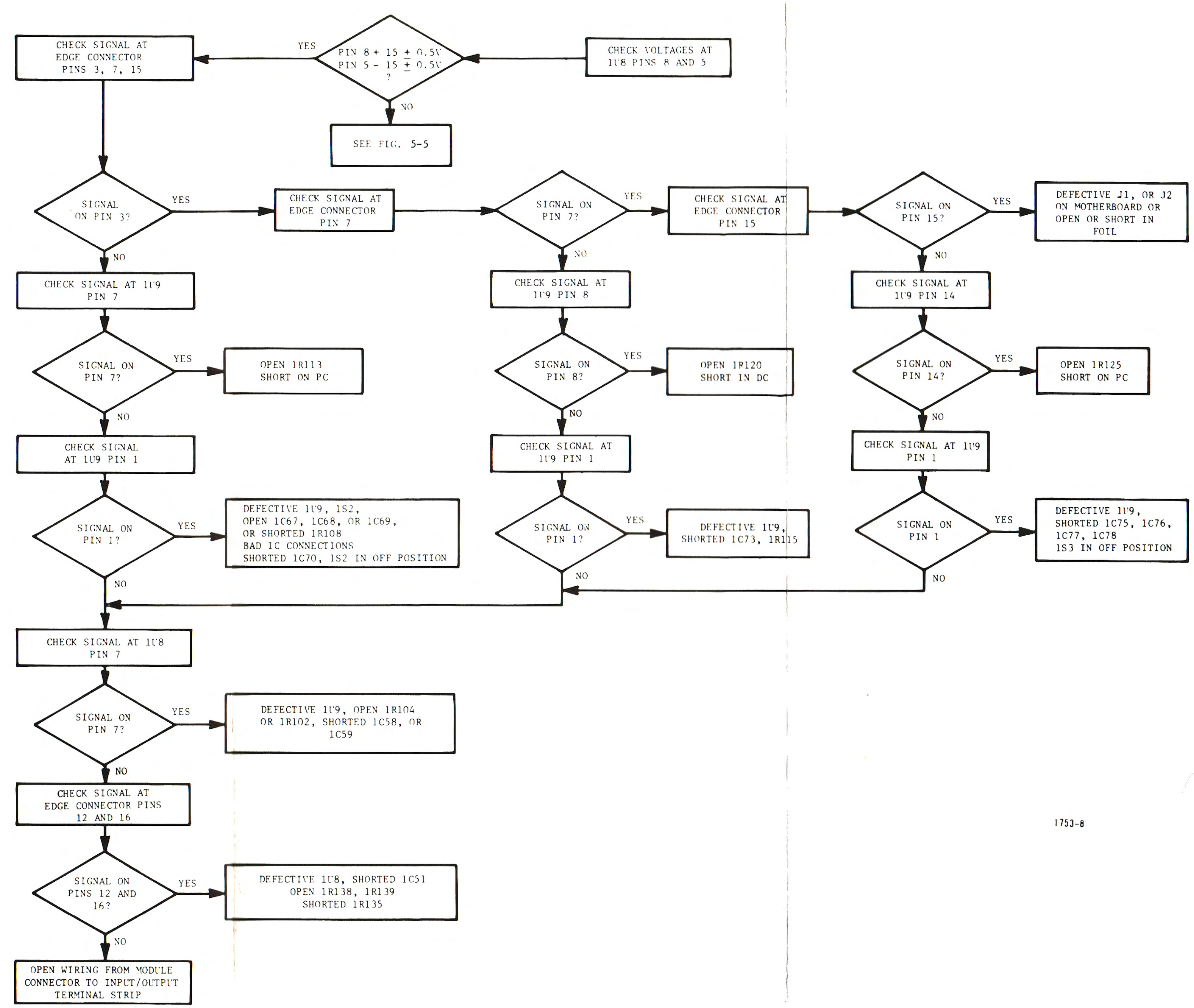

FIGURE 5-4.
INPUT/FILTER
TROUBLESHOOTING CHART

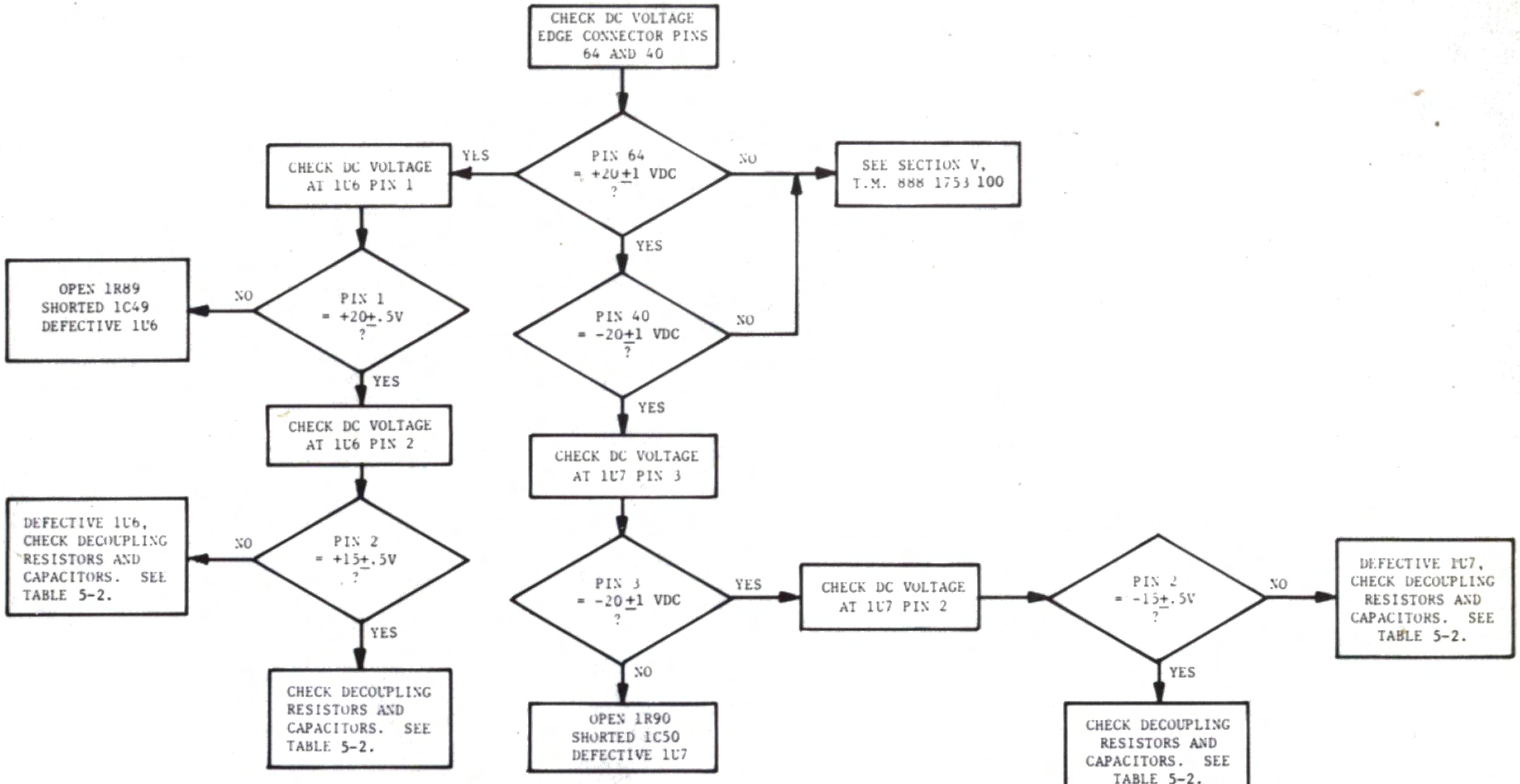

TABLE 5-2. POWER SUPPLY DECOUPLING NETWORK

DEVICE	POSITIVE SUPPLY		NEGATIVE SUPPLY	
	PIN	COMPONENTS	PIN	COMPONENTS
1U1	1	1R1, 1R8, 1C4, 1C5, 1C6	7	1R19, 1C7, 1C8, 1C9
1U2	1	1R26, 1R27, 1C13, 1C14, 1C15	7	1R38, 1C16, 1C17, 1C18
1U3	1	1R45, 1R46, 1C22, 1C23, 1C24	7	1R57, 1C25, 1C26, 1C27
1U4	4	1R72, 1C42, 1C43, 1C45	11	1R85, 1C46, 1C47, 1C48
1U5	4	1R58, 1C28, 1C29, 1C30	11	1R62, 1C32, 1C33, 1C34
1U6	1	1R89, 1C49		
1U7			3	1R90, 1C50
1U8	8	1R98, 1C52, 1C53, 1C54	5	1R101, 1C55, 1C56, 1C57
1U9	4	1R105, 1C60, 1C61, 1C62	11	1R107, 1C64, 1C65, 1C66

Figure 5-5. Input/AGC Module Power Supply Troubleshooting Chart

WARNING: Disconnect primary power prior to servicing.

SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This section provides a description, reference designator, and order number for replaceable electrical parts, assemblies, and selected mechanical parts necessary for proper maintenance of the input/AGC module. Table 6-1 lists the replaceable parts for the input/AGC module assembly, and table 6-2 lists the parts for the input/AGC P.C. board assembly.

6-3. REPLACEABLE PARTS SERVICE.

6-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Service Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

6-5. TECHNICAL ASSISTANCE.

6-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Department during normal working hours. Emergency technical service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301. The Harris factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

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Table 6-1. Input/AGC Module Assembly - 994 7971 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	650 0271 000	Knob	1
	358 2063 000	Insert, Blue	1
	992 4950 001	Input/AGC Printed Circuit Board (Refer to table 6-2)	1
	598 0344 000	Toggle Boot, Blue	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-2. Input/AGC Printed Circuit Board - 992 4950 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1,C2,C3	500 0759 000	Capacitor, 100 pF, 500V	3
C4	516 0375 000	Capacitor, .01 mF, 50V	1
C5	526 0048 000	Capacitor, 10 mF, 20V	1
C6,C7	516 0375 000	Capacitor, .01 mF, 50V	2
C8	526 0048 000	Capacitor, 10 mF, 20V	1
C9	516 0375 000	Capacitor, .01 mF, 50V	1
C10,C11,C12	500 0759 000	Capacitor, 100 pF, 500V	3
C13	516 0375 000	Capacitor, .01 mF, 50V	1
C14	526 0048 000	Capacitor, 10 mF, 20V	1
C15,C16	516 0375 000	Capacitor, .01 mF, 50V	2
C17	526 0048 000	Capacitor, 10 mF, 20V	1
C18	516 0375 000	Capacitor, .01 mF, 50V	1
C19,C20,C21	500 0759 000	Capacitor, 100 pF, 500V	3
C22	516 0375 000	Capacitor, .01 mF, 50V	1
C23	526 0048 000	Capacitor, 10 mF, 20V	1
C24,C25	516 0375 000	Capacitor, .01 mF, 50V	2
C26	526 0048 000	Capacitor, 10 mF, 20V	1
C27,C28,C29	516 0375 000	Capacitor, .01 mF, 50V	3
C30	526 0048 000	Capacitor, 10 mF, 20V	1
C31	500 0759 000	Capacitor, 100 pF, 500V	1
C32	526 0048 000	Capacitor, 10 mF, 20V	1
C33,C34	516 0375 000	Capacitor, .01 mF, 50V	2
C35,C36,C37	500 0759 000	Capacitor, 100 pF, 500V	3

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WARNING: Disconnect primary power prior to servicing.

Table 6-2. Input/AGC Printed Circuit Board - 992 4950 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C38	526 0308 000	Capacitor, 22 uF, 10V	1
C39	500 0813 000	Capacitor, 33 pF, 500V	1
C40	500 0759 000	Capacitor, 100 pF, 500V	1
C41	526 0048 000	Capacitor, 10 mF, 20V	1
C42	516 0375 000	Capacitor, .01 mF, 50V	1
C43	526 0048 000	Capacitor, 10 mF, 20V	1
C44	500 0813 000	Capacitor, 33 pF, 500V	1
C45,C46	516 0375 000	Capacitor, .01 mF, 50V	2
C47	526 0048 000	Capacitor, 10 mF, 20V	1
C48	516 0375 000	Capacitor, .01 mF, 50V	1
C49,C50	526 0050 000	Capacitor, 1 mF, 35V	2
C51	500 0759 000	Capacitor, 100 pF, 500V	1
C52,C53	516 0375 000	Capacitor, .01 mF, 50V	2
C54,C55	526 0048 000	Capacitor, 10 mF, 20V	2
C56,C57	516 0375 000	Capacitor, .01 mF, 50V	2
C58	500 0783 000	Capacitor, 5100 pF, 500V	1
C59	500 0759 000	Capacitor, 100 pF, 500V	1
C60,C61	516 0375 000	Capacitor, .01 mF, 50V	2
C62	526 0048 000	Capacitor, 10 mF, 20V	1
C63	500 0820 000	Capacitor, 62 pF, 500V	1
C64	526 0048 000	Capacitor, 10 mF, 20V	1
C65,C66	516 0375 000	Capacitor, .01 mF, 50V	2
C67	500 0834 000	Capacitor, 430 pF, 500V	1

Table 6-2. Input/AGC Printed Circuit Board - 992 4950 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C68	500 0784 000	Capacitor, 300 pF, 500V	1
C69	500 0754 000	Capacitor, 220 pF, 500V	1
C70	500 0759 000	Capacitor, 100 pF, 500V	1
C71	500 0802 000	Capacitor, 3 pF, 500V	1
C73	500 0759 000	Capacitor, 100 pF, 500V	1
C74	500 0812 000	Capacitor, 30 pF, 500V	1
C75	508 0215 000	Capacitor, .01 mF, 100V	1
C76	508 0191 000	Capacitor, .0068 mF, 100V	1
C77	508 0076 000	Capacitor, .005 uF, 100V	1
C78	500 0759 000	Capacitor, 100 pF, 500V	1
C79	500 0802 000	Capacitor, 3 pF, 500V	1
C80,C81,C82	526 0048 000	Capacitor, 10 mF, 20V	3
C87,C88,C89	500 0844 000	Capacitor, 1000 pF, 500V	3
CR1,CR2,CR3	384 0205 000	Diode, 1N914	3
CR4	384 0663 000	Rectifier Bridge, VM-28	1
DS1,DS2	384 0662 000	LED, Right Angle, Red	2
R1	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R2	548 1356 000	Resistor, 4320 ohm, 1/4W, 1%	1
R3	548 0278 000	Resistor, 200 ohm, 1/4W, 1%	1
R4	550 0623 000	Potentiometer, 5k ohm, (Spectrol 63P)	1
R5	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R6	548 0312 000	Resistor, 3.01k ohm, 1/4W, 5%	1
R7	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R8	540 1165 000	Resistor, 3.3k ohm, 1/2W, 5%	1

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Input/AGC Printed Circuit Board - 992 4950 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R9,R10	548 0312 000	Resistor, 3.01k ohm, 1/4W, 1%	2
R11	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R12	548 0559 000	Resistor, 825 ohm, 1/4W, 1%	1
R13	540 1319 000	Resistor, 510k ohm, 1/2W, 5%	1
R14,R15	540 1115 000	Resistor, 470 ohm, 1/2W, 5%	2
R16,R17	550 0943 000	Potentiometer, 50k ohm, 1/2W, 5%	2
R18	540 1114 000	Resistor, 4.7k ohm, 1/2W, 5%	1
R19	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R20	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R21	548 1356 000	Resistor, 4320 ohm, 1/4W, 1%	1
R22	548 0278 000	Resistor, 200 ohm, 1/4W, 1%	1
R23	550 0623 000	Potentiometer, 5k ohm, (Spectrol 63P)	1
R24	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R25	548 0312 000	Resistor, 3.01k ohm, 1/4W, 1%	1
R26	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R27	540 1165 000	Resistor, 3.3k ohm, 1/2W, 5%	1
R28,R29	548 0312 000	Resistor, 3.01k ohm, 1/4W, 1%	2
R30	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R31	548 0559 000	Resistor, 825 ohm, 1/4W, 1%	1
R32	540 1319 000	Resistor, 510k ohm, 1/2W, 5%	1
R33,R34	540 1115 000	Resistor, 470 ohm, 1/2W, 5%	2
R35,R36	550 0943 000	Potentiometer, 50k ohm, 1/2W, 5%	2

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Table 6-2. Input/AGC Printed Circuit Board - 992 4950 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R37	540 1114 000	Resistor, 4.7k ohm, 1/2W, 5%	1
R38	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R39	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R40	548 1356 000	Resistor, 4320 ohm, 1/4W, 1%	1
R41	548 0278 000	Resistor, 200 ohm, 1/4W, 1%	1
R42	550 0623 000	Potentiometer, 5k ohm, (Spectrol 63P)	1
R43	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R44	548 0312 000	Resistor, 3.01k ohm, 1/4W, 1%	1
R45	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R46	540 1165 000	Resistor, 3.3k ohm, 1/2W, 5%	1
R47,R48	548 0312 000	Resistor, 3.01k ohm, 1/4W, 1%	2
R49	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R50	548 0559 000	Resistor, 825 ohm, 1/4W, 1%	1
R51	540 1319 000	Resistor, 510k ohm, 1/2W, 5%	1
R52,R53	540 1115 000	Resistor, 470 ohm, 1/2W, 5%	2
R54,R55	550 0943 000	Potentiometer, 50k ohm, 1/2W, 20%	2
R56	540 1114 000	Resistor, 4.7k ohm, 1/2W, 5%	1
R57,R58	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R59	548 0334 000	Resistor, 24.3k ohm, 1/4W, 1%	1
R60	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R61	550 0626 000	Potentiometer, 10k ohm (Spectrol 63P)	1
R62	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1

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Table 6-2. Input/AGC Printed Circuit Board - 992 4950 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R63	548 0334 000	Resistor, 24.3k ohm, 1/4W, 1%	1
R64	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R65	550 0626 000	Potentiometer, 10k ohm, (Spectrol 63P)	1
R66	548 0334 000	Resistor, 24.3k ohm, 1/4W, 1%	1
R67	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R68	550 0626 000	Potentiometer, 10k ohm, (Spectrol 63P)	1
R69,R70	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	2
R71,R72	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R73 thru R78	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	6
R79	540 1193 000	Resistor, 2.4k ohm, 1/2W, 5%	1
R80	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R81	540 1105 000	Resistor, 5.1k ohm, 1/2W, 5%	1
R82	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R83 thru R86	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	4
R87,R88	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	2
R89,R90	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	2
R91,R92,R93	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	3
R94,R95,R96	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	3
R97,R98	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R99	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R100	550 0626 000	Potentiometer, 10k ohm, (Spectrol 63P)	1

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Table 6-2. Input/AGC Printed Circuit Board - 992 4950 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R101,R102,R103	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	3
R104	550 0916 000	Potentiometer, 10k ohm, 2W	1
R105	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R106	540 1105 000	Resistor, 5.1k ohm, 1/2W, 5%	1
R107	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R108	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R109	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R110	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R112,R113	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R114	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R115	548 0313 000	Resistor, 4990 ohm, 1/4W, 1%	1
R116,R117,R118	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	3
R119	540 1315 000	Resistor, 1100 ohm, 1/2W, 5%	1
R120,R121	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R122	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R123	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R125,R126	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R128	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R129,R130,R131	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	3
R132,R133,R134	550 0797 000	Potentiometer, 50k ohm	3
R135	540 1130 000	Resistor, 620 ohm, 1/2W, 5%	1
R136,R137	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	2
R138,R139	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	2

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Table 6-2. Input/AGC Printed Circuit Board - 992 4950 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R140	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
S1	604 0856 000	Switch, Toggle, SPDT	1
S2,S3	604 0852 000	Switch, (Grayhill 76B04)	2
U1,U2,U3	382 0480 000	Integrated Circuit, MC1595L	3
U4	382 0450 000	Integrated Circuit, HA1-4741-5	1
U5	382 0519 000	Integrated Circuit, TL084	1
U6	382 0359 000	Integrated Circuit, MC7815CP	1
U7	382 0360 000	Integrated Circuit, MC7915 CP	1
U8	382 0544 000	Integrated Circuit, AD521JD	1
U9	382 0450 000	Integrated Circuit, HA1-4741-5	1
XU1,XU2,XU3,XU4, XU5	404 0505 000	Socket, Integrated Circuit, 14 Pin	5
XU8,XU9	404 0505 000	Socket, Integrated Circuit, 14 Pin	2
	843 1854 001	Printed Circuit Board	1

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CONTROL MODULE
800 1753 300

TECHNICAL MANUAL

CONTROL MODULE

994 7973 001

HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1753 300

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SAFETY NOTICE

WARNING: THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND UNDER CERTAIN CONDITIONS, COULD BE FATAL.

This manual is intended as general guidance for trained and qualified installation, operating, maintenance and service personnel who are familiar with and aware of the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

THE INSTALLATION, OPERATION, MAINTENANCE AND SERVICING OF THIS EQUIPMENT INVOLVES RISKS TO BOTH PERSONNEL AND EQUIPMENT, AND MUST BE PERFORMED ONLY BY PROPERLY TRAINED AND EXPERIENCED PERSONNEL EXERCISING DUE CARE. PERSONNEL MUST FAMILIARIZE THEMSELVES WITH SAFETY REQUIREMENTS, SAFE HANDLING AND OPERATING PRACTICE, AND RELATED FIRST-AID PROCEDURES (E.G., FOR ELECTRICAL BURNS AND ELECTRICAL SHOCK).

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The procedures outlined in this Manual are based on the information available at the time of publication and should permit the specified use with minimum risk. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

The manufacturer is specifically not liable for any damage or injury arising out of failure to follow the instructions in this Manual or failure to exercise due care and caution during installation, operation, maintenance and service of this equipment.

CAUTIONARY NOTICE

Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

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WARNING: Disconnect primary power prior to servicing.

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LIST OF ILLUSTRATIONS

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SECTION I

GENERAL DESCRIPTION

1-1. GENERAL.

1-2. EQUIPMENT PURPOSE.

1-3. There are two control modules (left and right channels) in the Audio Processor System which are identical. The module detects signal peak levels and supplies the dc control signals necessary to perform compression and expansion to the Input/AGC module. Also included are circuits which automatically control attack and recovery time during compression and expansion.

1-4. TECHNICAL CHARACTERISTICS.

1-5. Table 1-1 lists the technical characteristics of the module.

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Table 1-1. Electrical Characteristics

FUNCTION	CHARACTERISTIC
COMPRESSION	
Ratio	Selectable (by the COMPRESSION SLOPE switches on the AGC meter modules): 12:0.5, 12:1, 12:2 and 12:4.
Threshold	Variable. Determined by the setting of the COMPRESSION THRESHOLD controls on the AGC meter module.
Attack Time	Selectable (by the ATTACK TIME switches on the AGC meter modules): 250 uSec, 800 uSec, 2.5 mSec, 8 mSec, and 25 mSec
Recovery Time	Selectable (by the RECOVERY TIME switches on the AGC meter module): 0.4 Sec, 0.75 Sec, 1.5 Sec, 3 Sec, 6 Sec.
EXPANSION	
Range	12 dB
Threshold	Variable. Determined by the setting of the EXPANSION THRESHOLD controls on the AGC meter modules. NOTE The EXPANSION THRESHOLD and COMPRESSION THRESHOLD controls are factory adjusted for flat response, and for most applications, need not be readjusted. See T.M. 888 1753 001, Section III, para. 3-72.
Attack Time	Selectable (by the ATTACK TIME switches on the AGC meter module): 250 uSec, 800 uSec, 2.4 mSec, 8 mSec, and 24 mSec
Recovery Time	Selectable (by the RECOVERY TIME switches on the AGC meter module): 0.4 Sec, 0.75 Sec, 1.5 Sec, 3 Sec, 6 Sec.

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Table 1-1. Electrical Characteristics (Continued)

FUNCTION	CHARACTERISTIC
POWER	Internal, ±15 vdc, regulated. ±20 vdc supplied from main frame primary power supply.

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SECTION II

INSTALLATION

2-1. GENERAL.

2-2. Installation of the Control Module is convered in Technical Manual 888 1753 001, MSP 100 FM Audio Processor, Volume I, Section II, Installation.

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SECTION III

CONTROLS AND INDICATORS

3-1. GENERAL.

3-2. Figure 3-1 shows all of the user controls and indicators provided on the Control Module, and table 3-1 describes the function of each and its affect on module operation.

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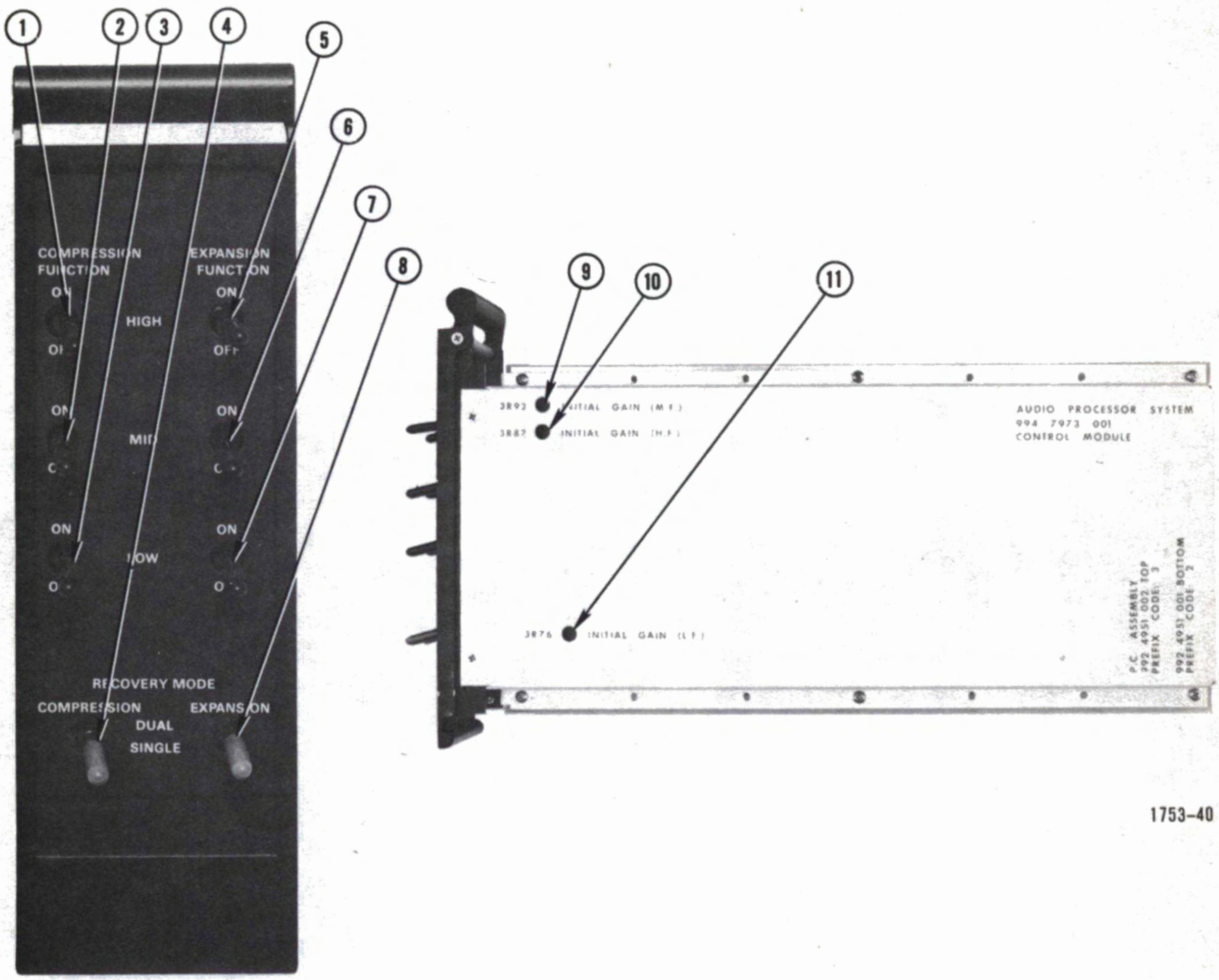

Figure 3-1. Control Module Controls and Indicators

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Table 3-1. Control Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	COMPRESSION FUNCTION/ ON/OFF/HIGH, 2S3	ON Position: Routes the high band audio signal from the COMPRESSION THRESHOLD control on the high AGC meter module to the compression control circuits. OFF Position: Disables the high band compression control circuits.
2	EXPANSION FUNCTION/ ON/OFF/HIGH, 3S2	ON Position: Routes the high band audio signal from the EXPANSION THRESHOLD control on the high AGC meter module to the expansion control circuits. OFF Position: Disables the expansion circuits.
3	EXPANSION FUNCTION/ ON/OFF/MID, 3S3	ON Position: Routes the mid band audio signal from the mid AGC meter module EXPANSION THRESHOLD control to the expansion control circuits. OFF Position: Disables the expansion circuits.
4	INITIAL GAIN (M.F.), 3R92	Sets mid band gain without expansion or compression.
5	INITIAL GAIN (H.F.), 3R87	Sets high band gain without compression or expansion.
6	INITIAL GAIN (L.F.), 3R76	Sets low band gain without compression or expansion.
7	EXPANSION FUNCTION/ ON/OFF/LOW, 3S1	ON Position: Routes the low band audio signal from the low AGC meter module EXPANSION THRESHOLD control to the expansion control circuits. OFF Position: Disables the expansion circuits.
8	RECOVERY MODE/EXPANSION/DUAL/SINGLE, 3S7	DUAL Position: Allows expansion recovery time over a dual time constant, exact times determined by the program signal. Recovery time is scaled by the RECOVERY TIME switch on the AGC meter module (each band).

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Table 3-1. Control Module Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
8 (Cont'd)		SINGLE Position: Expansion recovery time is fixed as selected by the RECOVERY TIME switch on each AGC meter module.
9	RECOVERY MODE/COMPRESSION/DUAL/SINGLE, 2S4	DUAL Position: Allows compression recovery time over a dual time constant, exact time determined by the program signal. Recovery time is scaled by the RECOVERY TIME switches on the AGC meter modules. SINGLE Position: Compression recovery time is fixed as selected by the RECOVERY time switches on the AGC meter modules.
10	COMPRESSION FUNCTION/ON/OFF/LOW, 2S1	ON Position; Routes the low band audio signal from the low AGC meter module COMPRESSION THRESHOLD control to the compression control circuits. OFF Position: Disables the compression circuits.
11	COMPRESSION FUNCTION/ON/OFF/MID, 2S3	ON Position: Routes the mid band audio signal from the mid AGC meter module COMPRESSION THRESHOLD control to the compression control circuits. OFF Position: Disables the compression control circuits.

SECTION IV

PRINCIPLES OF OPERATION

4-1. GENERAL.

4-2. The control module consists of two major circuits, as shown in figures 4-1 and 4-2, which are contained on two printed circuit boards, one for compression and the other for expansion. The signal for each board is split into three frequency bands (low, medium, and high). Since the three circuits perform identical functions for each of the three bands, only the mid band will be considered in the following discussions.

4-3. COMPRESSION CIRCUITS.

4-4. THRESHOLD AMPLIFIER SECTION. The audio signal enters the control module compression circuits through the COMPRESSION THRESHOLD control in the AGC Meter Module and the COMPRESSION FUNCTION ON/OFF switch 2S3 where it is ac coupled to the threshold amplifier 2U3A through capacitor 2C40 (figure 4-1). The gain of 2U3A is 6 dB, determined by 2R41 and 2R43. Any audio peaks below ± 1.4 volts will be blocked by diodes 2CR18, 2CR19, 2CR20, and 2CR21; the audio peaks which exceeds ± 1.4 volts in amplitude will be passed on to pulse stretcher 2U3B. The gain of 2U3B is determined by the resistors selected by the COMPRESSION SLOPE switch (in the AGC Meter Module) in combination with 2R47 and 2R49, which in turn determines the length of the pulse at the output of 2U3B.

4-5. PRECISION RECTIFIER SECTION. The positive and negative pulses from 2U3B enter the precision full-wave rectifier circuit through 2R53 and 2R54 to the noninverting input of 2U3C and the inverting input of 2U3D. 2U3C rectifies the positive pulses and 2U3D rectifies the negative pulses. The resulting positive output pulses are developed across 2R58 and fed to the attack/recovery circuits through gating diode 2CR26.

4-6. ATTACK/RECOVERY SECTION. Positive pulses gated through 2CR26 are fed to the base of 2Q3 which supplies current to the attack/recovery time constant circuits located on the AGC meter module. In figure 4-1, the attack time resistor labeled 8R17 establishes the attack time, the rate at which the gain of the AGC circuit changes. Capacitor 8C21 is charged by 2Q3 through 8R17; therefore, the rate of which 8C21 is charged is determined by the value of 8R17. The COMPRESSION ATTACK TIME switch selects one of five different values providing five different charge rates for 8C21.

4-7. The discharge path for 8C21 is through the selected recovery time resistor. The COMPRESSION RECOVERY TIME switch on the AGC Meter Module selects one of five different values, providing five different discharge rates for 8C21. The final result is a voltage across 8C21 which follows the audio envelope (above the compression threshold), but with the leading and trailing slopes modified by the attack and recovery resistors.

4-8. The voltage across 8C21 is fed directly to the noninverting input of 2U6 which is connected as a voltage follower, presenting a high impedance to the attack/recovery circuit so the circuit will not be loaded. A small portion of the output of 2U6 is fed back to the base of 2Q3 through 2R91 to reduce leakage currents.

4-9. Dual Recovery Function. The RECOVERY MODE switch 2S4 may be used to further modify the circuit recovery time. With 2S4 closed, 8R50 and 8C20 are placed in parallel with 8C21 and 8R47, and in series with the 2Q3 emitter. 8C29 will charge when 2Q3 conducts, but because of 8R50 in series, there will be little effect on the 8C21 charge time. However, with rapid repetitive pulses are present, the charge on 8C20 will build up. This will decrease the discharge rate of 8C21 because 8C20 and 8C21 are in parallel. Thus, with fast pulse rates, the charge on 8C20 is greater and 8C21 discharges slowly; with slow pulse rates, the charge on 8C21 is small and 8C21 discharges faster.

4-10. SUMMING AMPLIFIER SECTION. The summing amplifier 2U7D sums the compression control signal, twice the expansion signal, and a -2.5 vdc bias signal taken from a voltage divider (3R92 through 3R96) located on the expansion board. With the EXPANSION FUNCTION 3S3 in the OFF position, the bias voltage to the summing amplifier is -10 vdc and -7.5 vdc is routed to the AGC Meter Module for meter biasing. Added to this -10 vdc bias is the positive control voltage from 2U6. If the COMPRESSION FUNCTION switch 2S3 is also in the OFF position, the compression control voltage to the summing amplifier will be zero. Since 2U7D is an inverting amplifier the -10 vdc at its input will be inverted to +10 vdc at its output. With both the COMPRESSION FUNCTION switch 3S3 and the EXPANSION FUNCTION switch 2S3 in the ON position, the compression control voltage, the bias voltage, and twice the expansion control voltage are summed through resistors 2R84, 2R85, and 2R86, respectively. The ratio of resistors 2R88 to 2R86 (2:1) sets the scale factor of 2 for the expansion control voltage. The net result at the output of 2U7D is a control voltage which varies between 0 and +10 volts. This control voltage is used to control the four-quadrant multipliers in the Input/AGC module.

4-11. EXPANSION CIRCUITS.

4-12. THRESHOLD AMPLIFIER SECTION. The ac control signal is applied to EXPANSION FUNCTION switch 3S3 through the EXPANSION THRESHOLD control located on the AGC Meter Module. With 3S3 in the ON position the signal is ac coupled to the threshold amplifier 3U3A at its noninverting input. Gain of 3U3A is 24 dB. Diodes 3CR27 and 3CR28 do not conduct until the output of 3U3A exceeds ±0.6 volt. The voltage at the cathode of 3CR30 is +0.6V; therefore, the signal is clamped at the input to 3U3B at +1.3V and -1.3V. This establishes the expansion range of 12 dB. In a similar manner, the output of 3U3B is clamped at ±9.5V by 3CR31 through 3CR34 (see figure 4-2).

4-13. PRECISION RECTIFIER SECTION. The precision rectifier section is similar to the compression precision rectifier (paragraph 4-5). The only difference being that negative pulses are passed instead of positive pulses.

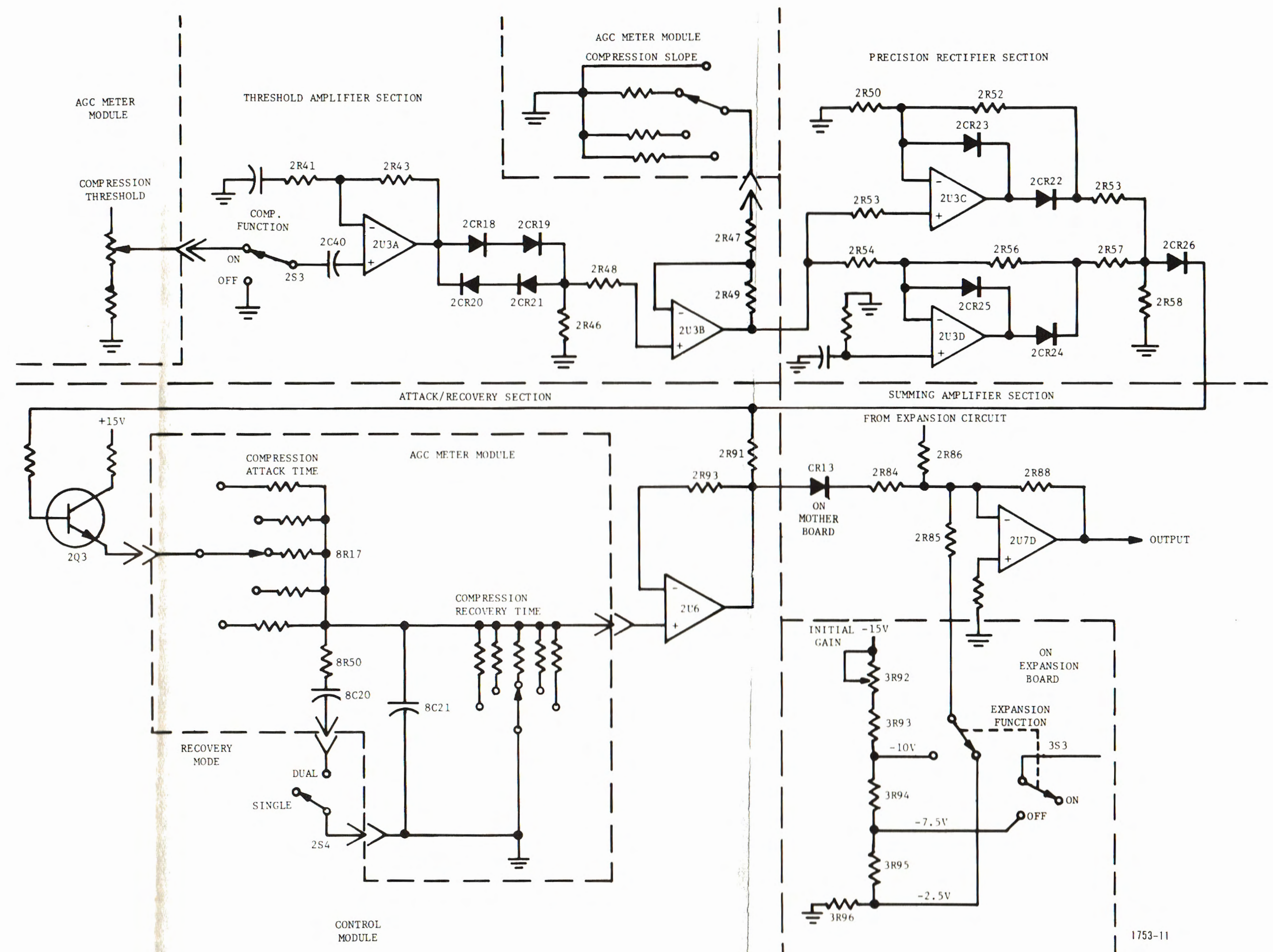


FIGURE 4-1.
COMPRESSION CIRCUITS
BLOCK DIAGRAM

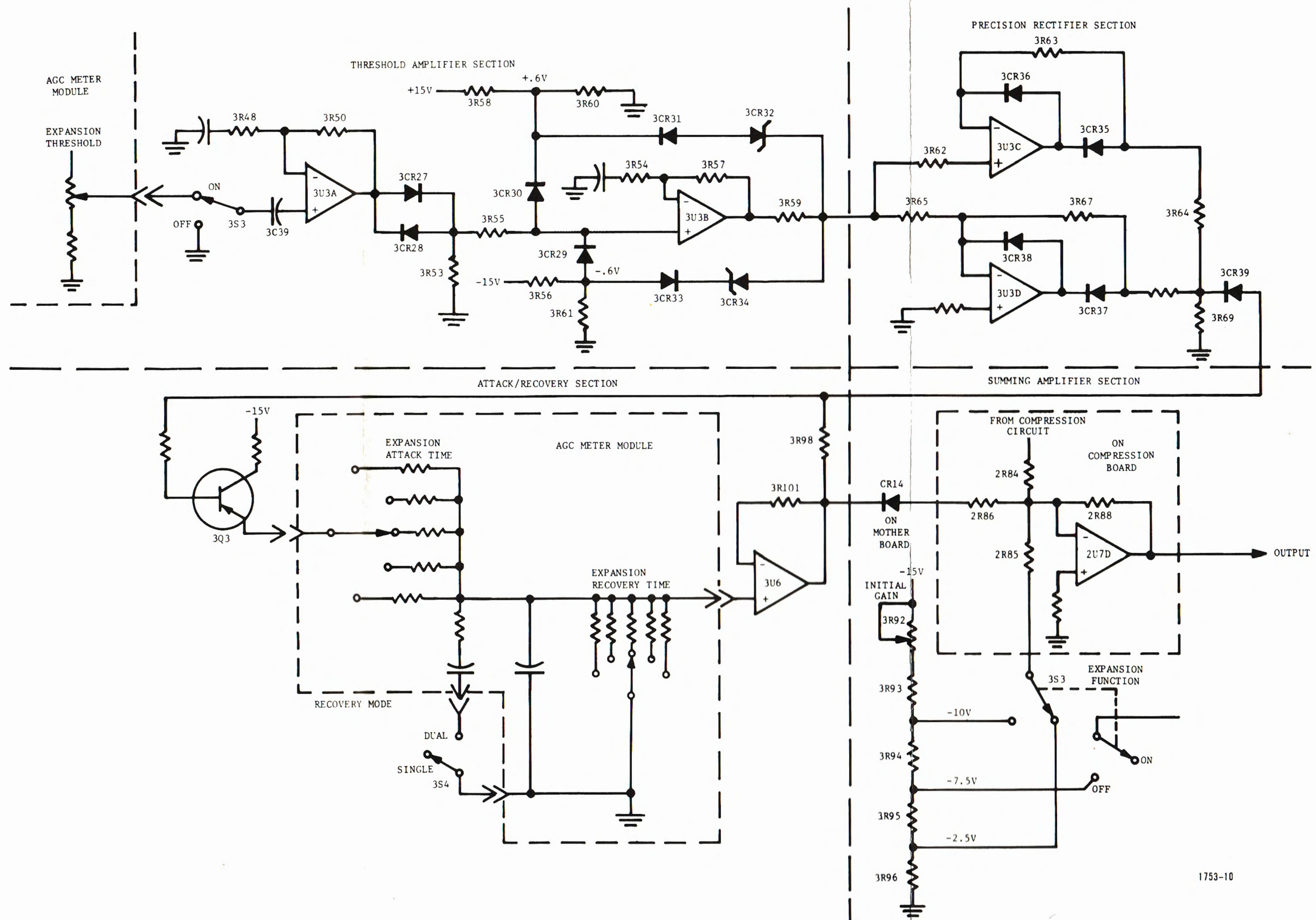


FIGURE 4-2.
EXPANSION CIRCUITS
BLOCK DIAGRAM

4-14. ATTACK/RECOVERY SECTION. The attack/recovery section is similar to the compression attack/recovery section (paragraphs 4-6 through 4-9); polarities are reversed and the time constant circuits are charged from the negative supply through PNP transistor 3Q3.

4-15. SUMMING AMPLIFIER SECTION. The summing amplifier is described in paragraph 4-10.

SECTION V

MAINTENANCE AND TROUBLESHOOTING

5-1. GENERAL.

5-2. This section describes the maintenance and troubleshooting procedures for the Control module. As shown in figure 5-1, reference designators are printed on the printed circuit board. In addition, certain parts significant to the procedures which follow are flagged. In the text and on the schematic (figure 5-2), the reference designators shown on the printed circuit board are prefixed with the number "2" or "3". If the module does not perform properly, figures 5-3 through 5-5 may be used as guides in locating the fault. For general repair and cleaning techniques and a list of recommended test equipment, refer to Technical Manual 888 1753 001, Volume I, Section V.

5-3. MODULE ALIGNMENT.

5-4. The only adjustments necessary for the Control module are the initial gain adjustments. To perform these adjustments, install the module into the main frame using a card extender. When using the card extender, care should be taken that the module is properly supported on the front panel end and is inserted straight into the extender card edge connector.

5-5. ADJUSTMENT PROCEDURES.

5-6. The control module internal conrrols are factory adjusted before shipment, and should rarely, if ever require readjustment. If adjustment is required, such as following troubleshooting or parts replacement, the following procedures must be used.

5-7. INITIAL GAIN ADJUSTMENT. This control adjusts the gain of each frequency band (low, mid, and high) with no compression or expansion. In the following procedure, the reference designators enclosed in parentheses refer to corresponding components in the low band, mid band, and high band, respectively.

a. Using an accurate dc voltmeter, preferably digital, measure the voltage at the junction of (3R77, 3R78; 3R93, 3R94; 3R88, 3R89) on the upper PC board with respect to ground.

b. Adjust (3R76, 3R92, 3R87) to obtain a -10 ±0.1 vdc reading on the voltmeter.

WARNING: Disconnect primary power prior to servicing.

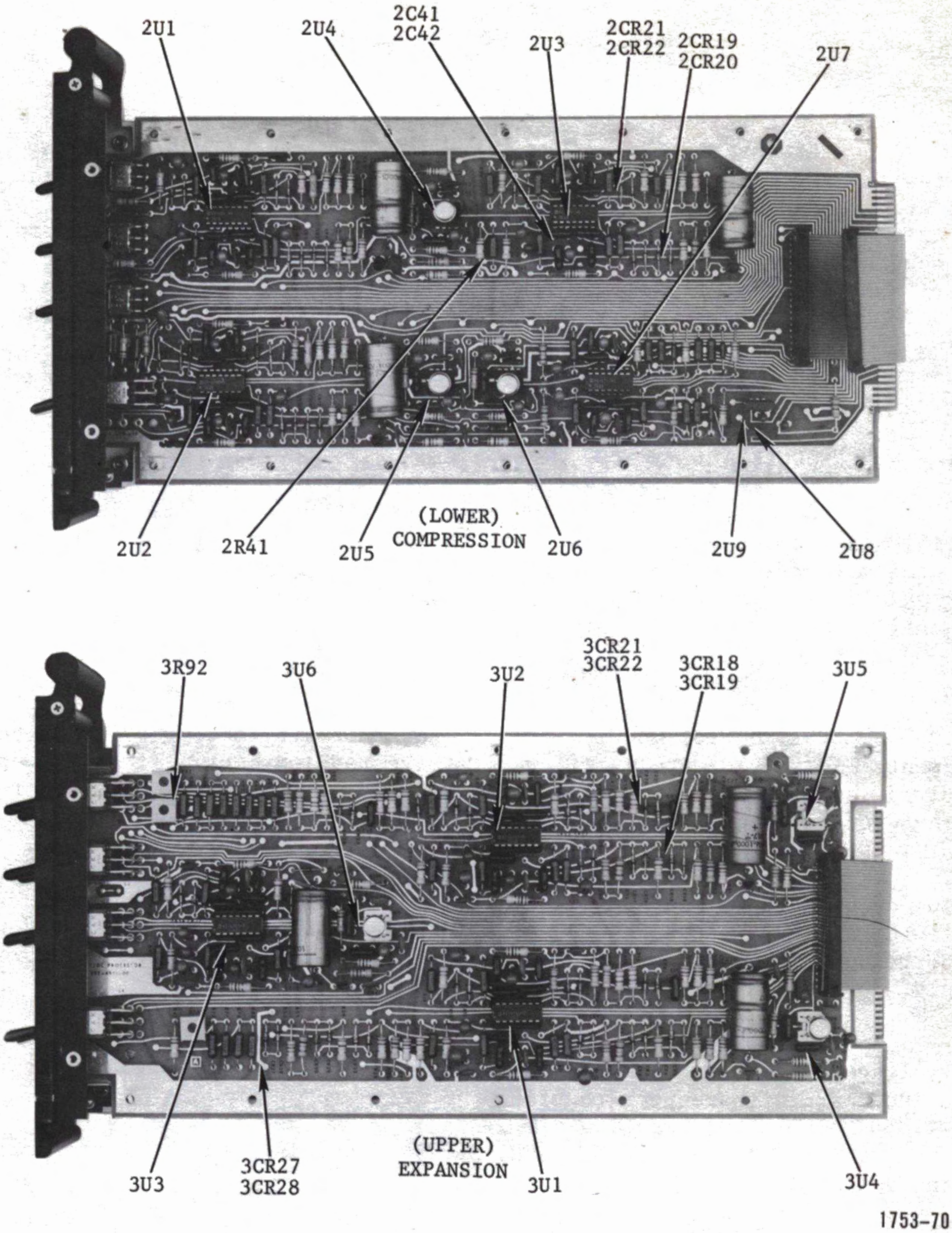


Figure 5-1. Control Module Parts Layout

1753 300

WARNING: Disconnect primary power prior to servicing.

B

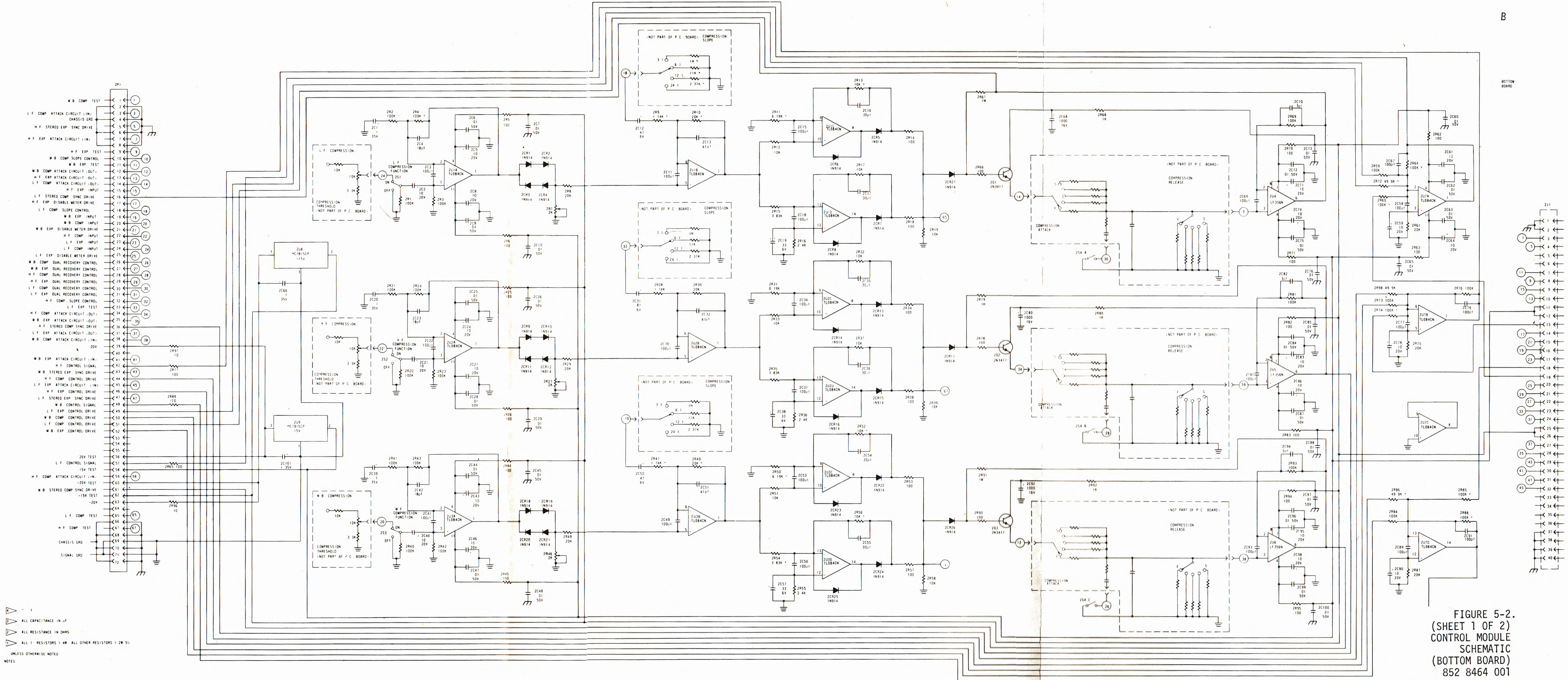


FIGURE 5-2.
(SHEET 1 OF 2)
CONTROL MODULE
SCHEMATIC
(BOTTOM BOARD)
852 8464 001

A

Rev. B: 10/78

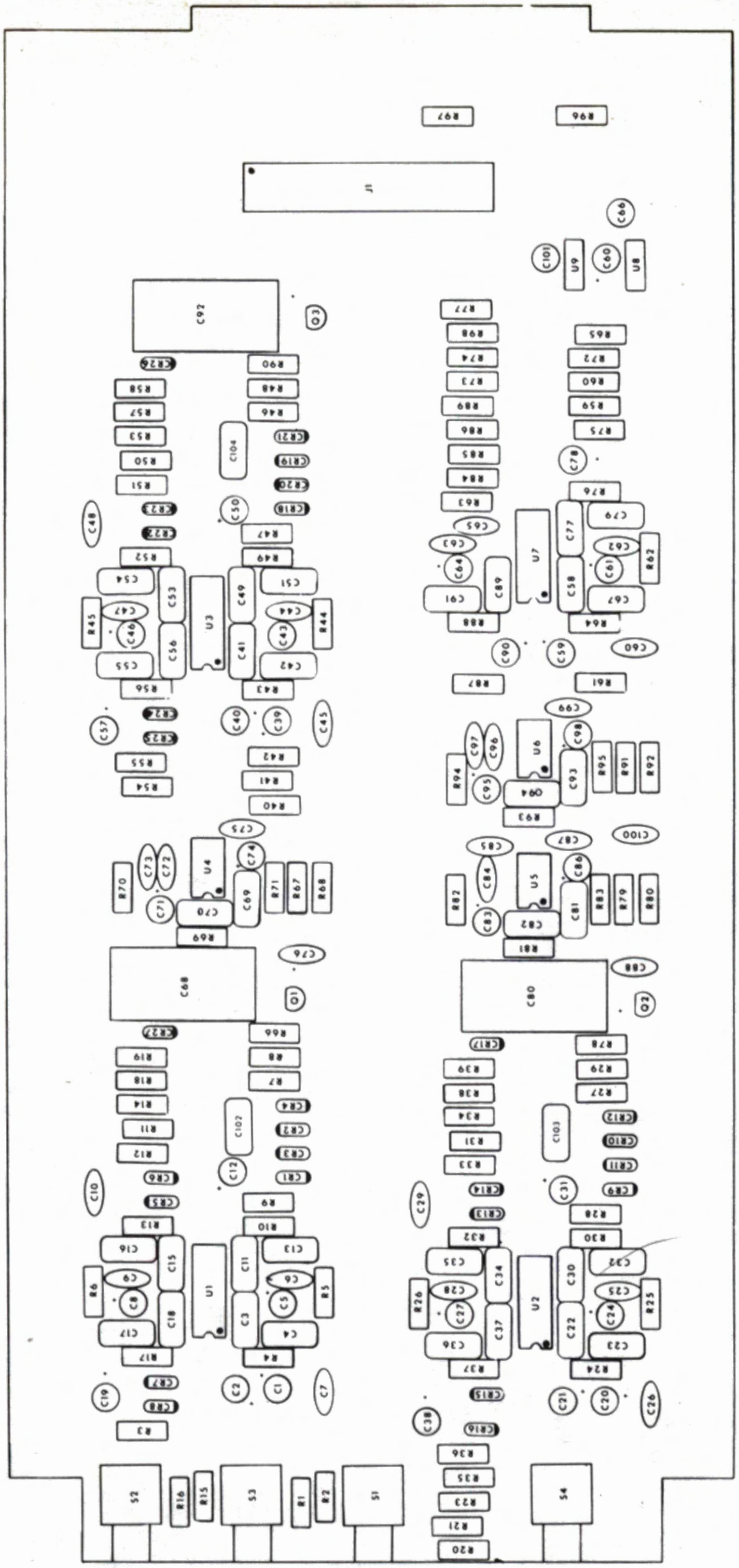
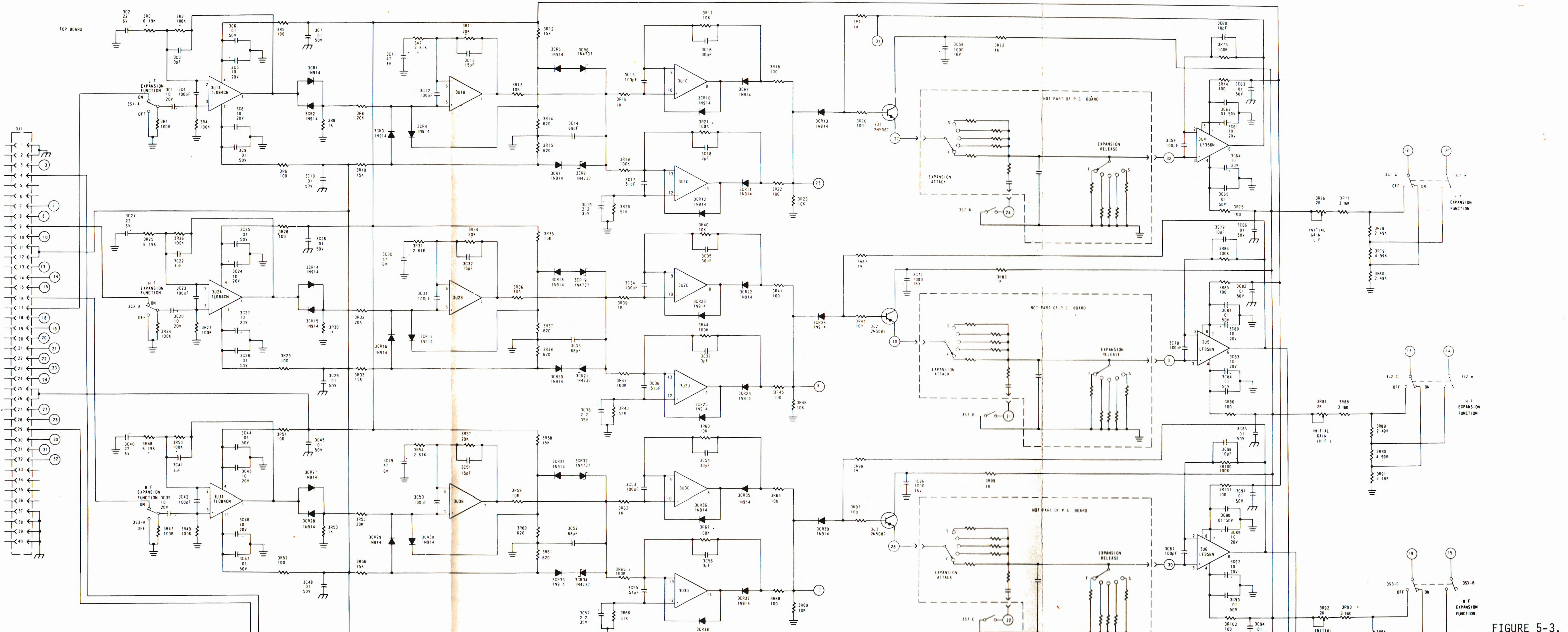


FIGURE 5-2. (SHEET 2 OF 2) CONTROL #2
COMPONENT LOCATION - 843 2190 001

WARNING: Disconnect primary power prior to servicing.

C



4 ALL CAPACITANCE IN uF

3 ALL RESISTANCE IN OHMS

2 ALL OTHER RESISTORS 1 2WATT 5%

1 • 1% 1 4 WATT RESISTORS

UNLESS OTHERWISE SPECIFIED

NOTES

FIGURE 5-3.
(SHEET 1 OF 2)
CONTROL MODULE
SCHEMATIC
(TOP BOARD)
852 8465 001

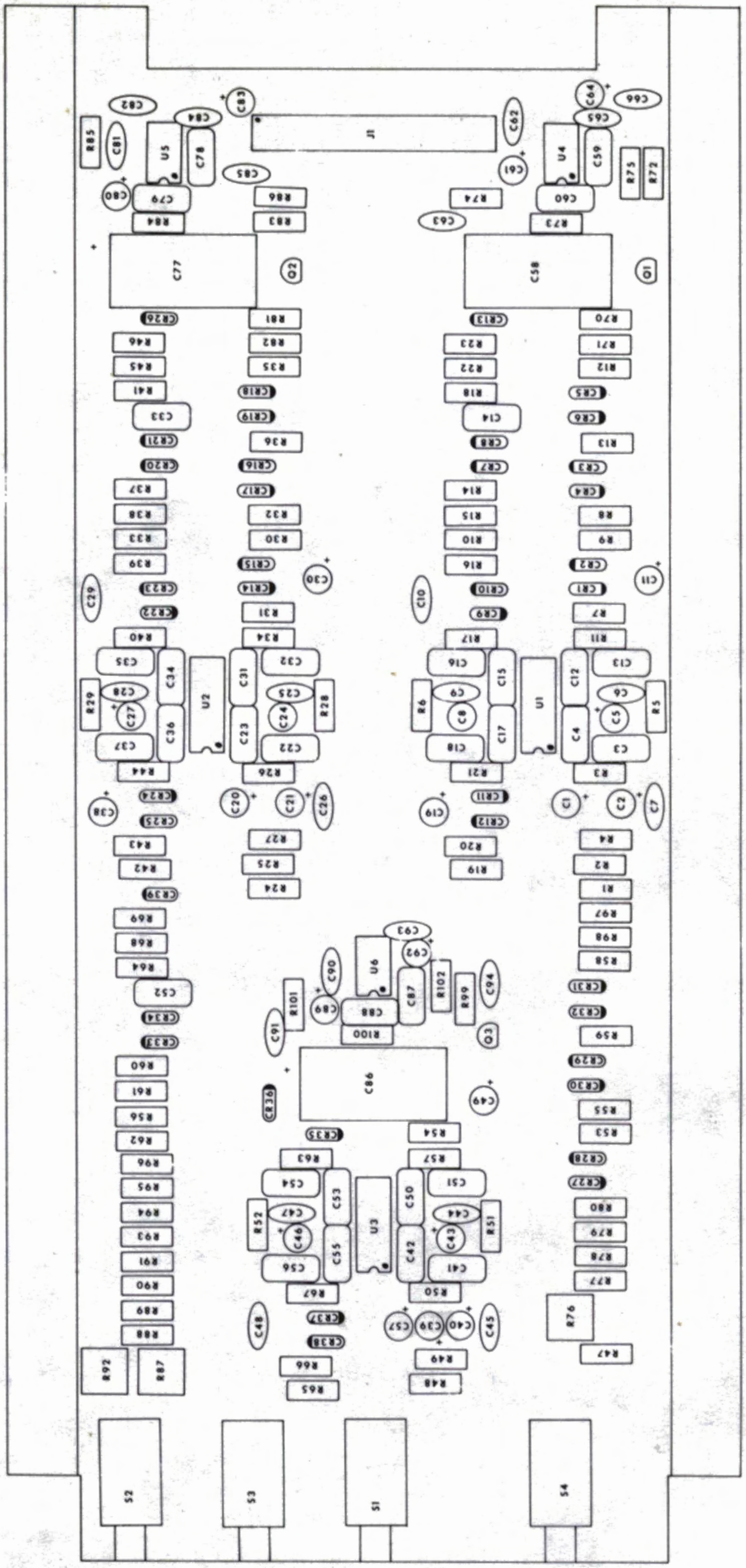


FIGURE 5-3. (SHEET 2 OF 2) CONTROL #1
COMPONENT LOCATION - 843 2188 001

WARNING: Disconnect primary power prior to servicing.

5-8. TROUBLESHOOTING.

5-9. When the system does not perform properly and the fault has been traced to the Control Module, figures 5-3 through 5-5 may be used as guides for locating a fault within the module. A thorough visual inspection should always be performed first. Discolored or charred parts indicate heat damage. Feeling a component (while power is on) can detect excessive heat dissipation. Finally, look for broken conductors and whiskers on the PC board with the aid of a magnifying glass; these defects are often too small to be detected with the naked eye.

5-10. The troubleshooting charts that follow call out components in the mid band only. To find the corresponding components in the other two bands, refer to the table referenced on each figure.

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CONTROL POSITIONS:
COMPRESSION FUNCTION - ON (ALL BANDS)
EXPANSION FUNCTION - ON (ALL BANDS)

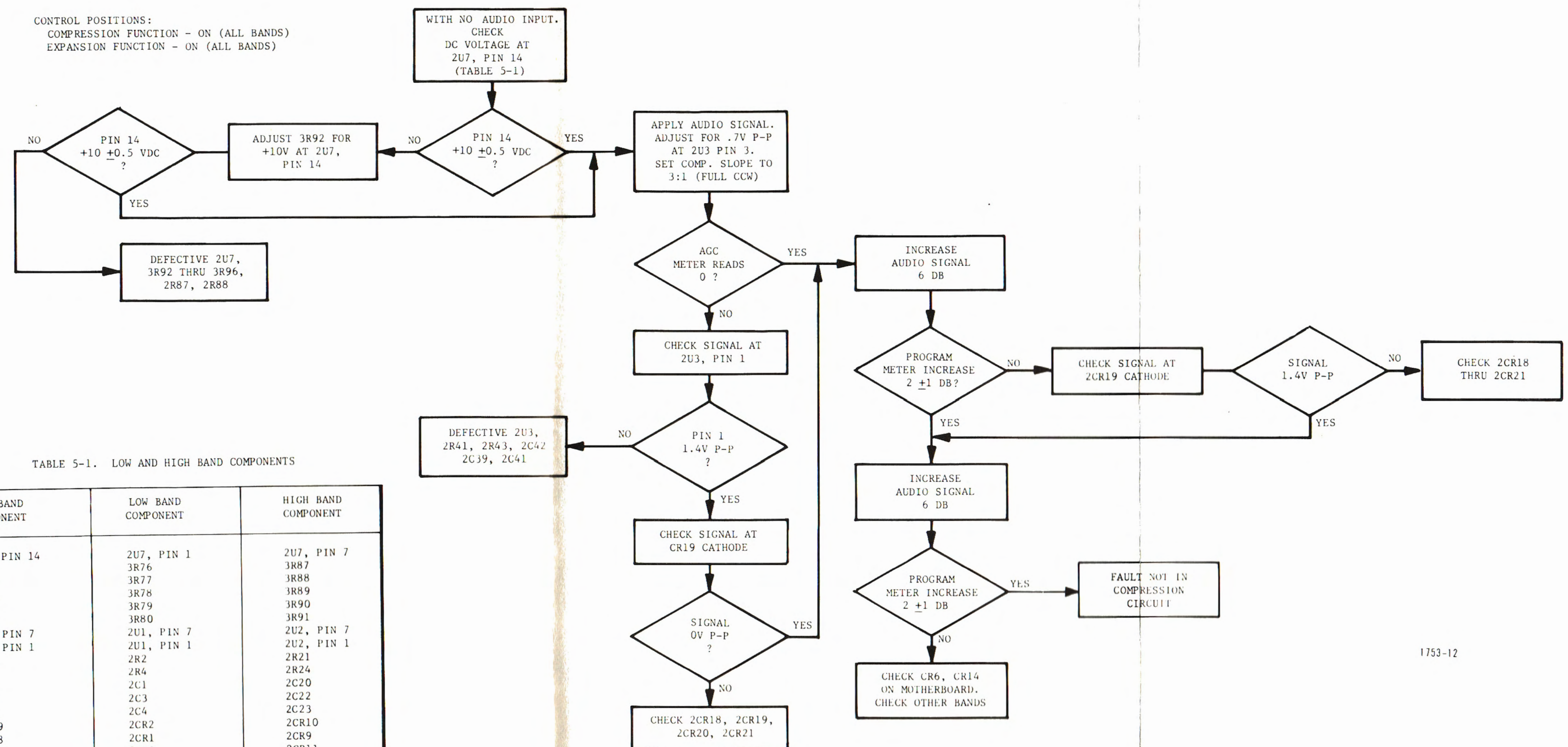

TABLE 5-1. LOW AND HIGH BAND COMPONENTS

MID BAND COMPONENT	LOW BAND COMPONENT	HIGH BAND COMPONENT
2U7, PIN 14	2U7, PIN 1	2U7, PIN 7
3R92	3R76	3R87
3R93	3R77	3R88
3R94	3R78	3R89
3R95	3R79	3R90
3R96	3R80	3R91
2U3, PIN 7	2U1, PIN 7	2U2, PIN 7
2U3, PIN 1	2U1, PIN 1	2U2, PIN 1
2R41	2R2	2R21
2R43	2R4	2R24
2C39	2C1	2C20
2C41	2C3	2C22
2C42	2C4	2C23
2CR19	2CR2	2CR10
2CR18	2CR1	2CR9
2CR20	2CR3	2CR11
2CR21	2CR4	2CR12

FIGURE 5-4.
COMPRESSION CIRCUITS
TROUBLESHOOTING CHART

CONTROL POSITIONS:
COMPRESSION FUNCTION - OFF (ALL BANDS)
EXPANSION FUNCTION - OFF (ALL BANDS)

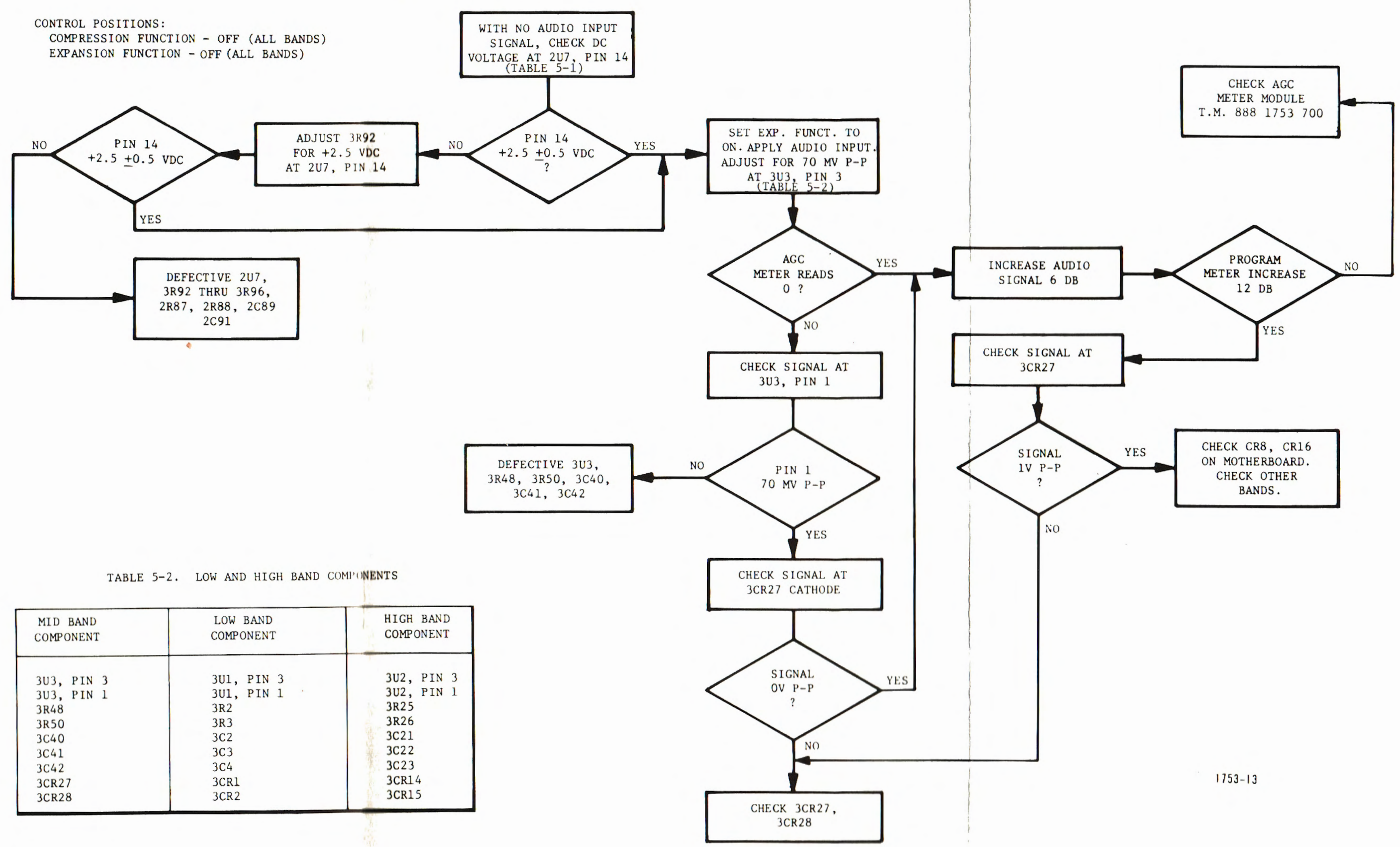

TABLE 5-2. LOW AND HIGH BAND COMPONENTS

MID BAND COMPONENT	LOW BAND COMPONENT	HIGH BAND COMPONENT
3U3, PIN 3	3U1, PIN 3	3U2, PIN 3
3U3, PIN 1	3U1, PIN 1	3U2, PIN 1
3R48	3R2	3R25
3R50	3R3	3R26
3C40	3C2	3C21
3C41	3C3	3C22
3C42	3C4	3C23
3CR27	3CR1	3CR14
3CR28	3CR2	3CR15

FIGURE 5-5.
EXPANSION CIRCUITS
TROUBLESHOOTING CHART

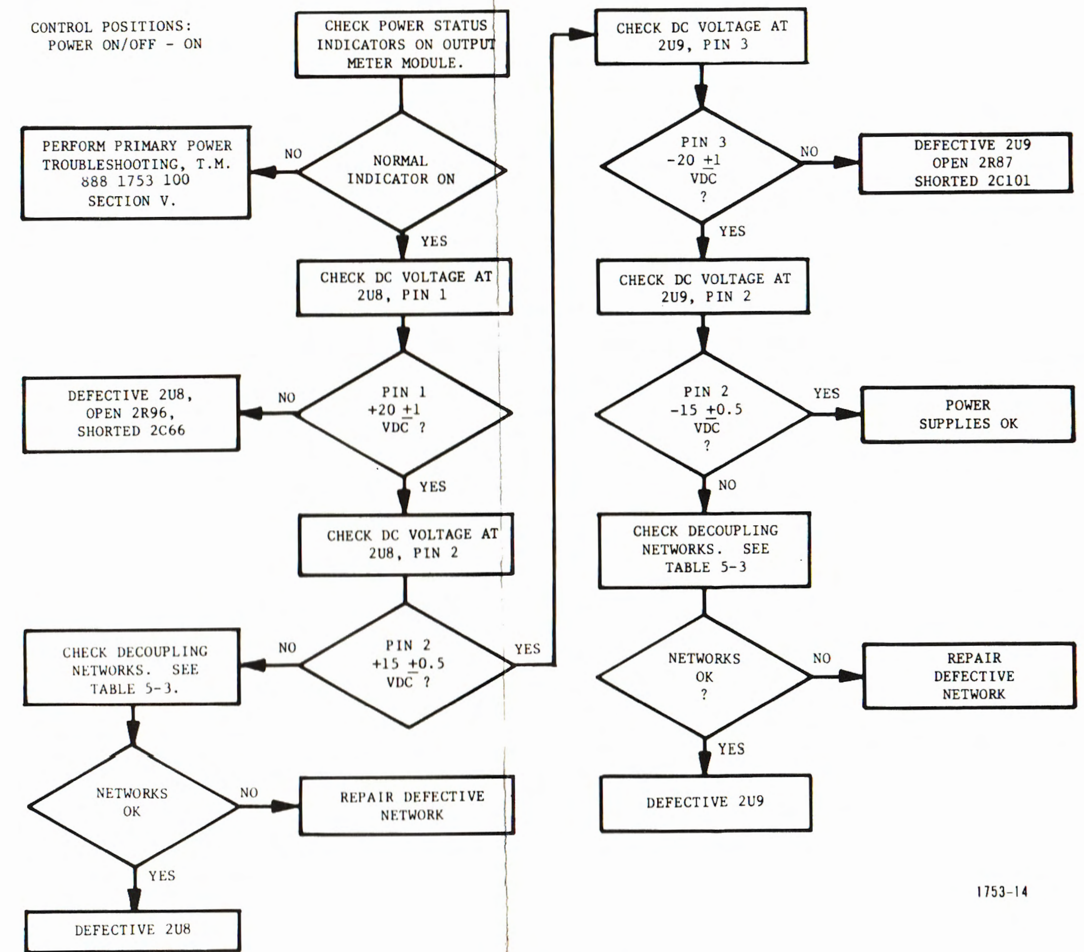

TABLE 5-3. POWER SUPPLY DECOUPLING NETWORK

DEVICE	POSITIVE SUPPLY		NEGATIVE SUPPLY	
	PIN	COMPONENTS	PIN	COMPONENTS
2U1	4	2R5, 2C5, 2C6, 2C7	11	2R6, 2C8, 2C9, 2C10
2U2	4	2R25, 2C24, 2C25, 2C26	11	2R26, 2C27, 2C28, 2C29
2U3	4	2R44, 2C43, 2C44, 2C45	11	2R45, 2C46, 2C47, 2C48
2U4	7	2R70, 2C71, 2C72, 2C73	4	2R71, 2C74, 2C75, 2C76
2U5	7	2R82, 2C83, 2C84, 2C85	4	2R83, 2C86, 2C87, 2C88
2U6	7	2R94, 2C95, 2C96, 2C97	4	2R95, 2C98, 2C99, 2C100
2U7	4	2R62, 2C60, 2C61, 2C62	11	2R63, 2C63, 2C64, 2C65
2U8	1	2R96, 2C66		
2U9			3	2R87, 2C101
3U1	4	3R5, 3C5, 3C6, 3C7	11	3R6, 3C8, 3C9, 3C10
3U2	4	3R28, 3C24, 3C25, 3C26	11	3R29, 3C27, 3C28, 3C29
3U3	4	3R51, 3C43, 3C44, 3C45	11	3R52, 3C46, 3C47, 3C48
3U4	7	3R74, 3C61, 3C62, 3C63	4	3R75, 3C64, 3C65, 3C66
3U5	7	3R85, 3C80, 3C81, 3C82	4	3R68, 3C83, 3C84, 3C85
3U6	7	3R101, 3C89, 3C90, 3C91	4	3R102, 3C92, 3C93, 3C94

FIGURE 5-6.
POWER SUPPLY
TROUBLESHOOTING CHART

SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This section provides a description, reference designator, and order number for replaceable electrical parts, assemblies, and selected mechanical parts necessary for proper maintenance of the control module. Table 6-1 lists the parts for the control module assembly, table 6-2 lists the parts for the Control module upper PC board assembly, and table 6-3 lists the parts for the control module lower PC board assembly.

6-3. REPLACEABLE PARTS SERVICE.

6-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Serivce Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

6-5. TECHNICAL ASSISTANCE.

6-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Department during normal working hours. Emergency techncial service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301. The Harris factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

Table 6-1. Control Module Assembly - 994 7973 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	992 4951 002	Control Module PC Assembly (Refer to table 6-2)	1
	992 4951 001	Control Module PC Assembly (Refer to table 6-3	1
	598 0341 000	Toggle Boot, Black	6
	598 0343 000	Toggle Boot, Green	2

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WARNING: Disconnect primary power prior to servicing.

Table 6-2. Control Module Upper PC Board Assembly
(Reference Designator Prefix: 3) - 992 4951 002

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	526 0048 000	Capacitor, 10 uF, 20V	1
C2	526 0308 000	Capacitor, 22 uF, 10V	1
C3	500 0802 000	Capacitor, 3 pF, 500V	1
C4	500 0759 000	Capacitor, 100 pF, 500V	1
C5	526 0048 000	Capacitor, 10 uF, 20V	1
C6,C7	516 0375 000	Capacitor, 0.01 uF, 50V	2
C8	526 0048 000	Capacitor, 10 uF, 20V	1
C9,C10	516 0375 000	Capacitor, 0.01 uF, 50V	2
C11	526 0101 000	Capacitor, 47 uF, 6V	1
C12	500 0759 000	Capacitor, 100 pF, 500V	1
C13	500 0806 000	Capacitor, 15 pF, 500V	1
C14	500 0821 000	Capacitor, 68 pF, 500V	1
C15	500 0759 000	Capacitor, 100 pF, 500V	1
C16	500 0812 000	Capacitor, 30 pF, 500V	1
C17	500 0819 000	Capacitor, 51 pF, 500V	1
C18	500 0802 000	Capacitor, 3 pF, 500V	1
C19	526 0311 000	Capacitor, 2.2 uF, 35V	1
C20	526 0048 000	Capacitor, 10 uF, 20V	1
C21	526 0308 000	Capacitor, 22 uF, 10V	1
C22	500 0802 000	Capacitor, 3 pF, 500V	1
C23	500 0759 000	Capacitor, 100 pF, 500V	1
C24	526 0048 000	Capacitor, 10 uF, 20V	1
C25,C26	516 0375 000	Capacitor, 0.01 uF, 50V	2

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Control Module Upper PC Board Assembly (Reference Designator Prefix: 3) - 992 4951 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C27	526 0048 000	Capacitor, 10 uF, 20V	1
C28,C29	516 0375 000	Capacitor, 0.01 uF, 50V	2
C30	526 0101 000	Capacitor, 47 uF, 6V	1
C31	500 0759 000	Capacitor, 100 pF, 500V	1
C32	500 0806 000	Capacitor, 15 pF, 500V	1
C33	500 0821 000	Capacitor, 68 pF, 500V	1
C34	500 0759 000	Capacitor, 100 pF, 500V	1
C35	500 0812 000	Capacitor, 30 pF, 500V	1
C36	500 0819 000	Capacitor, 51 pF, 500V	1
C37	500 0802 000	Capacitor, 3 pF, 500V	1
C38	526 0311 000	Capacitor, 2.2 uF, 35V	1
C39	526 0048 000	Capacitor, 10 uF, 20V	1
C40	526 0308 000	Capacitor, 22 uF, 10V	1
C41	500 0802 000	Capacitor, 3 pF, 500V	1
C42	500 0759 000	Capacitor, 100 pF, 500V	1
C43	526 0048 000	Capacitor, 10 uF, 20V	1
C44,C45	516 0375 000	Capacitor, 0.01 uF, 50V	2
C46	526 0048 000	Capacitor, 10 uF, 20V	1
C47,C48	516 0375 000	Capacitor, 0.01 uF, 50V	2
C49	526 0101 000	Capacitor, 47 uF, 6V	1
C50	500 0759 000	Capacitor, 100 pF, 500V	1
C51	500 0806 000	Capacitor, 15 pF, 500V	1
C52	500 0821 000	Capacitor, 68 pF, 500V	1

1753 300

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Control Module Upper PC Board Assembly
(Reference Designator Prefix: 3) - 992 4951 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C53	500 0759 000	Capacitor, 100 pF, 500V	1
C54	500 0812 000	Capacitor, 30 pF, 500V	1
C55	500 0819 000	Capacitor, 51 pF, 500V	1
C56	500 0802 000	Capacitor, 3 pF, 500V	1
C57	526 0311 000	Capacitor, 2.2 uF, 35V	1
C58	522 0391 000	Capacitor, 1000 uF, 16V	1
C59	500 0759 000	Capacitor, 100 pF, 500V	1
C60	500 0804 000	Capacitor, 10 pF, 500V	1
C61	526 0048 000	Capacitor, 10 uF, 20V	1
C62,C63	516 0375 000	Capacitor, 0.01 uF, 50V	2
C64	526 0048 000	Capacitor, 10 uF, 20V	1
C65,C66	516 0375 000	Capacitor, 0.01 uF, 50V	2
C77	522 0391 000	Capacitor, 1000 uF, 16V	1
C78	500 0759 000	Capacitor, 100 pF, 500V	1
C79	500 0804 000	Capacitor, 10 pF, 500V	1
C80	526 0048 000	Capacitor, 10 uF, 20V	1
C81,C82	516 0375 000	Capacitor, 0.01 uF, 50V	2
C83	526 0048 000	Capacitor, 10 uF, 20V	1
C84,C85	516 0375 000	Capacitor, 0.01 uF, 50V	2
C86	522 0391 000	Capacitor, 1000 uF, 16V	1
C87	500 0759 000	Capacitor, 100 pF, 500V	1
C88	500 0804 000	Capacitor, 10 pF, 500V	1
C89	526 0048 000	Capacitor, 10 uF, 20V	1

1753 300

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Control Module Upper PC Board Assembly
(Reference Designator Prefix: 3) - 992 4951 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C90,C91	516 0375 000	Capacitor, 0.01 uF, 50V	2
C92	526 0048 000	Capacitor, 10 uF, 20V	1
C93,C94	516 0375 000	Capacitor, 0.01 uF, 50V	2
CR1 thru CR5	384 0205 000	Diode, 1N914	5
CR6	386 0186 000	Diode, 1N4738A	1
CR7	384 0205 000	Diode, 1N914	1
CR8	386 0186 000	Diode, 1N4738A	1
CR9 thru CR18	384 0205 000	Diode, 1N914	10
CR19	386 0186 000	Diode, 1N4738A	1
CR20	384 0205 000	Diode, 1N914	1
CR21	386 0186 000	Diode, 1N4738A	1
CR22 thru CR31	384 0205 000	Diode, 1N914	10
CR32	386 0186 000	Diode, 1N4738A	1
CR33	384 0205 000	Diode, 1N914	1
CR34	386 0186 000	Diode, 1N4738A	1
CR35 thru CR39	384 0205 000	Diode, 1N914	5
J1	610 0748 000	Cable Connector, 90 Pin	1
Q1,Q2,Q3	380 0112 000	Transistor, 2N5087	3
R1	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R2	548 0281 000	Resistor, 6190 ohm, 1/4W, 1%	1
R3	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R4	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R5,R6	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2

1753 300

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Control Module Upper PC Board Assembly
(Reference Designator Prefix: 3) - 992 4951 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R7	548 0324 000	Resistor, 2610 ohm, 1/4W, 1%	1
R8	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R9	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R10	540 1184 000	Resistor, 15k ohm, 1/2W, 5%	1
R11	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R12	540 1184 000	Resistor, 15k ohm, 1/2W, 5%	1
R13	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R14,R15	540 1130 000	Resistor, 620 ohm, 1/2W, 5%	2
R16	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R17	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R18	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R19	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R20	540 1202 000	Resistor, 51k ohm, 1/2W, 5%	1
R21	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R22	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R23	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R24	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R25	548 0281 000	Resistor, 6190 ohm, 1/4W, 1%	1
R26	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R27	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R28,R29	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R30	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R31	548 0324 000	Resistor, 2610 ohm, 1/4W, 1%	1

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Control Module Upper PC Board Assembly
(Reference Designator Prefix: 3) - 992 4951 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R32	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R33	540 1184 000	Resistor, 15k ohm, 1/2W, 5%	1
R34	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R35	540 1184 000	Resistor, 15k ohm, 1/2W, 5%	1
R36	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R37,R38	540 1130 000	Resistor, 620 ohm, 1/2W, 5%	2
R39	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R40	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R41	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R42	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R43	540 1202 000	Resistor, 51k ohm, 1/2W, 5%	1
R44	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R45	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R46	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R47	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R48	548 0281 000	Resistor, 6190 ohm, 1/4W, 1%	1
R49	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R50	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R51,R52	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R53	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R54	548 0324 000	Resistor, 2610 ohm, 1/4W, 1%	1
R55	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R56	540 1184 000	Resistor, 15k ohm, 1/2W, 5%	1
R57	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1

1753 300

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Control Module Upper PC Board Assembly
(Reference Designator Prefix: 3) - 992 4951 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R58	540 1184 000	Resistor, 15k ohm, 1/2W, 5%	1
R59	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R60,R61	540 1130 000	Resistor, 620 ohm, 1/2W, 5%	2
R62	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R63	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R64	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R65	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R66	540 1202 000	Resistor, 51k ohm, 1/2W, 5%	1
R67	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R68	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R69	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R70	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R71	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R72	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R73	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R74,R75	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R76	550 0813 000	Potentiometer, 2k ohm	1
R77	548 0404 000	Resistor, 3.16K ohm, 1/4W, 1%	1
R78	548 1403 000	Resistor, 2490 ohm, 1/4W, 1%	1
R79	548 0313 000	Resistor, 4990 ohm, 1/4W, 1%	1
R80	548 1403 000	Resistor, 2490 ohm, 1/4W, 1%	1
R81	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R82	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-2. Control Module Upper PC Board Assembly
(Reference Designator Prefix: 3) - 992 4951 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R83	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R84	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R85,R86	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R87	550 0813 000	Potentiometer, 2k ohm	1
R88	548 0404 000	Resistor, 3.16k ohm, 1/4W, 1%	1
R89	548 1403 000	Resistor, 2490 ohm, 1/4W, 1%	1
R90	548 0313 000	Resistor, 4990 ohm, 1/4W, 1%	1
R91	548 1403 000	Resistor, 2490 ohm, 1/4W, 1%	1
R92	550 0813 000	Potentiometer, 2k ohm	1
R93	548 0404 000	Resistor, 3.16k ohm, 1/4W, 1%	1
R94	548 1403 000	Resistor, 2490 ohm, 1/4W, 1%	1
R95	548 0313 000	Resistor, 4990 ohm, 1/4W, 1%	1
R96	548 1403 000	Resistor, 2490 ohm, 1/4W, 1%	1
R97	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R98	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R99	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R100	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R101,R102	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
S1 thru S4	604 0855 000	Switch, 3PDT	4
U1 thru U3	382 0519 000	Integrated Circuit, TL0-84-CN	3
U4 thru U6	382 0549 000	Integrated Circuit, LF356N	3
XU1 thru XU3	404 0505 000	Socket, 14 Pin	3
XU4 thru XU6	404 0504 000	Socket, 8 Pin	3
	843 1900 001	Printed Circuit Board	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-3. Control Module Lower PC Board Assembly
(Reference Designator Prefix: 2) - 992 4951 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	526 0050 000	Capacitor, 1 uF, 35V	1
C2	526 0048 000	Capacitor, 10 uF, 20V	1
C3	500 0759 000	Capacitor, 100 pF, 500V	1
C4	500 0807 000	Capacitor, 3 pF, 500V	1
C5	526 0048 000	Capacitor, 10 uF, 20V	1
C6,C7	516 0375 000	Capacitor, 0.01 uF, 50V	2
C8	526 0048 000	Capacitor, 10 uF, 20V	1
C9,C10	516 0375 000	Capacitor, 0.01 uF, 50V	2
C11	500 0759 000	Capacitor, 100 pF, 500V	1
C12	526 0101 000	Capacitor, 47 uF, 6V	1
C13	500 0817 000	Capacitor, 47 pF, 500V	1
C15	500 0759 000	Capacitor, 100 pF, 500V	1
C16,C17	500 0812 000	Capacitor, 30 pF, 500V	2
C18	500 0759 000	Capacitor, 100 pF, 500V	1
C19	526 0042 000	Capacitor, 33 uF, 6V	1
C20	526 0050 000	Capacitor, 1 uF, 35V	1
C21	526 0048 000	Capacitor, 10 uF, 20V	1
C22	500 0759 000	Capacitor, 100 pF, 500V	1
C23	500 0807 000	Capacitor, 3 pF, 500V	1
C24	526 0048 000	Capacitor, 10 uF, 20V	1
C25,C26	516 0375 000	Capacitor, 0.01 uF, 50V	2
C27	526 0048 000	Capacitor, 10 uF, 20V	1
C28,C29	516 0375 000	Capacitor, 0.01 uF, 50V	2

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WARNING: Disconnect primary power prior to servicing.

Table 6-3. Control Module Lower PC Board Assembly
(Reference Designator Prefix: 2) - 992 4951 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C30	500 0759 000	Capacitor, 100 pF, 500V	1
C31	526 0101 000	Capacitor, 47 uF, 6V	1
C32	500 0817 000	Capacitor, 47 pF, 500V	1
C34	500 0759 000	Capacitor, 100 pF, 500V	1
C35,C36	500 0812 000	Capacitor, 30 pF, 500V	2
C37	500 0759 000	Capacitor, 100 pF, 500V	1
C38	526 0042 000	Capacitor, 33 uF, 6V	1
C39	526 0050 000	Capacitor, 1 uF, 35V	1
C40	526 0048 000	Capacitor, 10 uF, 20V	1
C41	500 0759 000	Capacitor, 100 pF, 500V	1
C42	500 0807 000	Capacitor, 3 pF, 500V	1
C43	526 0048 000	Capacitor, 10 uF, 20V	1
C44,C45	516 0375 000	Capacitor, 0.01 uF, 50V	2
C46	526 0048 000	Capacitor, 10 uF, 20V	1
C47,C48	515 0375 000	Capacitor, 0.01 uF, 50V	2
C49	500 0759 000	Capacitor, 100 pF, 500V	1
C50	526 0101 000	Capacitor, 47 uF, 6V	1
C51	500 0817 000	Capacitor, 47 pF, 500V	1
C53	500 0759 000	Capacitor, 100 pF, 500V	1
C54,C55	500 0812 000	Capacitor, 30 pF, 500V	2
C56	500 0759 000	Capacitor, 100 pF, 500V	1
C57	526 0042 000	Capacitor, 33 uF, 6V	1
C58	500 0759 000	Capacitor, 100 pF, 500V	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-3. Control Module Lower PC Board Assembly
(Reference Designator Prefix: 2) - 992 4951 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C59	526 0048 000	Capacitor, 10 uF, 20V	1
C60	516 0375 000	Capacitor, 0.01 uF, 50V	1
C61	526 0048 000	Capacitor, 10 uF, 20V	1
C62,C63	516 0375 000	Capacitor, 0.01 uF, 50V	2
C64	526 0048 000	Capacitor, 10 uF, 20V	1
C65	516 0375 000	Capacitor, 0.01 uF, 50V	1
C66	526 0050 000	Capacitor, 1 uF, 35V	1
C67	500 0759 000	Capacitor, 100 pF, 500V	1
C68	522 0391 000	Capacitor, 1000 uF, 16V	1
C69	500 0759 000	Capacitor, 100 pF, 500V	1
C70	500 0802 000	Capacitor, 3 pF, 500V	1
C71	526 0048 000	Capacitor, 10 uF, 20V	1
C72,C73	516 0375 000	Capacitor, 0.01 uF, 50V	2
C74	526 0048 000	Capacitor, 10 uF, 20V	1
C75,C76	516 0375 000	Capacitor, 0.01 uF, 50V	2
C77	500 0759 000	Capacitor, 100 pF, 500V	1
C78	526 0048 000	Capacitor, 10 uF, 20V	1
C79	500 0759 000	Capacitor, 100 pF, 500V	1
C80	522 0391 000	Capacitor, 1000 uF, 16V	1
C81	500 0759 000	Capacitor, 100 pF, 500V	1
C82	500 0802 000	Capacitor, 3 pF, 500V	1
C83	526 0048 000	Capacitor, 10 uF, 20V	1
C84,C85	516 0375 000	Capacitor, 0.01 uF, 50V	2

WARNING: Disconnect primary power prior to servicing.

Table 6-3. Control Module Lower PC Board Assembly
(Reference Designator Prefix: 2) - 992 4951 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C86	526 0048 000	Capacitor, 10 uF, 20V	1
C87,C88	516 0375 000	Capacitor, 0.01 uF, 50V	2
C89	500 0759 000	Capacitor, 100 pF, 500V	1
C90	526 0048 000	Capacitor, 10 uF, 20V	1
C91	500 0759 000	Capacitor, 100 pF, 500V	1
C92	522 0391 000	Capacitor, 1000 uF, 16V	1
C93	500 0759 000	Capacitor, 100 pF, 500V	1
C94	500 0802 000	Capacitor, 3 pF, 500V	1
C95	526 0048 000	Capacitor, 10 uF, 20V	1
C96,C97	516 0375 000	Capacitor, 0.01 uF, 50V	2
C98	526 0048 000	Capacitor, 10 uF, 20V	1
C99,C100	516 0375 000	Capacitor, 0.01 uF, 50V	2
C101	526 0050 000	Capacitor, 1 uF, 35V	1
CR1 thru CR27	384 0205 000	Diode, 1N914	27
J1	610 0748 000	Cable Connector, 40 Pin	1
Q1,Q2,Q3	380 0111 000	Transistor, 2N3417	3
R1	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R2	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R3	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R4	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R5,R6	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R7	550 0813 000	Potentiometer, 2k ohm	1
R8	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1

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WARNING: Disconnect primary power prior to servicing

Table 6-3. Control Module Lower PC Board Assembly
(Reference Designator Prefix: 2) - 992 4951 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R9	548 1390 000	Resistor, 1740 ohm, 1/4W, 1%	1
R10	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R11	548 0281 000	Resistor, 6190 ohm, 1/4W, 1%	1
R12	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R13	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	
R14	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R15	548 1419 000	Resistor, 3830 ohm, 1/4W, 1%	1
R16	540 1193 000	Resistor, 2.4k ohm, 1/2W, 5%	1
R17	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R18	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R19	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R20	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R21	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R23	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R24	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R25,R26	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R27	550 0813 000	Potentiometer, 2k ohm	1
R28	548 1390 000	Resistor, 1740 ohm, 1/4W, 1%	1
R29	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R30	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R31	548 0281 000	Resistor, 6190 ohm, 1/4W, 1%	1
R32	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R33	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1

WARNING: Disconnect primary power prior to servicing.

Table 6-3. Control Module Lower PC Board Assembly
(Reference Designator Prefix: 2) - 992 4951 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R34	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R35	548 1419 000	Resistor, 3830 ohm, 1/4W, 1%	1
R36	540 1193 000	Resistor, 2.4k ohm, 1/2W, 5%	1
R37	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R38	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R39	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R40	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R41	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R42	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R43	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R44,R45	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R46	550 0813 000	Potentiometer, 2k ohm	1
R47	548 1390 000	Resistor, 1740 ohm, 1/4W, 1%	1
R48	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R49	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R50	548 0281 000	Resistor, 6190 ohm, 1/4W, 1%	1
R51	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R52	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R53	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R54	548 1419 000	Resistor, 3830 ohm, 1/4W, 1%	1
R55	540 1193 000	Resistor, 2.4k ohm, 1/2W, 5%	1
R56	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R57	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1

Table 6-3. Control Module Lower PC Board Assembly
(Reference Designator Prefix: 2) - 992 4951 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R58	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R59,R60	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	2
R61	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R62,R63	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R64	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R65,R66	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R67	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R68	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R69	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R70,R71	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R72	548 0745 000	Resistor, 49,900 ohm, 1/4W, 1%	1
R73,R74	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	2
R75	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R76	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R77,R78	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R79	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R80	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R81	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R82,R83	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R84,R85	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	2
R86	548 0745 000	Resistor, 49,900 ohm, 1/4W, 1%	1
R87	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R88	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1

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Table 6-3. Control Module Lower PC Board Assembly
(Reference Designator Prefix: 2) - 992 4951 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R89,R90	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R91	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R92	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R93	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R94,R95	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R96,R97	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	2
R98	548 0745 000	Resistor, 49,900 ohm, 1/4W, 1%	1
S1 thru S3	604 0856 000	Switch, SPDT	3
S4	604 0855 000	Switch, 3 PDT	1
U1,U2,U3	382 0519 000	Integrated Circuit, TLO-84-CN	3
U4,U5,U6	382 0549 000	Integrated Circuit, LF356N	3
U7	382 0519 000	Integrated Circuit, TLO-84-CN	1
U8	382 0359 000	Integrated Circuit, MC 7815 CP	1
U9	382 0360 000	Integrated Circuit, MC 7915 CP	1
XU1,XU2,XU3	404 0505 000	Socket, 14 Pin	3
XU4,XU5,XU6	404 0504 000	Socket, 8 Pin	
XU7	404 0505 000	Socket, 14 Pin	1
	843 1896 001	Printed Circuit Board	1

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LIMITER MODULE
888 1753 400

TECHNICAL MANUAL

LIMITER MODULE

994 7975 001

HARRIS CORPORATION

Broadcast Products Division

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WARNING: Disconnect primary power prior to servicing.

SAFETY NOTICE

WARNING: THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND UNDER CERTAIN CONDITIONS, COULD BE FATAL.

This manual is intended as general guidance for trained and qualified installation, operating, maintenance and service personnel who are familiar with and aware of the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

THE INSTALLATION, OPERATION, MAINTENANCE AND SERVICING OF THIS EQUIPMENT INVOLVES RISKS TO BOTH PERSONNEL AND EQUIPMENT, AND MUST BE PERFORMED ONLY BY PROPERLY TRAINED AND EXPERIENCED PERSONNEL EXERCISING DUE CARE. PERSONNEL MUST FAMILIARIZE THEMSELVES WITH SAFETY REQUIREMENTS, SAFE HANDLING AND OPERATING PRACTICE, AND RELATED FIRST-AID PROCEDURES (E.G., FOR ELECTRICAL BURNS AND ELECTRICAL SHOCK).

HARRIS CORPORATION Broadcast Equipment Division shall not be responsible for injury or damage resulting from improper installation, operation, maintenance or servicing, or from the use of improperly trained or inexperienced personnel in the performance of such tasks, or from the failure of persons engaged in such tasks to exercise due care.

As with all electronic equipment, care should be taken to avoid electrical shock in all circuits where substantial currents or voltages may be present, either through design or short circuit. Caution should also be observed in lifting and hoisting equipment, especially regarding large structures, during installation.

LIABILITY LIMITATION

The procedures outlined in this Manual are based on the information available at the time of publication and should permit the specified use with minimum risk. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

The manufacturer is specifically not liable for any damage or injury arising out of failure to follow the instructions in this Manual or failure to exercise due care and caution during installation, operation, maintenance and service of this equipment.

CAUTIONARY NOTICE

Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

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WARNING: Disconnect primary power prior to servicing.

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SECTION I

GENERAL DESCRIPTION

1-1. EQUIPMENT PURPOSE.

1-2. There are two limiter modules (left and right channels) in the Audio Processor System which are identical. The purpose of the module is to limit audio peaks and to automatically determine attack and recovery time in proportion to the repetition rate and frequency of the audio peaks. Four-quadrant multipliers are used for limiting and analog comparators and digital pulse counters are used for generation of attack and recovery time constants.

1-3. TECHNICAL CHARACTERISTICS.

1-4. Table 1-1 lists the electrical characteristics of the module.

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Table 1-1. Electrical Characteristics

FUNCTION	CHARACTERISTIC
Limiting Level	Variable. Determined by the setting of the LIMITING LEVEL control on the limiter meter module.
Attack Frequency Bands	Six filters: 1 kHz (low pass), 2 kHz, 3 kHz, 4 kHz, and 5 kHz (band pass), and 6 kHz (high pass).
Attack Time	Automatically or manually selected. In the automatic mode, attack time is varied according to the frequency components in the program signal as follows: FREQUENCY COMPONENT — ATTACK TIME <1 kHz — 3.6 mSec 2 kHz — 1.2 mSec 3 kHz — 400.0 uSec 4 kHz — 100.0 uSec 5 kHz — 40.0 uSec >6 kHz — 25.0 uSec In the manual mode, attack time is fixed in one of five ranges selected by the ATTACK TIME switch on the limiter meter module.
Recovery Time	Automatically or manually selected. In the automatic mode, the recovery time is proportional to audio envelope rate. In the manual mode, recovery time is fixed in one of five ranges selected by RECOVERY TIME switch on the limiter meter module.
Dual Recovery	In automatic mode, a dual time constant can be selected, making recovery time a function of the type of program signal being processed.

WARNING: Disconnect primary power prior to servicing.

Table 1-1. Electrical Characteristics (Continued)

FUNCTION	CHARACTERISTIC
Program Source	Internal or external. Selected by a jumper plug on the PC board.
Strapped (Stereo) or independent action	The left and right modules can be strapped together for stereo operation. In this mode, the module with the greatest control signal (most limiting) controls the gain of both modules.
Output Signal Level	5.3 volts peak
Power	Internal, $\pm$15 vdc and $\pm$8 vdc regulated. $\pm$20 vdc supplied from main frame primary power supply.
Frequency Response	$\pm$0.25 dB, 20 Hz to 20 kHz at 5.3V peak output with limiting function disabled.
Harmonic Distortion	0.5% maximum, 20 Hz to 20 kHz, recovery in auto mode, with 0 to 10 dB limiting.
Intermodulation Distortion	1% maximum, 60 Hz and 7 kHz mixed 4:1, 0 to 10 dB limiting with recovery in auto mode.

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SECTION II

INSTALLATION

2-1. GENERAL.

2-2. Installation of the Limiter Module is covered in Technical Manual 888 1753 001, MSP 100 FM Audio Processor System, Volume I, Section II, Installation.

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SECTION III

CONTROLS AND INDICATORS

3-1. GENERAL.

3-2. Figure 3-1 shows all of the user control and indicators on the Limiter Module, and Table 3-1 describes the function of each and its affect on module operation.

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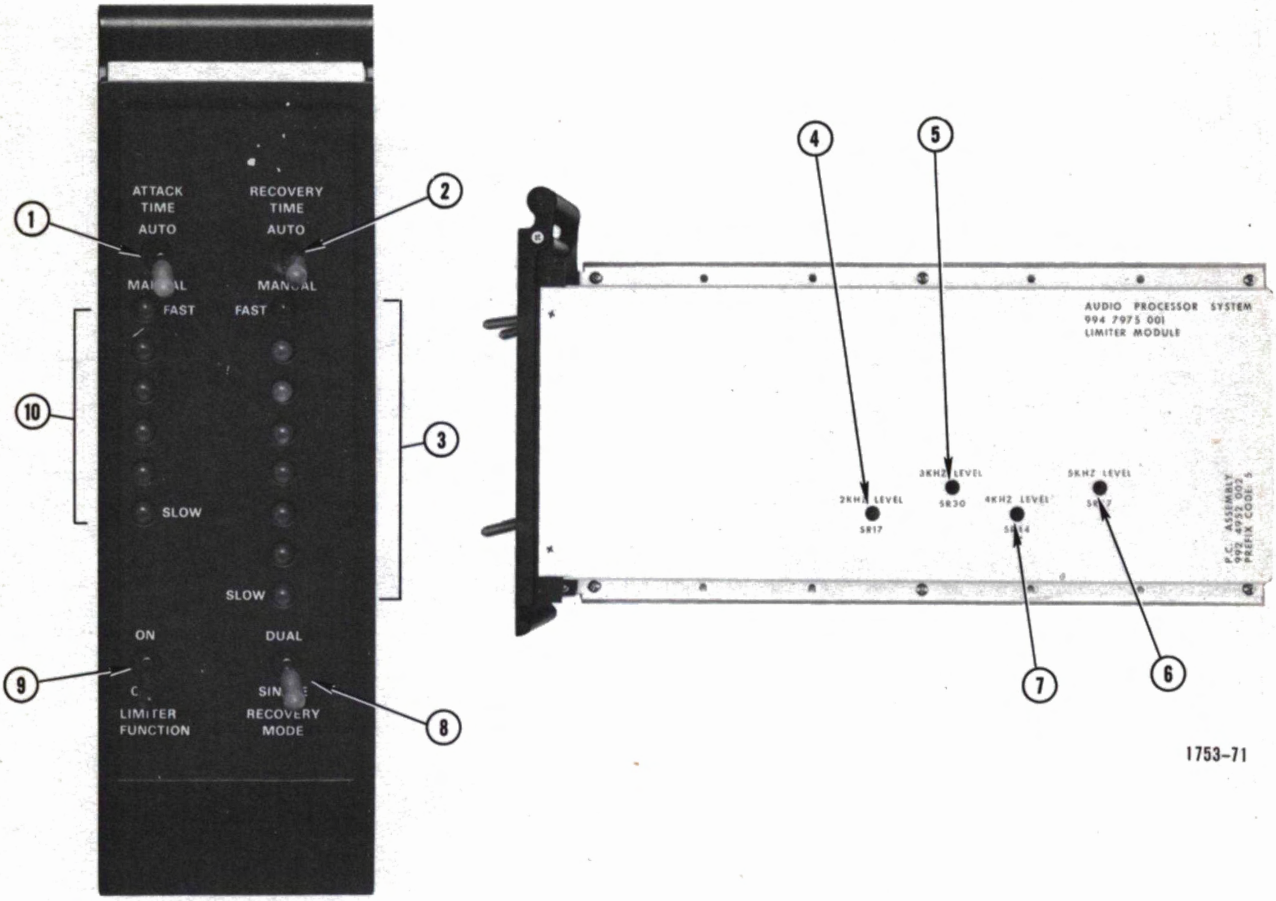

Figure 3-1. Limiter Module Controls and Indicators (Sheet 1 of 2)

WARNING: Disconnect primary power prior to servicing.

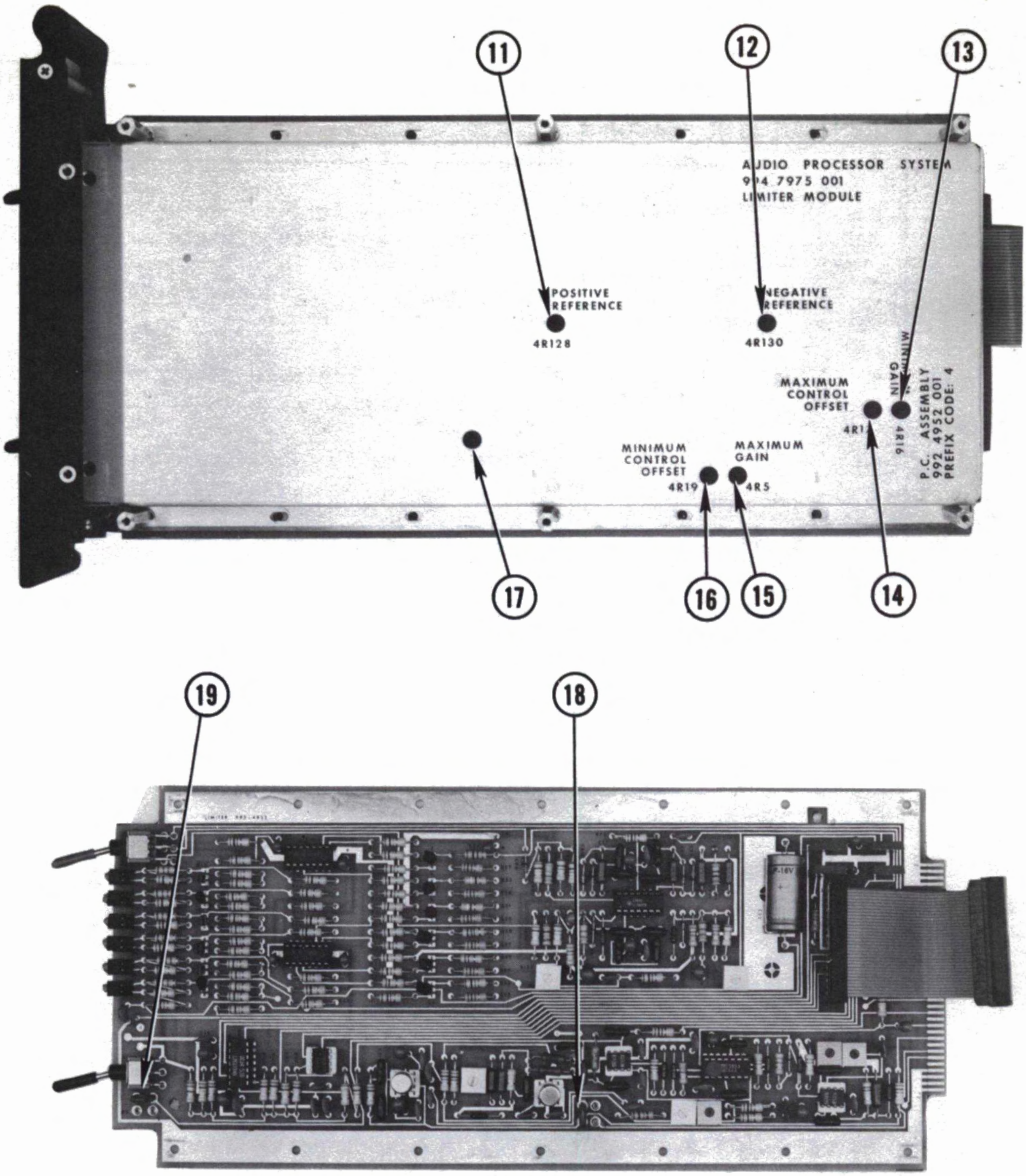

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Figure 3-1. Limiter Module Controls and Indicators (Sheet 2 of 2)

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WARNING: Disconnect primary power prior to servicing.

Table 3-1. Limiter Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	ATTACK TIME AUTO/ MANUAL, 4S2	AUTO Position: Produces an attack time which proportional to 6 signal frequency components. MANUAL Position: Produces attack time selected by the attack time switch.
2	RECOVERY TIME AUTO/ MANUAL, 5S2	AUTO Position: Selects recovery which automatically changes with audio envelope rate. MANUAL Position: Provides fixed recovery rate as selected by recovery time switch.
3	RECOVERY TIME SLOW/ FAST, 5DS1 through 5DS8	LED indicators. The number illuminated is determined by the rate of change of the audio signal. As the number of peaks per second increases, the number of LEDs illuminated increases from the bottom (SLOW) upward (FAST).
4	2 KHZ LEVEL, 5R17	Adjusts output level of the 2 kHz filter.
5	3 KHZ LEVEL, 5R30	Adjusts output level of the 3 kHz filter.
6	5 KHZ LEVEL, 5R44	Adjusts output level of the 5 kHz filter.
7	4 KHZ LEVEL, 5R57	Adjusts output level of the 4 kHz filter.
8	DUAL/SINGLE RECOVERY MODE, 5S1	DUAL Position: Establishes recovery time proportional to limiting rate. SINGLE Position: recovery time is fixed by recovery time switch in limiter meter module.
9	ON/OFF LIMITER FUNCTION, 4S1	ON Position: Connects the limiting circuits into the signal path. OFF Position: Bypasses the limiting circuits.
10	ATTACK TIME FAST/ SLOW, 4DS1 through 4DS6	LED indicators (green). Illuminate (in the AUTO mode) when the output of each of 6 filters exceeds a given threshold voltage. The top LED illuminate for the 6 kHz filter and the bottom LED illuminate for the 1 kHz filter. The remaining LEDs illuminate for the 5 kHz, 4 kHz, 3 kHz, and 2 kHz filters, respectively.

Table 3-1. Limiter Module Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
11	POSITIVE REFERENCE, 4R128	Adjusts positive reference voltage for attack gating circuit to allow symmetrical detection.
12	NEGATIVE REFERENCE, 4R130	Adjusts negative voltage for the attack gating to allow symmetrical detection.
13	MINIMUM GAIN, 4R16	Trims the four-quadrant multiplier gain with 0.625 vdc control voltage input.
14	MAXIMUM CONTROL OFFSET, 4R17	Controls dc output offset of four-quadrant multiplier with 10 vdc control voltage input.
15	MAXIMUM GAIN, 4R5	Adjusts maximum gain of four-quadrant multiplier.
16	MINIMUM CONTROL OFFSET, 4R19	Adjusts dc output offset of multiplier buffer to zero with 0.625 vdc control voltage input.
17	INITIAL GAIN SET, 4R59	Adjusts the dc control voltage to the multiplier gain controller with no limiting.
18	JUMPER PLUG, 4P2	Straps left and right channel limiters together. In the strapped configuration, the greater control signal controls both channels.
19	JUMPER PLUG, 4P3	Selects either the limiter multiplier output or an external signal for limiting.

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WARNING: Disconnect primary power prior to servicing.

SECTION IV

PRINCIPLES OF OPERATION

4-1. GENERAL.

4-2. BASIC CIRCUIT.

4-3. The basic circuit of the limiter may be broken down into six sections (multiplier, attack gating, filter, attack time, recovery time, and dc control), as shown in figure 4-1. The multiplier gain controller functions in the same manner as the gain controllers in the Input/AGC, and Control modules; however, it exercises control over the broadband signal. The attack and recovery circuits are split into six frequency bands and the relative amount of limiting and degree of limiting are displayed. Finally, these six limited outputs are combined and used to control a dc amplifier which in turn controls the gain of the multiplier.

4-4. MULTIPLIER SECTION. The multiplier receives a broadband signal input from the LIMITING LEVEL control on the Limiter Meter Module through coupling capacitor 4C62. The gain controlling function is performed by voltage controlled current source 4U1. Four quadrant-multiplier 4U2 is used in the two-quadrant connection; signal is injected into the Y input (pin 4), and the dc control current is fed to the X input (pin 9). As in the other multiplier circuits in the system the dc voltage at the input of 4U1 is attenuated by a factor of .0762 by resistors 4R2 and 4R4 to prevent overdriving the multiplier. MAXIMUM GAIN control 4R5 the multiplier gain, or scale factor (before limiting) to a value of 27 dB. As the signal amplitude increases, limiting takes place, increasing the output of the dc control amplifier which in turn decreases the multiplier gain. MAXIMUM GAIN control 4R16 trims the multiplier gain with 0.625 vdc control voltage input, and MINIMUM CONTROL OFFSET control 4R19 adjusts the dc offset of multiplier buffer 4U3 to zero with 0 vdc control voltage. 4R11 and 4R12 are load resistors for the multiplier feeding differential buffer amplifier 4U3. The output of buffer 4U3 is applied to the attack gating circuit through jumper plug 4P3; alternatively, an external source can be used to drive the limiting circuitry.

4-5. ATTACK GATING SECTION. The attack gating circuit sets a threshold at which pulse amplification takes place. Bias voltage of +5.1 vdc and -5.1 vdc are placed at the inverting inputs of 4U9A and 4U9B, respectively by the voltage divider 4R128, 4R76, 4R72, 4R79, 4R131, and 4R130. When POSITIVE REFERENCE potentiometer 4R128 and NEGATIVE REFERENCE potentiometer 4R130 are adjusted for 0 vdc at the junction of 4R72 and 4R79, and +5.1 vdc at the inverting input of 4U9A, the voltage at the inverting input of 4U9B will be -5.1 vdc. Then, the output of 4U9A will be -5.1 vdc and 4CR2 will be reverse biased and loop feedback current will be zero. Likewise, the output of 4U9B will be +5.1 vdc, reverse biasing 4CR4, and blocking loop feedback current. Output of the circuit (junction of 4CR2 and 4CR4) is zero until signal peaks exceeding ±5.1 are received at the input. Should a peak which exceeds 5.1 volts by 0.1 dB appear at the input, a pulse of 0.82 volt amplitude would result.

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4-6. The positive and negative pulses from the gating circuit are routed to two precision half wave rectifiers, 4U9C and 4U9D, whose outputs are combined to produce full wave rectification. Positive pulses applied to the noninverting input of 4U9C will be passed by diode 4CR7 and negative pulses will be blocked by 4CR8, giving a positive pulse at 4CR6 anode. Similarly, negative pulses at the inverting input of 4U9D will be inverted and passed as positive pulses by 4CR9, while positive pulses will be blocked by 4CR10. Both 4U9C and 4U9D have a pulse gain of 18.5 dB, producing a 6.9 volt output for a 0.1 dB output from the gating circuit. This output will cause 8.6 dB of gain reduction, fixing the compression ratio at 7.1 into 0.1 for the first 0.1 dB, or an equivalent ratio of 70:1 or better for 10 dB of limiting. Gating diode 4CR6 passes the positive pulses to the ATTACK TIME switch 4S2B. If switch 4S2B is in the MANUAL position, the pulses are routed to the emitter follower current amplifier and the switch selected attack time resistors in the Limiter Meter Module. In the AUTO position, pulses are fed to quad bilateral switches 4U4 and 4U5.

4-7. FILTER SECTION. The signal at the input to the attack gating circuit is also applied to the filter circuits through 4S2A (when in the AUTO position). Here the signal is split into six bands. 5U1A is a low pass, unity gain filter with a cutoff frequency of 1 kHz and 12 dB/octave rolloff. Frequency determining components are 5R1, 5C1, and 5R2, 5C3. 5U1C is a high pass, unity gain filter with a cutoff frequency of 6 kHz and a rolloff of 12 dB/octave. Note that the relative positions of the resistors and capacitors and the component value ratios are interchanged in the 5U1A and 5U1C circuits. 5U2A ia a bandpass, unity gain filter with a center frequency of 2 kHz and 12 dB/octave rolloff. Frequency determining components as 5R11, 5C11, 5R12, 5C12, and 5R13. Gain is adjusted to unity with 2 KHZ LEVEL control 5R17. Bandpass filters 5U2C, 5U3A, and 5U3C, are identical in configuration to 5U2A; their cutoff frequencies are 2 kHz, 3 kHz, and 4 kHz, respectively.

4-8. The six filter outputs are buffered by half wave rectifiers 5U1B, 5U2B, 5U2D, 5U3B, 5U3D, and 5U1D and fed to six emitter followers on monolithic array 5U8. Each emitter follower charges a one-second time constant network, 5C43, 5R10 which, in turn, feeds the inverting input of a comparator on comparator chips 4U10 or 4U11. The noninverting input of each comparator is biased at +0.88 vdc by voltage divider 4R91, 4R118. When a pulse exceeding this amplitude is applied to the inverting input of the comparator, its output goes low, causing one of the PNP transistors (4Q7 through 4Q12) to conduct, illuminating one of the LED indicators, 4DS1 through 4DS6. 4R93 supplies base bias for the PNP transistor and 4R94 limits base current (for 4Q7; the 4Q8 through 4Q12 circuits are identical). Thus, when the signal in any of the six frequency bands exceeds the threshold, its corresponding indicator (4DS1 through 4DS6) will light. 4R95 limits LED current, and 4R95 and 4R96 together provides a collector load for 4Q7, assuring that in the off state the collector will remain negative and the bilateral switch will not be triggered.

WARNING: Disconnect primary power prior to servicing.

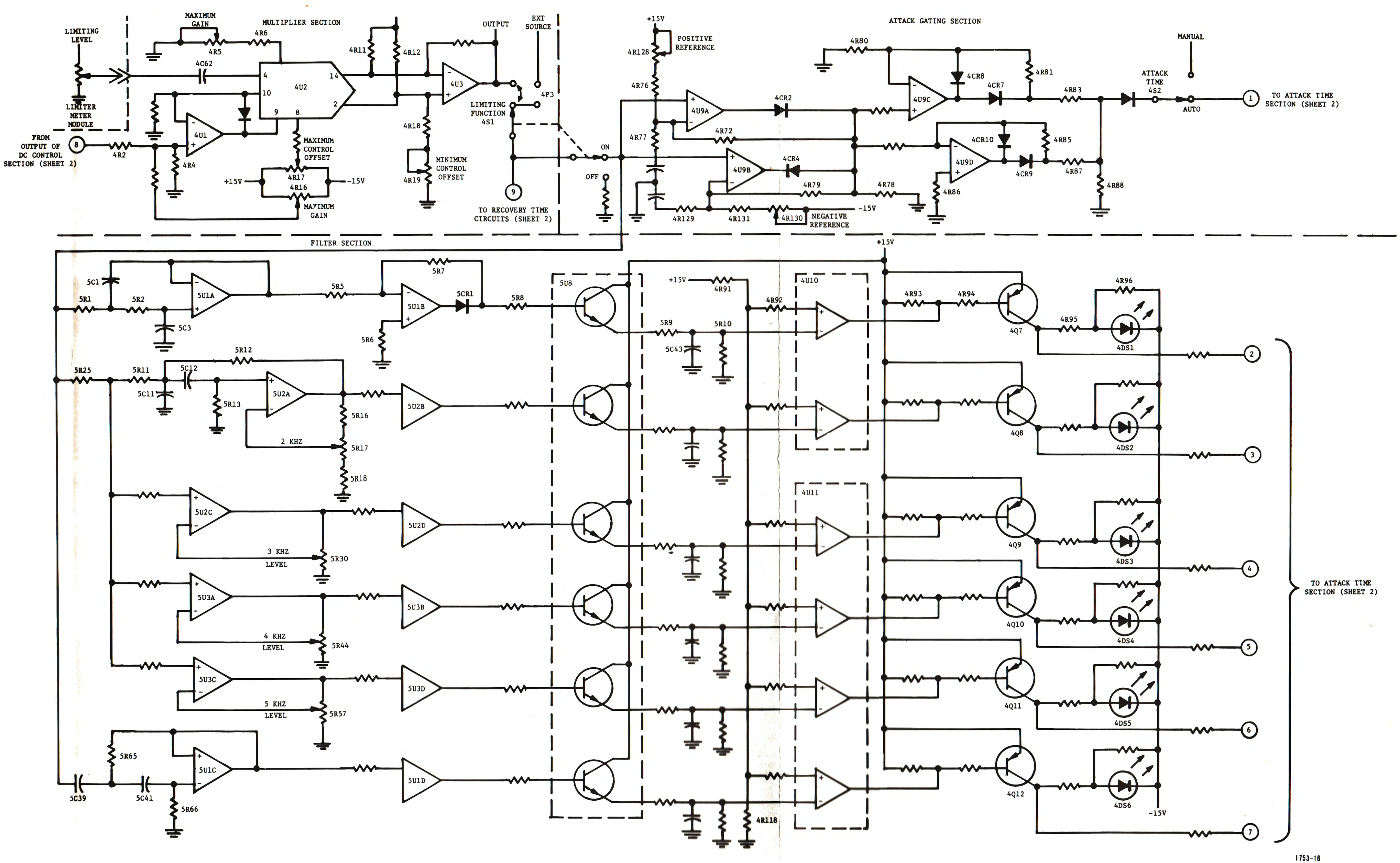

FIGURE 4-1.
LIMITER MODULE
BLOCK DIAGRAM
(SHEET 1 OF 2)

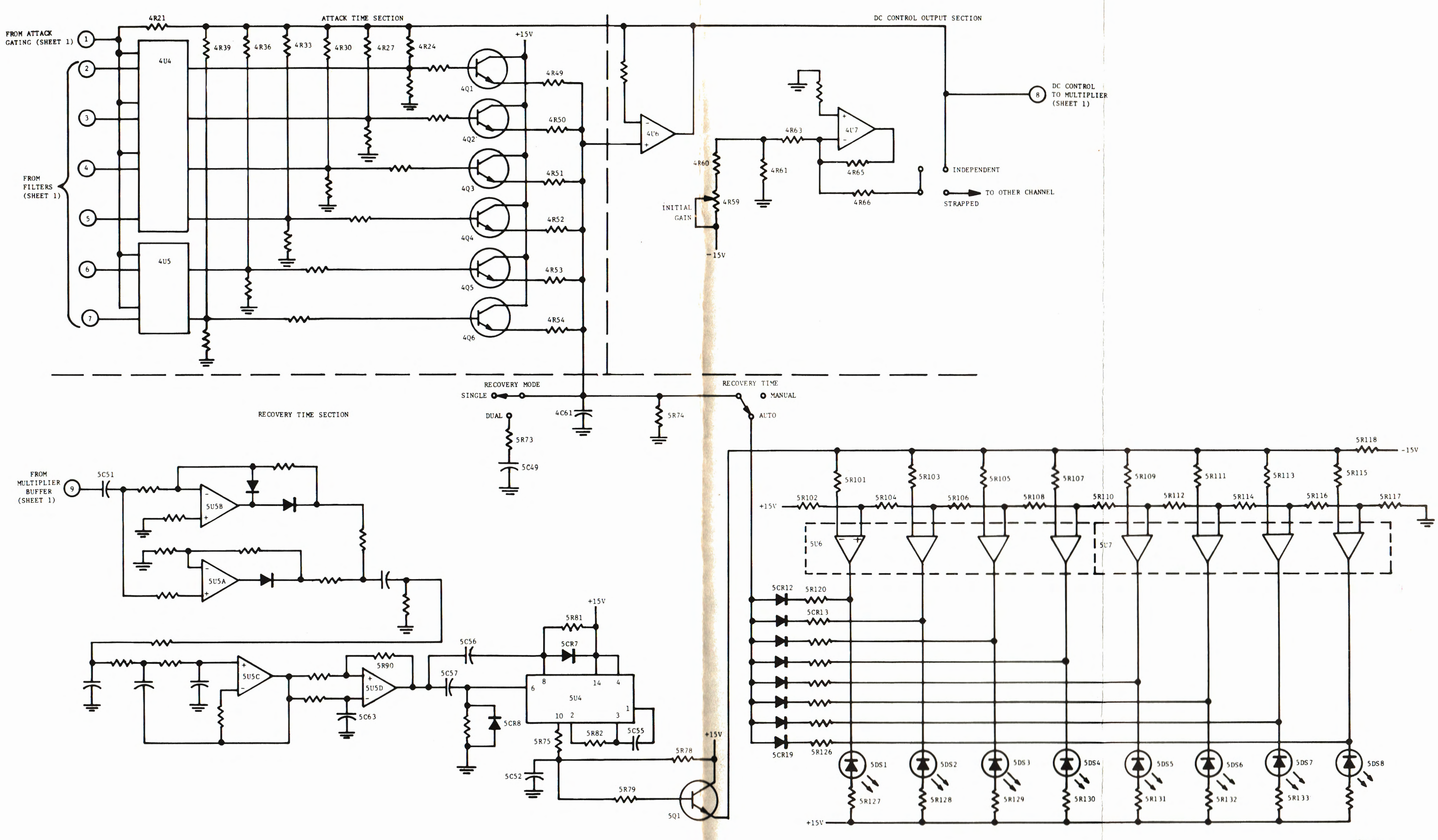

FIGURE 4-1.
LIMITER MODULE
BLOCK DIAGRAM
(SHEET 2 OF 2)

4-9 ATTACK TIME SECTION. The outputs of 4Q7 through 4Q12 are simultaneously routed to the inputs of quad bilateral switches 4U4 and 4U5. The switches are enabled by a positive input from attack gating circuit. As the limiter output exceeds the threshold, positive pulses propogated through the bilateral switches turn on 4Q1 through 4Q6, charging 4C61 through the appropriate attack time resistors 4R59 through 4R54. This causes attack time to be selected automatically as the signal in each of the six bands exceeds limiting threshold. The attack time for each of the bands is given in table 4-1.

Table 4-1. Attack Time for Frequency Bands

FREQUENCY BAND	NOMINAL ATTACK TIME
1 kHz	3.6 mSec
2 kHz	1.2 mSec
3 kHz	0.4 mSec
4 kHz	100.0 uSec
5 kHz	40.0 uSec
6 kHz	25.0 uSec

4-10. RECOVERY TIME SECTION. The output of the multiplier buffer is routed to the recovery time circuits through LIMITING FUNCTION switch 4S1, and is ac coupled to precision rectifiers 5U5A and 5U5B through 5CC51. 5U5A and 5U5B are connected as a full wave rectifier with a gain of 3. The rectifier output is fed to low pass filter 5U5C whose cutoff frequency is 10 Hz with a rolloff of 18 dB/octave. The filter output, therefore follows the audio signal envelope. 5U5D is connected as a zero crossing detector. The average long term dc output of 5U5C establishes the voltage across 5C63. Any time the output of 5U5C swings positive or negative from this value, a positive or negative pulse is generated by 5U5D. Resistor 5R90 provides a small amount of positive feedback around 5U5D for faster switching.

4-11. Pulses from 5U5D trigger one-shot 5U4 on the trailing edge. Trailing edge triggering is enabled by a positive bias on pin 8 through 5R81. Capacitors 5C56 and 5C57 provide charge storage to speed up the triggering. Diodes 5CR7 and 5CR8 limit the peak voltages on the positive (pin 8) and negative (pin 6) trigger inputs to protect 5U4 from damage by transient voltages. The output pulse width of 5U4 is 55 milliseconds, determined by 5C55 and 5R82. Each time the output of 5U5C swings negative an output pulse 55 milliseconds wide is generated at the output of 5U5D; therefore the pulse repetition rate of 5U5D id directly proportional to the rate of zero crossings up to the limit of 18 per second (limited by 5U5D pulse width).

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4-12. The output pulses from 5U5D are counted through integration. At the beginning of pulse, 5C52 begins to charge and the voltage at the base of 5Q1 ramps upward, and when 5U5D output goes low, the 5Q1 base voltage ramps downward. As the pulse repetition rate increases the average voltage at 5Q1 base increases. With increasing base drive, the emitter voltage of 5Q1 rises. The noninverting inputs of voltage comparators on 5U6 and 5U7 are biased by a ladder network. The bais on the lower comparator being 0.35 vdc, the second, 0.71 vdc, the third 1.07 vdc and so on up to the upper comparator which is biased at 2.85 vdc. As the voltage at 5Q1 emitter rises in step with the output pulses of 5U5D it will exceed the bias voltages of the comparators on the ladder, and this voltage will appear at inverting inputs of all the comparators. The voltage at the outputs of all the comparators is high (about +14 volts). When the voltage at the inverting input of any comparator exceeds the voltage at the noninverting input, the output will switch low (a few millivolts above ground). This places a forward bias on the corresponding LED indicator (5DS1 through 5DS8) causing it to conduct and glow. At the same time, a discharge path is created for 4C61 through one of the diodes (5CR12 through 5CR19), and one of the resistors (5R119 through 5R126). As successive comparators are switched low, more discharge paths are created in parallel and 4C61 discharges faster. Thus, the discharge rate of 4C61 is proportional to the limiting rate as indicated by the LED indicators on the front panel.

4-13. DUAL RECOVERY FUNCTION. When RECOVERY MODE switch 5S1 is in the DUAL position, an additional time constant circuit (consisting of 5R93 and 5C49 in series) is placed across 4C61. As transistors 4Q1 through 4Q6 are switched on by bilateral switches 4U4 and 4U5, a charge is built up on 5C49. This does not affect attack time because 5R93 reduces the charge rate of 5C49 to the point that it is insignificant compared to the charge rate of 4C61. Fast repetitive limiting will build a greater charge on 5C49 ald slower limiting will build less charge. With little charge on 5C49, the discharge rate of 5C61 is fast, and as the charge on 5C49 increases, 4C61 discharges slower, providing fast recovery with slow limiting and slow recovery with fast limiting.

4-14. DC CONTROL OUTPUT SECTION. The voltage across 4C61 is isolated from other circuits by unity gain buffer 4U6. As in the AGC circuits, a slight amount of positive feedback to transistors 4Q1 through 4Q6 is provided by resistors 4R24, 4R27, 4R30, 4R33, 4R36, and 4R39 to reduce leakage currents during recovery. The output of 4U6 is routed to 4U7 through plug 4P2 which provides the left or right limiting control independent of the other channel or the two channels may be strapped together as shown in figure 4-2.

4-16. Voltage divider 4R59, 4R60, and 4R61 biases the inverting input of 4U7 from -8.5 to -11.8 vdc; in practice, 4R59 is adjusted for -10 vdc, which produces a +10 vdc output in the absence of limiting. The output of 4U6, a positive dc voltage, is summed with the -10 vdc, which decreases the level of 4U7 control voltage output in proportion to the amount of limiting taking place. Finally the control voltage output of 4U7 is fed back to the control input to the multiplier where the multiplier gain follows the control voltage. The signal output of the module is tanken from the output of the multiplier buffer 4U3.

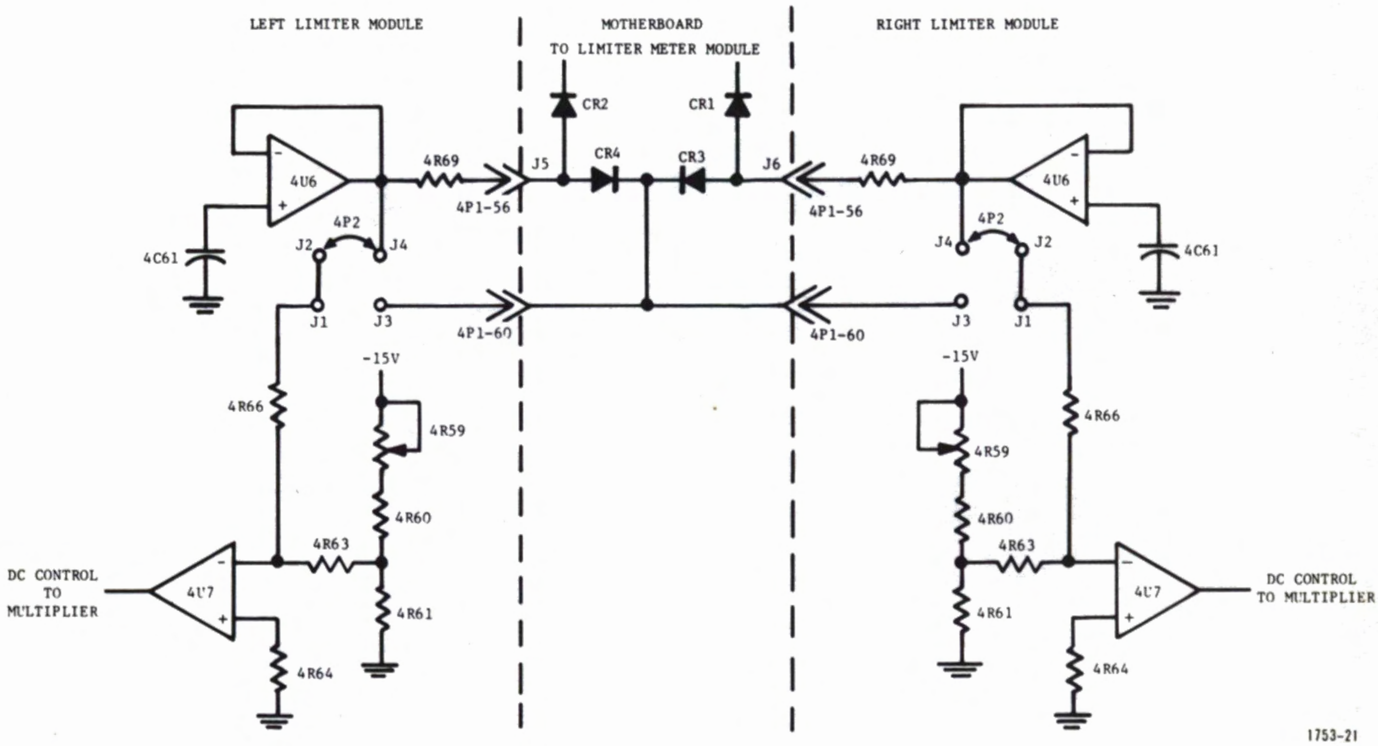

Figure 4-2. Strapping Left and Right Limiters

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WARNING: Disconnect primary power prior to servicing.

SECTION V

MAINTENANCE AND TROUBLESHOOTING

5-1. GENERAL.

5-2. This section describes the maintenance and troubleshooting procedures for the Limiter Module. As shown in Figure 5-1, reference designators are printed on the printed circuit board. In addition, certain parts, significant to the discussions that follow, are flagged. In the text and on the Schematic (figure 5-2), the reference designators are prefixed with either the number "4" or "5", the the lower board and upper board, respectively. If the module does not perform properly, figures 5-3 through 5-6 may be used as guide for locating the fault. For general repair and cleaning techniques and a list of recommended test equipment, refer to Technical Manual 888 1753 001, Volume I, Section V.

5-3. MODULE ADJUSTMENTS.

5-4. Internal controls on the module are set at the factory before shipment. Should any adjustment of these controls become necessary, such as following replacement of parts, the controls may be accessed through the access holes in the covers by using an extender card. The covers should not require removal except for troubleshooting or replacement of parts. When using the extender card, care should be taken that the module is properly supported at the front panel end, and is inserted straight into the extender card edge connector. If any parts are replaced and it becomes necessary to make measurements on the board, the module cover must be removed by removing eight cross-recessed screws. The lower board cover is then removed by removing six standoff posts.

5-5. ADJUSTMENT PROCEDURES.

5-6. Set the operational controls listed below to the specified positions:

Limiter Module

LIMITER FUNCTION	OFF
DUAL/SINGLE/RECOVERY MODE	SINGLE

5-7. INITIAL GAIN. Connect a dc voltmeter, preferably a digital type, between ground and the junction of 4R60 and 4R61. Adjust INITIAL GAIN SET controls 4R59 for a -10 $\pm$0.05 vdc reading on the voltmeter.

5-8. POSITIVE REFERENCE. Connect an accurate dc voltmeter, preferably a digital type, between ground and the junction of 4R76 and 4R72. Adjust POSITIVE REFERENCE control, 4R128, for a +5.1 $\pm$0.05 vdc reading on the voltmeter.

5-9. NEGATIVE REFERENCE. Connect an accurate dc voltmeter, preferably a digital type between ground and the junction of 4R131 and 4R79. Adjust NEGATIVE REFERENCE control, 4R130, for a -5.1 ±0.05 vdc reading on the volmeter.

5-10. MULTIPLIER ALIGNMENT PROCEDURE. The MINIMUM GAIN 4R16, MAXIMUM GAIN 4R5, MINIMUM CONTROL OFFSET 4R29, and MAXIMUM CONTROL OFFSET 4R17 controls calibrate the four-quadrant multiplier gain controller. These controls must be adjusted as a system since each control, to some degree, interacts with the others. Use the following procedure for adjusting these controls:

a. With no audio input, measure the dc voltage at pin 6 of 4U7. It should be +10 ±0.1 vdc. If it is not, the INITIAL GAIN adjustment should be checked (paragraph 5-7).

b. Remove 4U7 from its socket and jumper a 51k resistor from the junction of 4R60 and 4R61 to the junction of 4R65 and pin 6 of 4U7 socket. Connect a jumper from ground to the junction of 4R65 and 4R66.

c. Adjust MINIMUM CONTROL OFFSET control, 4R19, for 0.00 vdc at pin 6 of 4U3 with respect to ground.

d. Remove the two jumpers (b. above) and replace 4U7 in its socket.

e. Adjust MAXIMUM CONTROL OFFSET control, 4R17 for 0.00 vdc at pin 6 of 4U3.

f. Repeat b. through e. until 0.00 vdc offset at pin 6 of 4U3 is obtained under both conditions.

g. Reconnect the resistor and jumpers (b. above). Apply a sine wave (any audio frequency) at -30 dBm level to the MSP 100 input terminals. Adjust MINIMUM GAIN control 4R16 for 15 dB gain from pin 4 of 4U2 to pin 6 of 4U3.

h. Remove the resistor and jumpers (g. above) and replace 4U7 in its socket. Adjust MAXIMUM GAIN control, 4R5 for 27 dB gain from pin 4 of 4U2 to pin 6 of 4U3.

i. Repeat b. through h. until gain tracking and offset voltages are optimum.

5-11. 2 KHZ LEVEL ADJUSTMENT. Adjust the 2 kHz filter output level as follows:

a. Adjust the sine wave frequency to 2 kHz. Set the LIMITER FUNCTION switcn on the front panel to ON.

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b. With an ac voltmeter, measure the voltage at the junction of 5R1 and 5R25. Adjust 2 KHZ LEVEL control, 5R17 for an identical voltage reading at pin 1 of 5U2.

5-12. 3 KHZ LEVEL ADJUSTMENT. Adjust the 3 kHz filter output level as follows:

a. Adjust the sine wave frequency to 3 kHz .

b. With an ac voltmeter measure the voltage at the junction of 5R1 and 5R25. Adjust 3 KHZ LEVEL control, 5R30 for an identical voltage reading at pin 8 of 5U2.

5-13. 4 KHZ LEVEL ADJUSTMENT. Adjust the 4 kHz filter output level as follows:

a. Adjust the sine wave frequency to 4 kHz.

b. With an ac voltmeter, measure the voltage at the junction of 5R1 and 5R25. Adjust 4 KHZ LEVEL control, 5R44 for an identical voltage reading at pin 1 of 5U3.

5-14. 5 KHZ LEVEL ADJUSTMENT. Adjust the 5 kHz filter output level as follows:

a. Adjust the sine wave frequency to 5 kHz.

b. With an ac voltmeter, measure the voltage at the junction of 5R1 and 5R25. Adjust the 5 KHZ LEVEL control, 5R57 for an identical voltage reading at pin 8 of 5U3.

5-15. TROUBLESHOOTING.

5-16. Problems in the Limiter Module may be localized to one or both of two areas: either the multiplier gain control circuits or to the peak detector and automatic attack and recovery circuits. If the automatic attack and recovery timing circuits do not function properly, the nature of the problem may be determined quickly by switching between automatic and manual modes.

5-17. Specific troubleshooting procedures are given in figures 5-3 through 5-6. Nominal voltage measurements for the limiter peak detector are also provided in table 5-1. Should all LED indicators illuminate, even with no program signal, either failure of the LED drivers or random oscillation of the multiplier has occurred.

WARNING: Disconnect primary power prior to servicing.

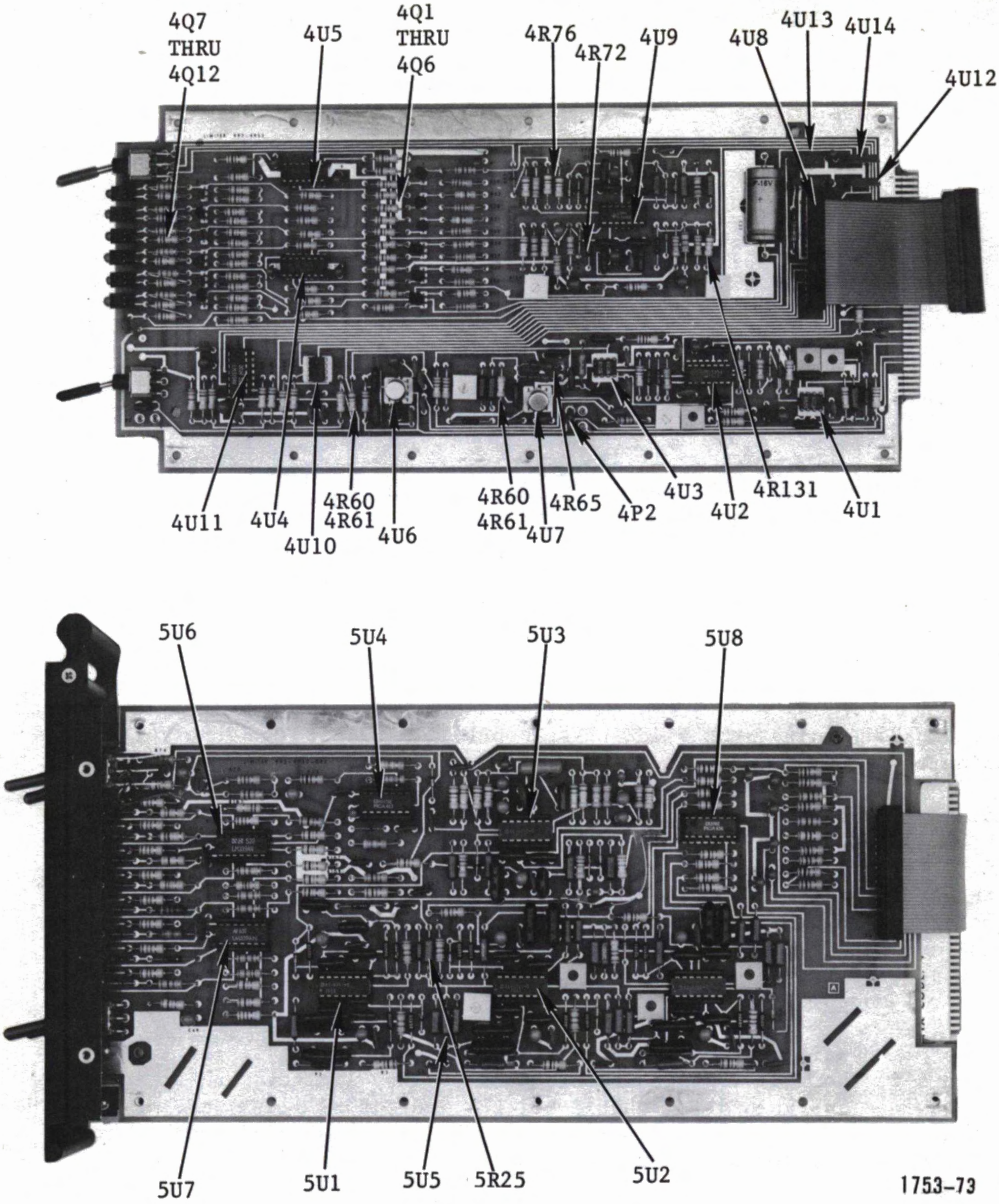


Figure 5-1. Limiter Module Parts Layout

WARNING: Disconnect primary power prior to servicing.

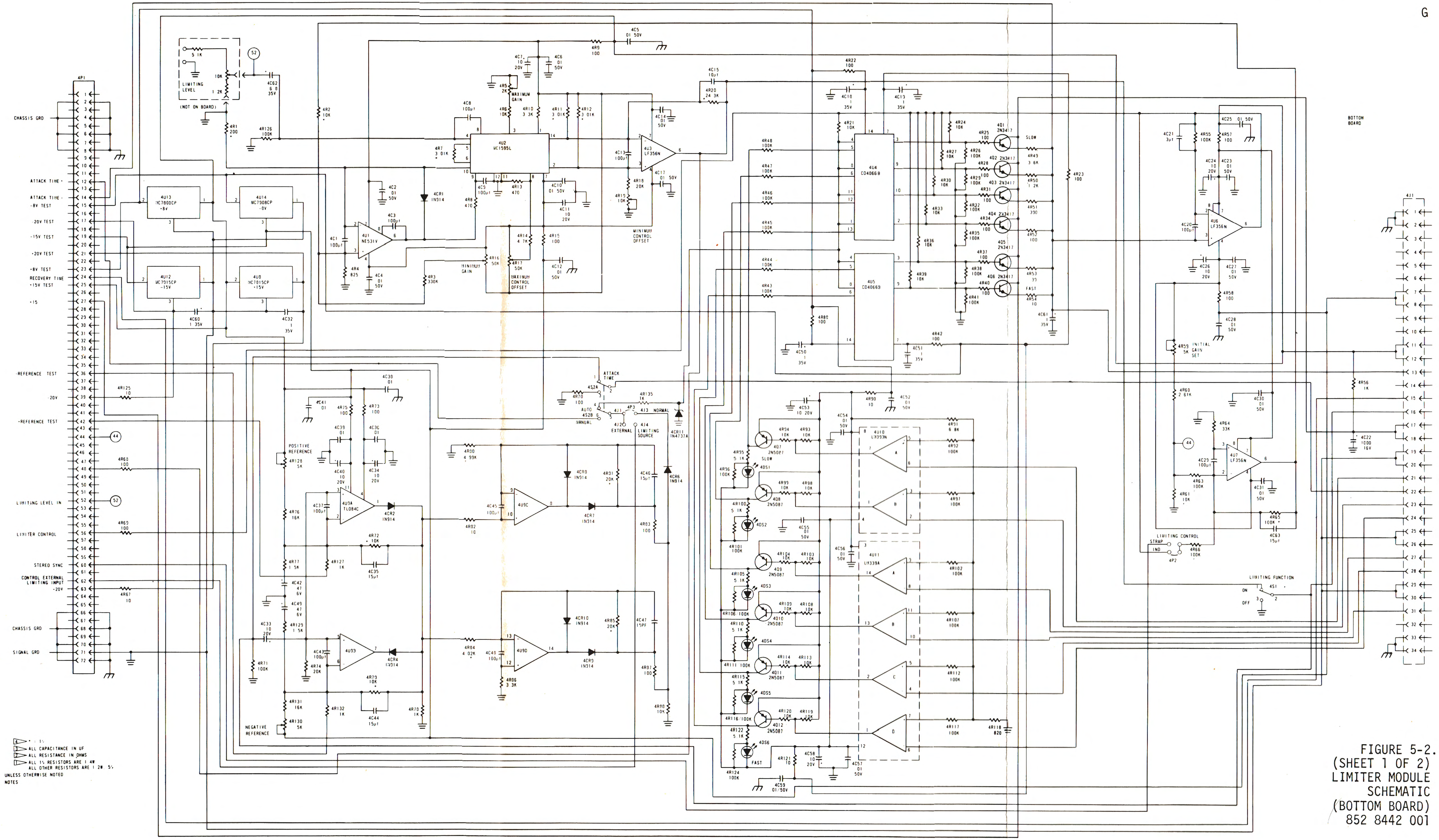


FIGURE 5-2.
(SHEET 1 OF 2)
LIMITER MODULE
SCHEMATIC
(BOTTOM BOARD)
852 8442 001

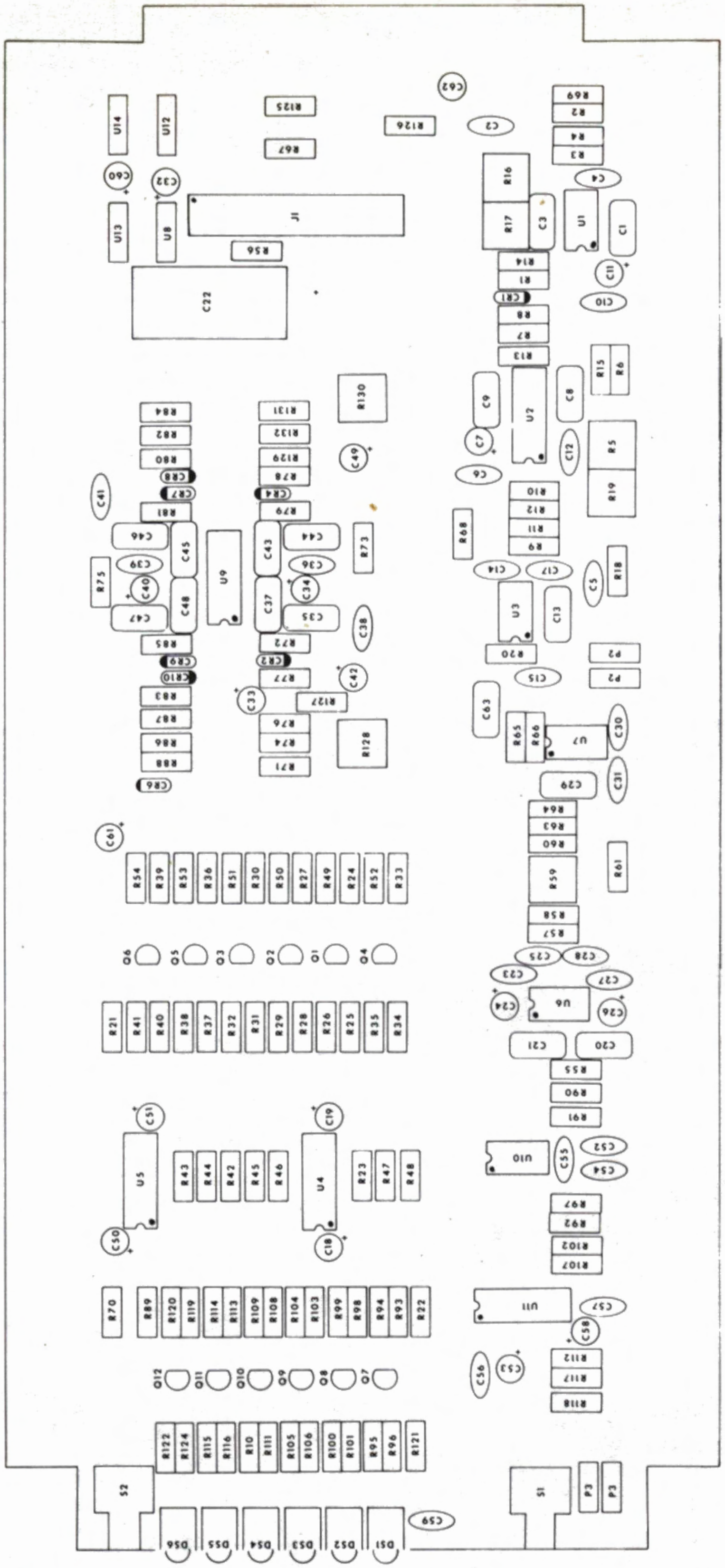
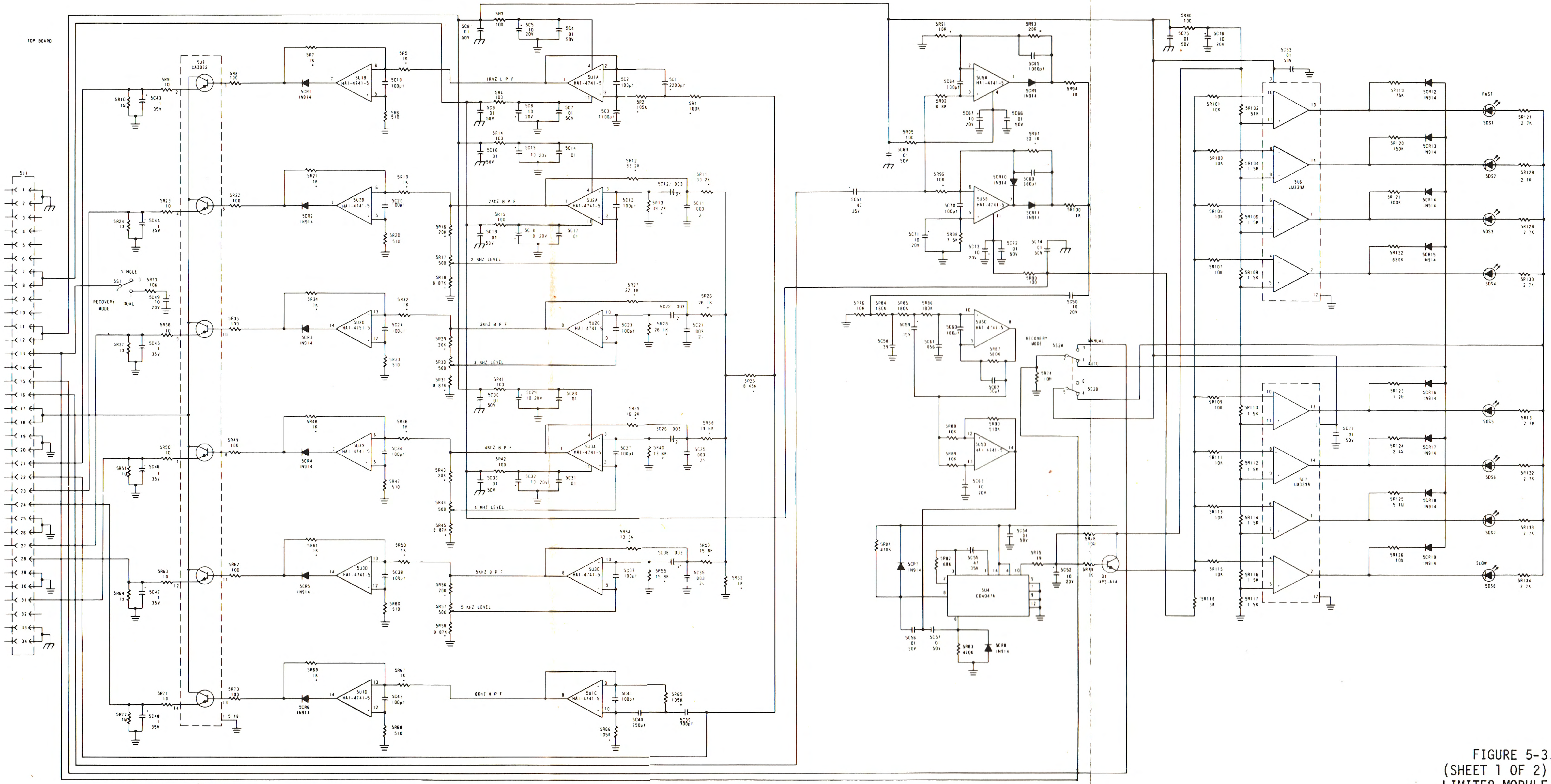


FIGURE 5-2. (SHEET 2 OF 2) LIMITER BOARD #1
COMPONENT LOCATION - 843 2196 001

WARNING: Disconnect primary power prior to servicing.

A



NOTES

UNLESS OTHERWISE NOTED

1. ALL 1% RESISTORS ARE 1/4W
ALL OTHER RESISTORS ARE 1/2W, 5%
2. ALL RESISTANCE IN OHMS
3. ALL CAPACITANCE IN UF
4. * = 1%

FIGURE 5-3.
(SHEET 1 OF 2)
LIMITER MODULE
SCHEMATIC
(TOP BOARD)
852 8443 001

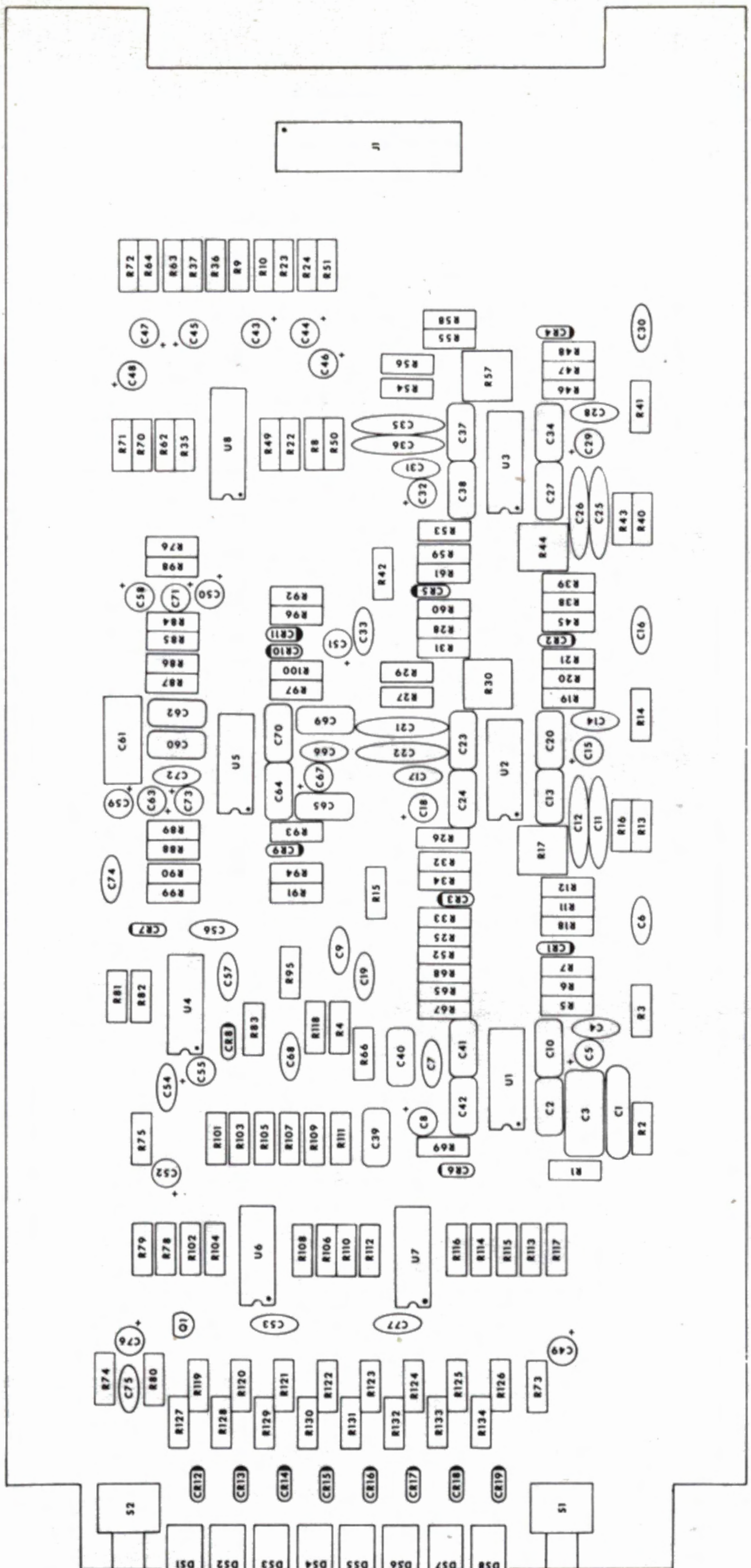


FIGURE 5-3. (SHEET 2 OF 2) LIMITER BOARD #2
COMPONENT LOCATION - 843 2199 001

WARNING: Disconnect primary power prior to servicing.

Table 5-1. Peak Detector Voltage Measurements

CIRCUIT MEASUREMENT	VOLTAGE	
	0 dB LIMITING	10 dB LIMITING
4U3, Pin 6	10.5V P-P	10.8V P-P
4U9, Pin 3	10.5V P-P	10.8V P-P
4U9, Pin 2	+5.3 VDC	+5.3 VDC and 0.1V P-P
4U9, Pin 5	10.5V P-P	10.8V P-P
4U9, Pin 6	-5.3 VDC	-5.3 VDC and 0.1 V P-P
4U9, Pin 10	0.0V	0.87V P-P
4R83-4R87 JCT.	0.0V	7.3V P-P
4C61 (high side)	0.0V	6.8V Peak
4U6, Pin 6	0.0V	6.8V Peak

Table 5-2. Multiplier Voltage Measurements

PIN	VOLTAGE	TOLERANCE	PIN	VOLTAGE	TOLERANCE
1	+7.8V	±0.5V	8	0.10V	±0.1V
2	+7.5V	±0.3V	9	2.2V	±0.05V
3	-13.4V	±0.2V	10	+0.764V	±0.005V
4	-0.007V	±0.002V	11	0.0V	NA
5	-1.40V	±0.05V	12	0.0V	NA
6	-1.35V	±0.1V	13	-14.2V	±0.5V
7	-15.0V	±0.5V	14	+7.5V	±0.3V

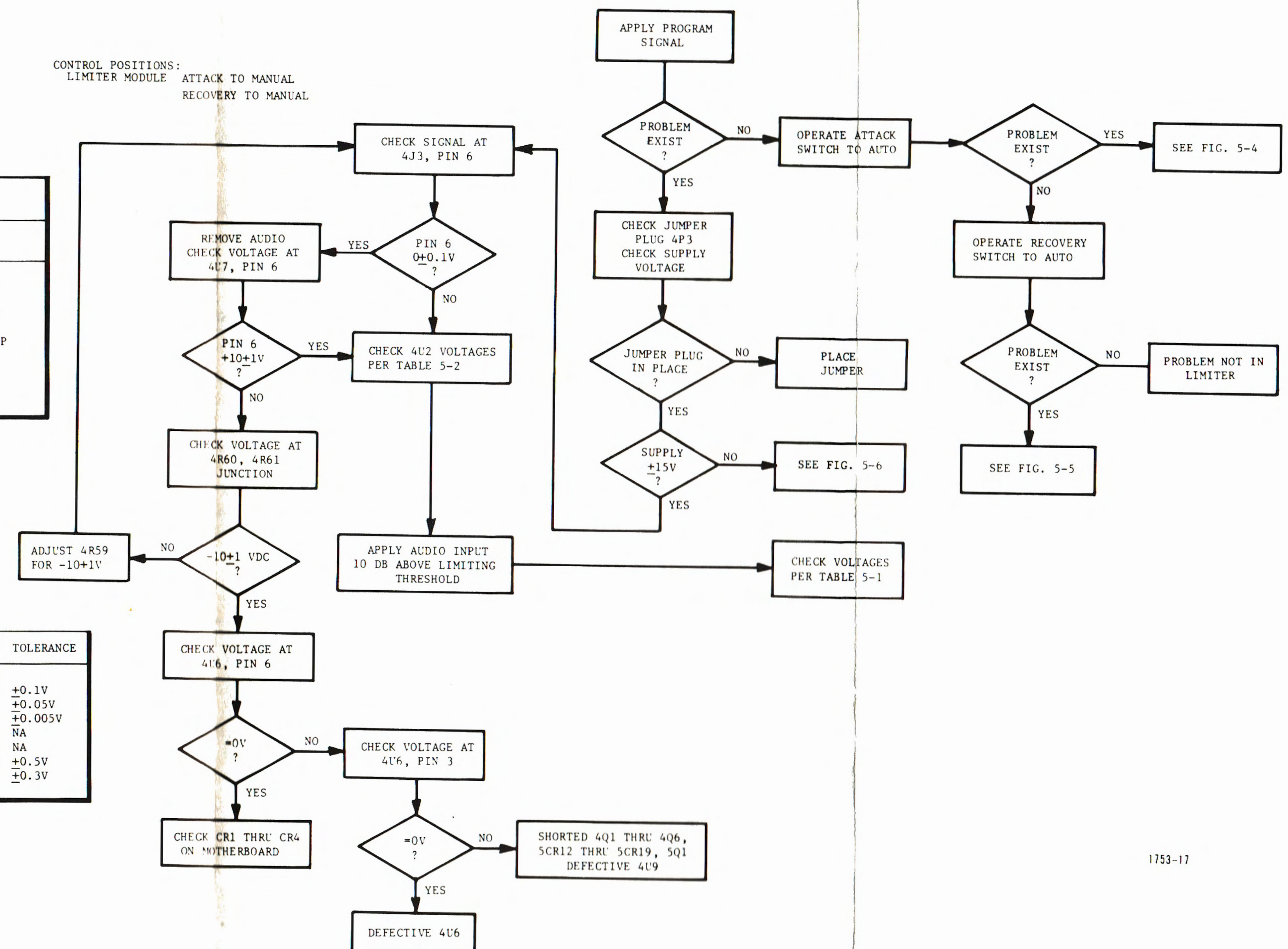
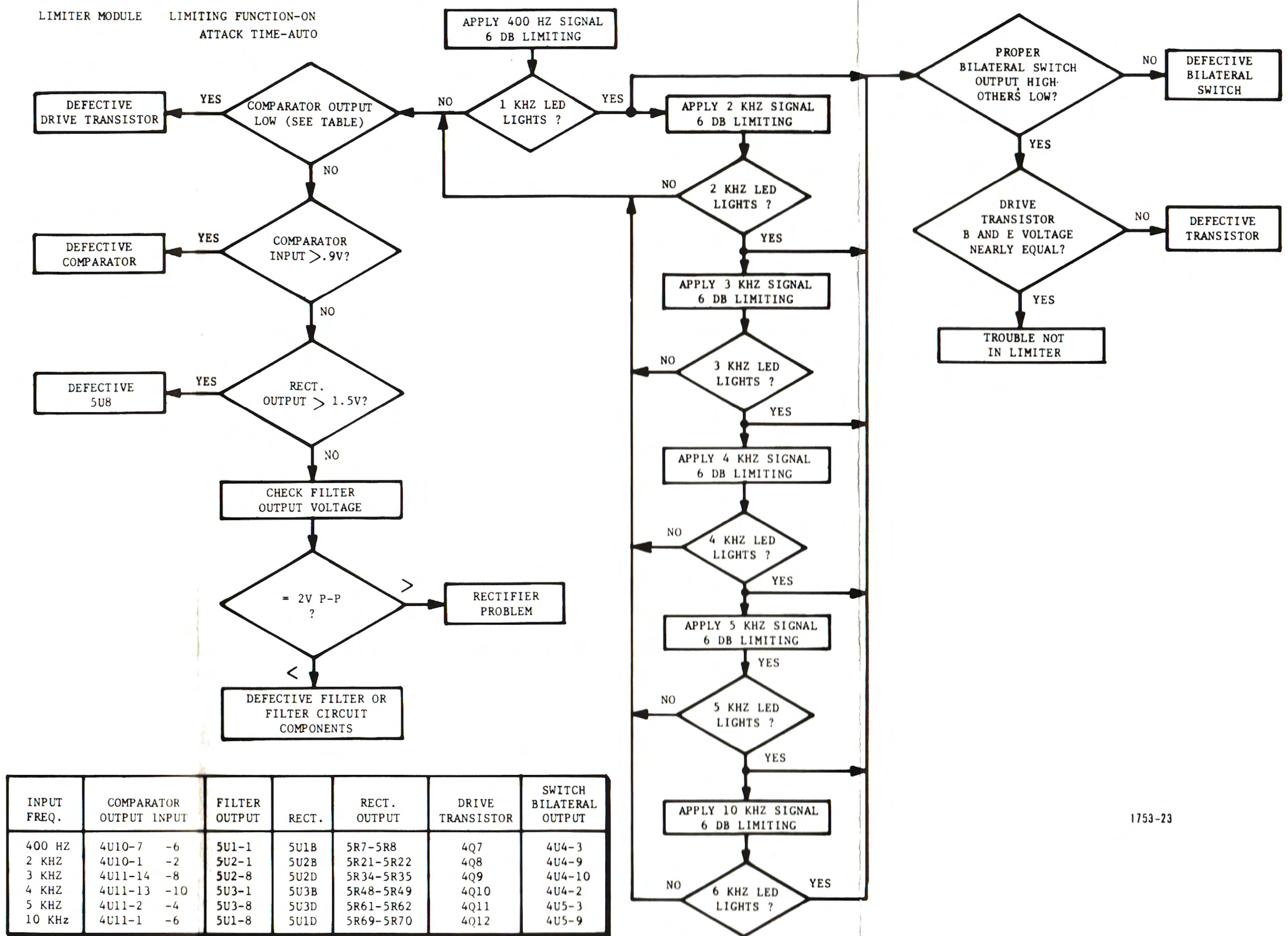


FIGURE 5-4.
LIMITER MODULE
FAULT ISOLATION

CONTROL POSITIONS:

LIMITER MODULE LIMITING FUNCTION-ON
ATTACK TIME-AUTO



INPUT FREQ.	COMPARATOR OUTPUT	COMPARATOR INPUT	FILTER OUTPUT	RECT.	RECT. OUTPUT	DRIVE TRANSISTOR	SWITCH BILATERAL OUTPUT
400 HZ	4U10-7	-6	5U1-1	5U1B	5R7-5R8	4Q7	4U4-3
2 KHZ	4U10-1	-2	5U2-1	5U2B	5R21-5R22	4Q8	4U4-9
3 KHZ	4U11-14	-8	5U2-8	5U2D	5R34-5R35	4Q9	4U4-10
4 KHZ	4U11-13	-10	5U3-1	5U3B	5R48-5R49	4Q10	4U4-2
5 KHZ	4U11-2	-4	5U3-8	5U3D	5R61-5R62	4Q11	4U5-3
10 KHz	4U11-1	-6	5U1-8	5U1D	5R69-5R70	4Q12	4U5-9

FIGURE 5-5.
AUTO ATTACK
TROUBLESHOOTING CHART

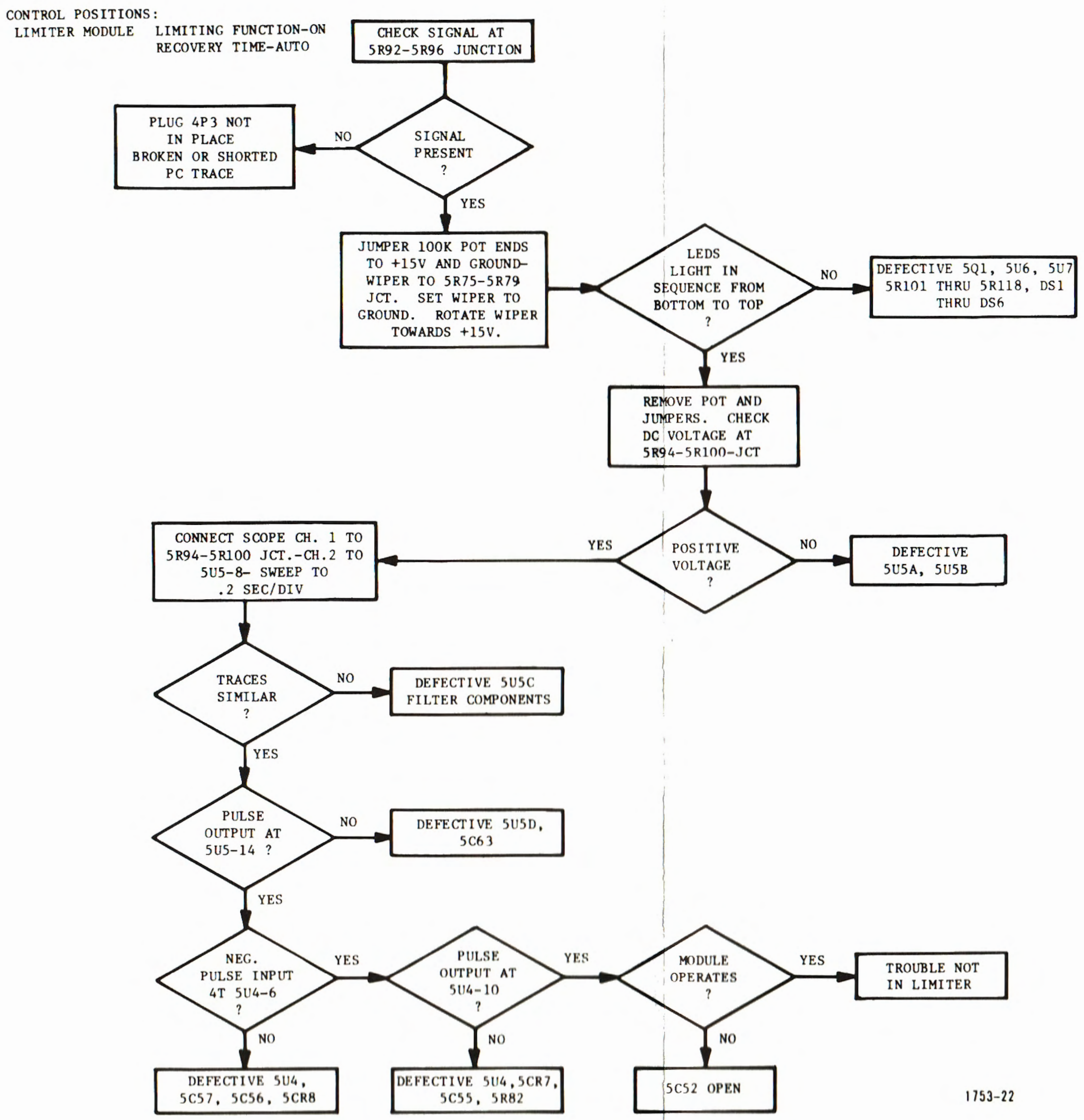


FIGURE 5-6.
AUTO RECOVERY
TROUBLESHOOTING CHART

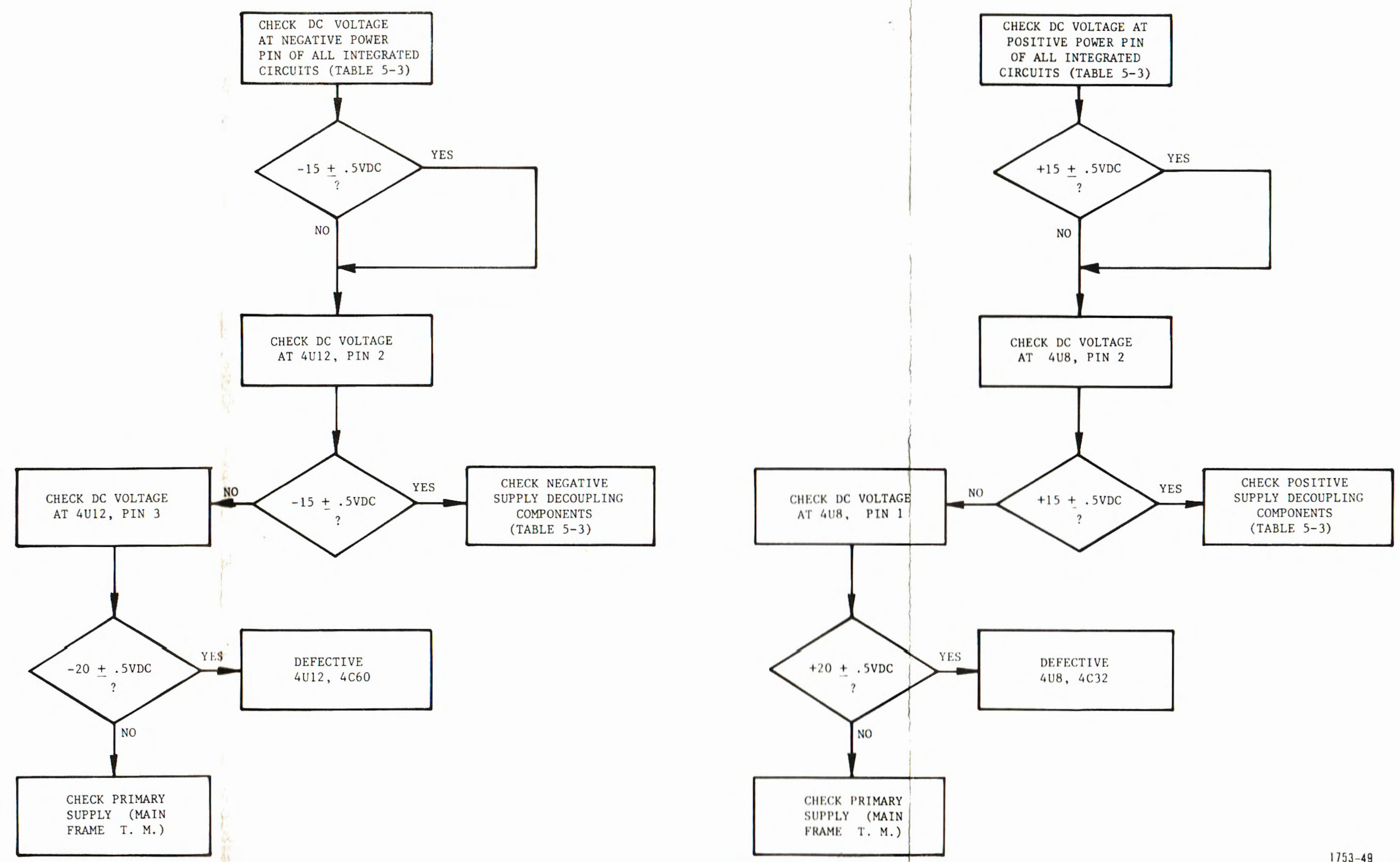


Table 5-3. Power Supply Decoupling Network

DEVICE	POSITIVE SUPPLY +15 ±0.6 VDC		NEGATIVE SUPPLY -15 ±0.6 VDC	
	PIN	COMPONENTS	PIN	COMPONENTS
4U1	7	4R9, 4C5, 4C6, 4C7, 4C2	4	4R15, 4C4, 4C10, 4C11, 4C12
4U2	1	4R9, 4C5, 4C6, 4C7	7	4R15, 4C10, 4C11, 4C12
4U3	7	4R9, 4C5, 4C6, 4C7, 4C14	4	4R15, 4C10, 4C11, 4C12, 4C17
4U4	14	(+8V) 4R22, 4C18	7	(-8V) 4R23, 4C19
4U5	14	(+8V) 4R89, 4C50	7	(-8V) 4R42, 4C51
4U6	7,8	4R57, 4C23, 4C24, 4C25	4	4R58, 4C26, 4C27, 4C28
4U7	7,8	4R57, 4C30	4	4R58, 4C31
4U8	1	4R67, 4C32		
4U9	4	4R73, 4C34, 4C36, 4C38	11	4R75, 4C39, 4C40, 4C41
4U10	8	4R90, 4C54	4	4R121, 4C55, 4C58
4U11	3	4R90, 4C56	12	4R121, 4C57, 4C59
4U12			3	4R125, 4C60
5U1	4	5R3, 5C4, 5C5, 5C6	11	5R4, 5C7, 5C8, 5C9
5U2	4	5R14, 5C14, 5C15, 5C16	11	5R15, 5C17, 5C18, 5C19
5U3	4	5R41, 5C28, 5C29, 5C30	11	5R42, 5C31, 5C32, 5C33
5U4	14	5C54		
5U5	4	5R95, 5C66, 6C67, 6C68	11	5R99, 5C72, 5C73, 5C74
5U6	3	5C119		
5U7	3	5C77		

FIGURE 5-7.
LIMITER MODULE POWER SUPPLY
TROUBLESHOOTING CHART

SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. Table 6-1 lists the replaceable parts, description and Harris part number for the Limiter Module. Table 6-2 lists the replaceable parts reference designator, description and part number for the lower printed circuit board (reference designator prefix: 4), and table 6-3 contains the same information for the upper printed circuit board (reference designator prefix: 5).

6-3. REPLACEABLE PARTS SERVICE

6-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Service Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

6-5. TECHNICAL ASSISTANCE.

6-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Department during normal working hours. Emergency technical service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301. The Harris factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

Table 6-1. Limiter Module - 994 7975 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	992 4952 001	Limiter (Lower PC Board) (Refer to table 6-2)	1
	992 4952 002	Limiter (Upper PC Board) (Refer to table 6-3)	1
	598 0342 000	Toggle Boot, Red	1
	598 0341 000	Toggle Boot, Black	1
	598 0343 000	Toggle Boot, Green	2

1753 400

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Limiter Module Lower Printed Circuit Board
(Reference Designator Prefix: 4) - 992 4952 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	500 0759 000	Capacitor, 100 pF, 500V	1
C2	516 0375 000	Capacitor, 0.01 mF, 50V	1
C3	500 0759 000	Capacitor, 100 pF, 500V	1
C4,C5,C6	516 0375 000	Capacitor, 0.01 mF, 50V	3
C7	526 0048 000	Capacitor, 10 mF, 20V	1
C8,C9	500 0759 000	Capacitor, 100 pF, 500V	2
C10	516 0375 000	Capacitor, 0.01 mF, 50V	1
C11	526 0048 000	Capacitor, 10 mF, 20V	1
C12	516 0375 000	Capacitor, 0.01 mF, 50V	1
C13	500 0759 000	Capacitor, 100 pF, 500V	1
C14	516 0375 000	Capacitor, 0.01 mF, 50V	1
C15	500 0804 000	Capacitor, 10 pF, 500V	1
C17	516 0375 000	Capacitor, 0.01 mF, 50V	1
C18,C19	526 0050 000	Capacitor, 1 mF, 35V	2
C20	500 0759 000	Capacitor, 100 pF, 500V	1
C21	500 0802 000	Capacitor, 3 pF, 500V	1
C22	522 0391 000	Capacitor, 1000 mF, 16V	1
C23	516 0375 000	Capacitor, 0.01 mF, 50V	1
C24	526 0048 000	Capacitor, 10 mF, 20V	1
C25	516 0375 000	Capacitor, 0.01 mF, 50V	1
C26	526 0048 000	Capacitor, 10 mF, 20V	1
C27,C28	516 0375 000	Capacitor, 0.01 mF, 50V	2

1753 400

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Limiter Module Lower Printed Circuit Board
(Reference Designator Prefix: 4) - 992 4952 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C29	500 0759 000	Capacitor, 100 pF, 500V	1
C30,C31	516 0375 000	Capacitor, 0.01 mF, 50V	2
C32	526 0050 000	Capacitor, 1 mF, 35V	1
C33,C34	526 0048 000	Capacitor, 10 mF, 20V	2
C35	500 0806 000	Capacitor, 15 pF, 500V	1
C36	516 0375 000	Capacitor, 0.01 mF, 50V	1
C37	500 0759 000	Capacitor, 100 pF, 500V	1
C38,C39	516 0375 000	Capacitor, 0.01 mF, 50V	2
C40	526 0048 000	Capacitor, 10 mF, 20V	1
C41	516 0375 000	Capacitor, 0.01 mF, 50V	1
C42	526 0101 000	Capacitor, 47 mF, 6V	1
C43	500 0759 000	Capacitor, 100 pF, 500V	1
C44	500 0806 000	Capacitor, 15 pF, 500V	1
C45	500 0759 000	Capacitor, 100 pF, 500V	1
C46,C47	500 0806 000	Capacitor, 15 pF, 500V	2
C48	500 0759 000	Capacitor, 100 pF, 500V	1
C49	526 0101 000	Capacitor, 47 mF, 6V	1
C50,C51	526 0050 000	Capacitor, 1 mF, 35V	2
C52	516 0375 000	Capacitor, 0.01 mF, 50V	1
C53	526 0048 000	Capacitor, 10 mF, 20V	1
C54,C55,C56,C57	516 0375 000	Capacitor, 0.01 mF, 50V	4
C58	526 0048 000	Capacitor, 10 mF, 20V	1
C59	516 0375 000	Capacitor, 0.01 mF, 50V	1

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Limiter Module Lower Printed Circuit Board
(Reference Designator Prefix: 4) - 992 4952 001 (Continued

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C60,C61	526 0050 000	Capacitor, 1 mF, 35V	2
C62	526 0049 000	Capacitor, 6.8 uF, 35V	1
C63	500 0806 000	Capacitor, 15 pF, 500V	1
CR1,CR2	384 0205 000	Diode, 1N914	2
CR4,CR6,CR7,CR8, CR9,CR10	384 0205 000	Diode, 1N914	6
CR11	386 0186 000	Diode, 1N4737A	1
DS1 thru DS6	384 0661 000	Diode, Light Emitting	6
J1 thru J8	612 0904 000	Jack PC MT For .040 Pins	8
P2,P3	610 0679 000	Plug	2
Q1,Q2,Q3,Q4,Q5, Q6	380 0111 000	Transistor, 2N3417	6
Q7,Q8,Q9,Q10,Q11, Q12	380 0112 000	Transistor, 2N5087	6
R1	548 0278 000	Resistor, 200 ohm, 1/4W, 1%	1
R2	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R3	540 1213 000	Resistor, 330k ohm, 1/2W, 5%	1
R4	548 1352 000	Resistor, 825 ohm, 1/4W, 1%	1
R5	550 0813 000	Potentiometer, 2k ohm	1
R6	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R7	548 0312 000	Resistor, 3.01k ohm, 1/4W, 1%	1
R8	540 1115 000	Resistor, 470 ohm, 1/2W, 5%	1
R9	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R10	540 1165 000	Resistor, 3.3k ohm, 1/2W, 5%	1
R11,R12	548 0312 000	Resistor, 3.01k ohm, 1/4W, 1%	2
R13	540 1115 000	Resistor, 470 ohm, 1/2W, 5%	1

Table 6-2. Limiter Module Lower Printed Circuit Board
(Reference Designator Prefix: 4) - 992 4952 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R14	540 1114 000	Resistor, 4.7k ohm, 1/2W, 5%	1
R15	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R16,R17	550 0797 000	Potentiometer, 50k ohm	2
R18	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R19	550 0626 000	Potentiometer, 10k ohm	1
R20	548 0334 000	Resistor, 24.3k ohm, 1/4W, 1%	1
R21	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R22,R23	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R24	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R25	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R26	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R27	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R28	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R29	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R30	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R31	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R32	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R33	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R34	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R35	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R36	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R37	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R38	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R39	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1

1753 400

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Limiter Module Lower Printed Circuit Board
(Reference Designator Prefix: 4) - 992 4952 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R40	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R41	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R42	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R43 thru R48	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	6
R49	540 1179 000	Resistor, 36k ohm, 1/2W, 5%	1
R50	540 1205 000	Resistor, 1.2k ohm, 1/2W, 5%	1
R51	540 1164 000	Resistor, 390 ohm, 1/2W, 5%	1
R52	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R53	540 1224 000	Resistor, 39 ohm, 1/2W, 5%	1
R54	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R55	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R56	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R57,R58	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R59	550 0623 000	Potentiometer, 5k ohm, (Spectrol 63P)	1
R60	548 0324 000	Resistor, 2610 ohm, 1/4W, 1%	1
R61	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R63	548 0932 000	Resistork 100k ohm, 1/4W, 1%	1
R64	540 1109 000	Resistor, 33k ohm, 1/2W, 5%	1
R65,R66	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	2
R67	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R68,R69,R70	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	3
R71	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1

1753 400

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Limiter Module Lower Printed Circuit Board
(Reference Desigantor Prefix: 4) - 992 4952 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R72	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R73	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R74	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R75	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R76	540 1195 000	Resistor, 16k ohm, 1/2W, 5%	1
R77	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	1
R78	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R79	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R80	548 0313 000	Resistor, 4990 ohm, 1/4W, 1%	1
R81	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R82	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R83	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R84	548 1355 000	Resistor, 4020 ohm, 1/4W. 1%	1
R85	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R86	540 1165 000	Resistor, 3.3k ohm, 1/2W, 5%	1
R87	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R88	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R89	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R90	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R91	540 1145 000	Resistor, 6.8k ohm, 1/2W, 5%	1
R92	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R93,R94	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R95	540 1105 000	Resistor, 5100 ohm, 1/2W, 5%	1
R96,R97	540 1159 000	Resistor, 100k ohm, 1/2 W, 5%	2

1753 400

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Limiter Module Lower Printed Circuit Board
(Reference Designator Prefix: 4) - 002 4952 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R98,R99	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	2
R100	540 1105 000	Resistor, 5100 ohm, 1/2W, 5%	1
R101,R102	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	2
R103,R104	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	2
R105	540 1105 000	Resistor, 5100 ohm, 1/2W, 5%	1
R106,R107	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	2
R108,R109	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	2
R110	540 1105 000	Resistor, 5100 ohm, 1/2W, 5%	1
R111,R112	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	2
R113,R114	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	2
R115	540 1105 000	Resistor, 5100 ohm, 1/2W, 5%	1
R116,R117	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	2
R118	540 1127 000	Resistor, 820 ohm, 1/2W, 5%	1
R119,R120	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	2
R121	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R122	540 1105 000	Resistor, 5100 ohm, 1/2W, 5%	1
R124	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R125	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R126	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R127	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R128	550 0623 000	Potentiometer, 5k ohm, (Spectrol 63P)	1
R129	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	1

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Limiter Module Lower Printed Circuit Board
(Reference Designator Prefix: 4) - 992 4952 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R130	550 0623 000	Potentiometer, 5k ohm, (Spectrol 63P)	1
R131	540 1195 000	Resistor, 16k ohm, 1/2W, 5%	1
R132	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
S1	604 0856 000	Switch, SPDT	1
S2	604 0854 000	Switch, DPDT	1
U1	382 0219 000	Integrated Circuit, NE531V	1
U2	382 0480 000	Integrated Circuit, MC1595L	1
U3	382 0549 000	Integrated Circuit, LF356N	1
U4,U5	382 0523 000	Integrated Circuit, MC4066B	2
U6,U7	382 0549 000	Integrated Circuit, LF356N	2
U8	382 0359 000	Integrated Circuit, MC7815CP	1
U9	382 0519 000	Integrated Circuit, TL084CN	1
U10	382 0522 000	Integrated Circuit, LM393N	1
U11	382 0521 000	Integrated Circuit, LM339A	1
U12	382 0360 000	Integrated Circuit, MC7915CP	1
U13	382 0273 000	Integrated Circuitm MC7808CP	1
U14	392 0385 000	Integrated Circuit, MC7908CP	1
XU1	404 0504 000	Socket, IC, 8 Pin	1
XU2	404 0505 000	Socket, IC, 14 Pin	1
XU3	404 0504 000	Socket, IC, 8 Pin	1
XU4,XU5	404 0505 000	Socket, IC, 14 Pin	2
XU6,XU7	404 0504 000	Socket, IC, 8 Pin	2

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Limiter Module Lower Printed Circuit Board (Reference Designator Prefix: 4) - 992 4952 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
XU9	404 0505 000	Integrated Circuit, 14 Pin	1
XU10	404 0504 000	Integrated Circuit, 8 Pin	1
XU11	404 0505 000	Integrated Circuit, 14 Pin	1
	843 1925 001	Printed Circuit Board	1

1753 400

WARNING: Disconnect primary power prior to servicing.

Table 6-3. Limiter Module Upper Printed Circuit Board
(Reference Designator Prefix: 5) - 994 4952 002

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	500 0781 000	Capacitor, 2200 pF, 500V, 1%	1
C2	500 0759 000	Capacitor, 100 pF, 500V	1
C3	500 0779 000	Capacitor, 1100 pF, 500V, 1%	1
C4	516 0375 000	Capacitor, 0.01 mF, 50V	1
C5	526 0048 000	Capacitor, 10 mF, 20V	1
C6,C7	516 0375 000	Capacitor, 0.01 mF, 50V	2
C8	526 0048 000	Capacitor, 10 mF, 20V	1
C9	516 0375 000	Capacitor, 0.01 mF, 50V	1
C10	500 0759 000	Capacitor, 100 pF, 500V	1
C11,C12	500 0898 000	Capacitor, 3000 pF, 300V, 2%	2
C13	500 0759 000	Capacitor, 100 pF, 500V	1
C14	516 0375 000	Capacitor, 0.01 mF, 50V	1
C15	526 0048 000	Capacitor, 10 mF, 20V	1
C16,C17	516 0375 000	Capacitor, 0.01 mF, 50V	2
C18	526 0048 000	Capacitor, 10 mF, 20V	1
C19	516 0375 000	Capacitor, 0.01 mF, 50V	1
C20	500 0759 000	Capacitor, 100 pF, 500V	1
C21,C22	500 0898 000	Capacitor, 3000 pF, 300V, 2%	2
C23,C24	500 0759 000	Capacitor, 100 pF, 500V	2
C25,C26	500 0898 000	Capacitor, 3000 pF, 300V, 2%	2
C27	500 0759 000	Capacitor, 100 pF, 500V	1
C28	516 0375 000	Capacitor, 0.01 mF, 50V	1
C29	526 0048 000	Capacitor, 10 mF, 20V	1

WARNING: Disconnect primary power prior to servicing.

Table 6-3. Limiter Module Upper Printed Circuit Board (Reference Designator Prefix: 5) - 992 4952 002 (Conintued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C30,C31	516 0375 000	Capacitor, 0.01 mF, 50V	2
C32	526 0048 000	Capacitor, 10 mF, 20V	1
C33	516 0375 000	Capacitor, 0.01 mF, 50V	1
C34	500 0759 000	Capacitor, 100 pF, 500V	1
C35,C36	500 0898 000	Capacitor, 3000 pF, 300V, 2%	2
C37,C38	500 0759 000	Capacitor, 100 pF, 500V	2
C39	500 0784 000	Capacitor, 300 pF, 500V	1
C40	500 0911 000	Capacitor, 750 pF, 500V	1
C41,C42	500 0759 000	Capacitor, 100 pF, 500V	2
C43 thru C48	526 0050 000	Capacitor, 1 mF, 35V	6
C49,C50	526 0048 000	Capacitor, 10 mF, 20V	2
C51	526 0316 000	Capacitor, .47 mF, 35V	1
C52	526 0048 000	Capacitor, 10 mF, 20V	1
C53,C54	516 0375 000	Capacitor, 0.01 mF, 50V	2
C55	526 0316 000	Capacitor, .47 mF, 35V	1
C56,C57	516 0375 000	Capacitor, 0.01 mF, 50V	2
C58	526 0353 000	Capacitor, .39 mF, 35V	1
C59	526 0050 000	Capacitor, 1 mF, 35V	1
C60	500 0759 000	Capacitor, 100 pF, 500V	1
C61	508 0367 000	Capacitor, .056 mF, 100V	1
C62	500 0812 000	Capacitor, 30 pF, 500V	1
C63	526 0048 000	Capacitor, 10 mF, 20V	1
C64	500 0759 000	Capacitor, 100 pF, 500V	1

WARNING: Disconnect primary power prior to servicing.

Table 6-3. Limiter Module Upper Printed Circuit Board
(Reference Designator Prefix: 5) - 992 4952 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C65	500 0852 000	Capacitor, 1000 pF	1
C66	516 0375 000	Capacitor, 0.01 mF, 50V	1
C67	526 0048 000	Capacitor, 10 mF, 20V	1
C68	516 0375 000	Capacitor, 0.01 mF, 50V	1
C69	500 0840 000	Capacitor, 680 pF	1
C70	500 0759 000	Capacitor, 100 pF, 500V	1
C71	526 0048 000	Capacitor, 10 mF, 20V	1
C72	516 0375 000	Capacitor, 0.01 mF, 50V	1
C73	526 0048 000	Capacitor, 10 mF, 20V	1
C74,C75	516 0375 000	Capacitor, 0.01 mF, 50V	2
C76	526 0048 000	Capacitor, 10 mF, 20V	1
C77	516 0375 000	Capacitor, 0.01 mF, 50V	1
CR1 thru CR19	384 0205 000	Diode, 1N914	19
DS1	384 0662 000	Diode, Light Emitting, Red	1
DS2,DS3	394 0664 000	Diode, Light Emitting, Yellow	2
DS4 thru DS8	384 0661 000	Diode, Light Emitting, Green	5
J1	610 0749 000	Connector, 34 Pin Plug	1
Q1	380 0319 000	Transistor, MPS-A14	1
R1	548 0432 000	Resistor, 100k ohm, 1/4W, 1%	1
R2	548 1370 000	Resistor, 105k ohm, 1/4W, 1%	1
R3,R4	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R5	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R6	540 1112 000	Resistor, 510 ohm, 1/2W, 5%	1

WARNING: Disconnect primary power prior to servicing.

Table 6-3. Limiter Module Upper Printed Circuit Board
(Reference Designator Prefix: 5) - 992 4952 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R7	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R8	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R9	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R10	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R11	548 1369 000	Resistor, 39.2k ohm, 1/4W, 1%	1
R12	548 0341 000	Resistor, 33.2k ohm, 1/4W, 1%	1
R13	548 1369 000	Resistor, 39.2k ohm, 1/4W, 1%	1
R14,R15	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R16	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R17	550 0625 000	Potentiometer, 500 ohm (Spectrol 63P)	1
R18	548 0414 000	Resistor, 8870 ohm, 1/4W, 1%	1
R19	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R20	540 1112 000	Resistor, 510 ohm, 1/2W, 5%	1
R21	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R22	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R23	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R24	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R25	548 1360 000	Resistor, 8450 ohm, 1/4W, 1%	1
R26	548 1367 000	Resistor, 26.1k ohm, 1/4W, 1%	1
R27	548 0366 000	Resistor, 22.1k ohm, 1/4W, 1%	1
R28	548 1367 000	Resistor, 26.1k ohm, 1/4W, 1%	1
R29	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1

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Table 6-3. Limiter Module Upper Printed Circuit Board
(Reference Designator Prefix: 5) - 992 4952 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R30	550 0625 000	Potentiometer, 500 ohm, (Spectrol 63P)	1
R31	548 0414 000	Resistor, 8870 ohm, 1/4W, 1%	1
R32	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R33	540 1112 000	Resistor, 510 ohm, 1/2W, 5%	1
R34	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R35	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R36	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R37	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R38	548 1366 000	Resistor, 19.6k ohm, 1/4W, 1%	1
R39	548 1364 000	Resistor, 16.2k ohm, 1/4W, 1%	1
R40	548 1366 000	Resistor, 19.6k ohm, 1/4W, 1%	1
R41,R42	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R43	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R44	550 0625 000	Potentiometer, 500 ohm, (Spectrol 63P)	1
R45	548 0414 000	Resistor, 8870 ohm, 1/4W, 1%	1
R46	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R47	540 1112 000	Resistor, 510 ohm, 1/2W, 5%	1
R48	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R49	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R50	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R51	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R52	548 0318 000	Resistor, 1k ohm, 1/4W, 5%	1

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Table 6-3. Limiter Module Upper Printed Circuit Board (Reference Designator Prefix: 5) - 992 4952 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R53	548 1363 000	Resistor, 15.8k ohm, 1/4W, 1%	1
R54	548 1362 000	Resistor, 13.3k ohm, 1/4W, 1%	1
R55	548 1363 000	Resistor, 15.8k ohm, 1/4W, 1%	1
R56	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R57	550 0625 000	Potentiometer, 500 ohm, (Spectrol 63P)	1
R58	548 0414 000	Resistor, 8870 ohm, 1/4W, 1%	1
R59	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R60	540 1112 000	Resistor, 510 ohm, 1/2W, 5%	1
R61	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R62	540 1102 000	Resistor, 100 ohm, 1/4W, 5%	1
R63	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R64	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R65,R66	548 1370 000	Resistor, 105k ohm, 1/4W, 1%	2
R67	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R68	540 1112 000	Resistor, 510 ohm, 1/2W, 5%	1
R69	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R70	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R71	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R72	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R73	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R74	540 1322 000	Resistor, 1 Megohm, 1/2W, 5%	1
R75	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1

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Table 6-3. Limiter Module Upper Printed Circuit Board
(Reference Designator Prefix: 5) - 992 4952 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R76	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R78	540 1322 000	Resistor, 10 Megohm, 1/2W, 5%	1
R79	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R80	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R81	540 1198 000	Resistor, 470k ohm, 1/2W, 5%	1
R82	540 1249 000	Resistor, 68k ohm, 1/2W, 5%	1
R83	540 1198 000	Resistor, 470k ohm, 1/2W, 5%	1
R84,R85,R86	540 1250 000	Resistor, 180k ohm, 1/2W, 5%	3
R87	540 1328 000	Resistor, 560k ohm, 1/2W, 5%	1
R88,R89	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	2
R90	540 1319 000	Resistor, 510k ohm, 1/2W, 5%	1
R91	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R92	540 1145 000	Resistor, 6800 ohm, 1/2W, 5%	1
R93	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R94	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R95	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R96	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R97	548 0416 000	Resistor, 30.1k ohm, 1/4W, 1%	1
R98	540 1154 000	Resistor, 7500 ohm, 1/2W, 5%	1
R99	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R100	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R101	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R102	540 1202 000	Resistor, 51k ohm, 1/2W, 5%	1

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Table 6-3. Limiter Module Upper Printed Circuit Board
(Reference Designator Prefix: 5) - 992 4952 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R103	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R104	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	1
R105	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R106	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	1
R107	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R108	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	1
R109	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R110	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	1
R111	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R112	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	1
R113	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R114	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	1
R115	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R116,R117	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	2
R118	540 1138 000	Resistor, 3k ohm, 1/2W, 5%	1
R119	540 1152 000	Resistor, 75k ohm, 1/2W, 5%	1
R120	540 1210 000	Resistor, 150k ohm, 1/2W, 5%	1
R121	540 1251 000	Resistor, 300k ohm, 1/2W, 5%	1
R122	540 1324 000	Resistor, 620k ohm, 1/2W, 5%	1
R123	540 1325 000	Resistor, 1.2 Megohm, 1/2W, 5%	1
R124	540 1326 000	Resistor, 2.4 Megohm, 1/2W, 5%	1
R125	540 1320 000	Resistor, 5.1 Megohm, 1/2W, 5%	1
R126	540 1322 000	Resistor, 10 Megohm, 1/2W, 5%	1

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Table 6-3. Limiter Module Upper Printed Circuit Board
(Reference Designator Prefix: 5) - 992 4952 002 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R127 thru R134	540 1156 000	Resistor, 2700 ohm, 1/2W, 5%	8
S1,S2	604 0856 000	Switch, SPDT	2
U1,U2,U3	382 0450 000	Integrated Circuit, HA1-4741-5	3
U4	382 0404 000	Integrated Circuit, CD4047A	1
U5	392 0450 000	Integrated Circuit, HA1-4741-5	1
U6,U7	382 0521 000	Integrated Circuit, LM339A	2
U8	382 0530 000	Integrated Circuit, CA3082	1
XU1 thru XU7	404 0505 000	Socket, Integrated Circuit, 14 Pin	7
XU8	404 0506 000	Socket, Integrated Circuit, 16 Pin	1
	843 1924 000	Printed Circuit Board	1

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FM PROTECTION MODULE
888 1753 500

TECHNICAL MANUAL

FM PROTECTION MODULE

994 7977 001

HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1753 500

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SAFETY NOTICE

WARNING: THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND UNDER CERTAIN CONDITIONS, COULD BE FATAL.

This manual is intended as general guidance for trained and qualified installation, operating, maintenance and service personnel who are familiar with and aware of the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

THE INSTALLATION, OPERATION, MAINTENANCE AND SERVICING OF THIS EQUIPMENT INVOLVES RISKS TO BOTH PERSONNEL AND EQUIPMENT, AND MUST BE PERFORMED ONLY BY PROPERLY TRAINED AND EXPERIENCED PERSONNEL EXERCISING DUE CARE. PERSONNEL MUST FAMILIARIZE THEMSELVES WITH SAFETY REQUIREMENTS, SAFE HANDLING AND OPERATING PRACTICE, AND RELATED FIRST-AID PROCEDURES (E.G., FOR ELECTRICAL BURNS AND ELECTRICAL SHOCK).

HARRIS CORPORATION Broadcast Equipment Division shall not be responsible for injury or damage resulting from improper installation, operation, maintenance or servicing, or from the use of improperly trained or inexperienced personnel in the performance of such tasks, or from the failure of persons engaged in such tasks to exercise due care.

As with all electronic equipment, care should be taken to avoid electrical shock in all circuits where substantial currents or voltages may be present, either through design or short circuit. Caution should also be observed in lifting and hoisting equipment, especially regarding large structures, during installation.

LIABILITY LIMITATION

The procedures outlined in this Manual are based on the information available at the time of publication and should permit the specified use with minimum risk. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

The manufacturer is specifically not liable for any damage or injury arising out of failure to follow the instructions in this Manual or failure to exercise due care and caution during installation, operation, maintenance and service of this equipment.

CAUTIONARY NOTICE

Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

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SECTION I

GENERAL DESCRIPTION

1-1. EQUIPMENT PURPOSE.

1-2. There are two protection modules (left and right) in the Audio Processor System which are identical. Circuits within the module limit the amplitude of the high frequency components of the program signal to prevent instantaneous overmodulation of the transmitter due to preemphasis. Provisions for preemphasis and deemphasis curve selection are also included.

1-3. TECHNICAL CHARACTERISTICS.

1-4. Table 1-1 lists the technical characteristics of the module.

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Table 1-1. Electrical Characteristics

FUNCTION	CHARACTERISTIC
Input Signal Level	5.3 volts peak
Type of Protection	Clipping or low distortion limiting in the high frequency band followed by a broadband clipper.
Frequency Bands	Two, with crossover at 450 Hz.
High Frequency Limiting Ratio	50:1
Clipping Level (High Frequency and Broadband)	Adjustable by controls on the PC board.
Distortion	Adjustable. Controlled by HIGH FREQUENCY MODE/SOFT/HARD control on the front panel.
Output Signal Level	0.71 volt RMS, 2V p-p
Power	Internal, ±15 vdc, regulated. ±20 vdc supplied from main frame primary power supply.
Noise	70 dB below 2V p-p output over a 20 Hz to 20 kHz bandwidth.
Frequency Response	±0.5 dB, 20 Hz to 20 kHz below control/clipping thresholds.

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SECTION II

INSTALLATION

2-1. GENERAL.

2-2. Installation of the protection module is covered in Technical Manual 888 1753 001, MSP 100 Audio Processor, Volume I, Section II, Installation.

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SECTION III

CONTROLS AND INDICATORS

3-1. GENERAL.

3-2. Figure 3-1 shows all of the user controls and indicators provided on the protection module, and table 3-1 describes the function of each and its affect on module operation.

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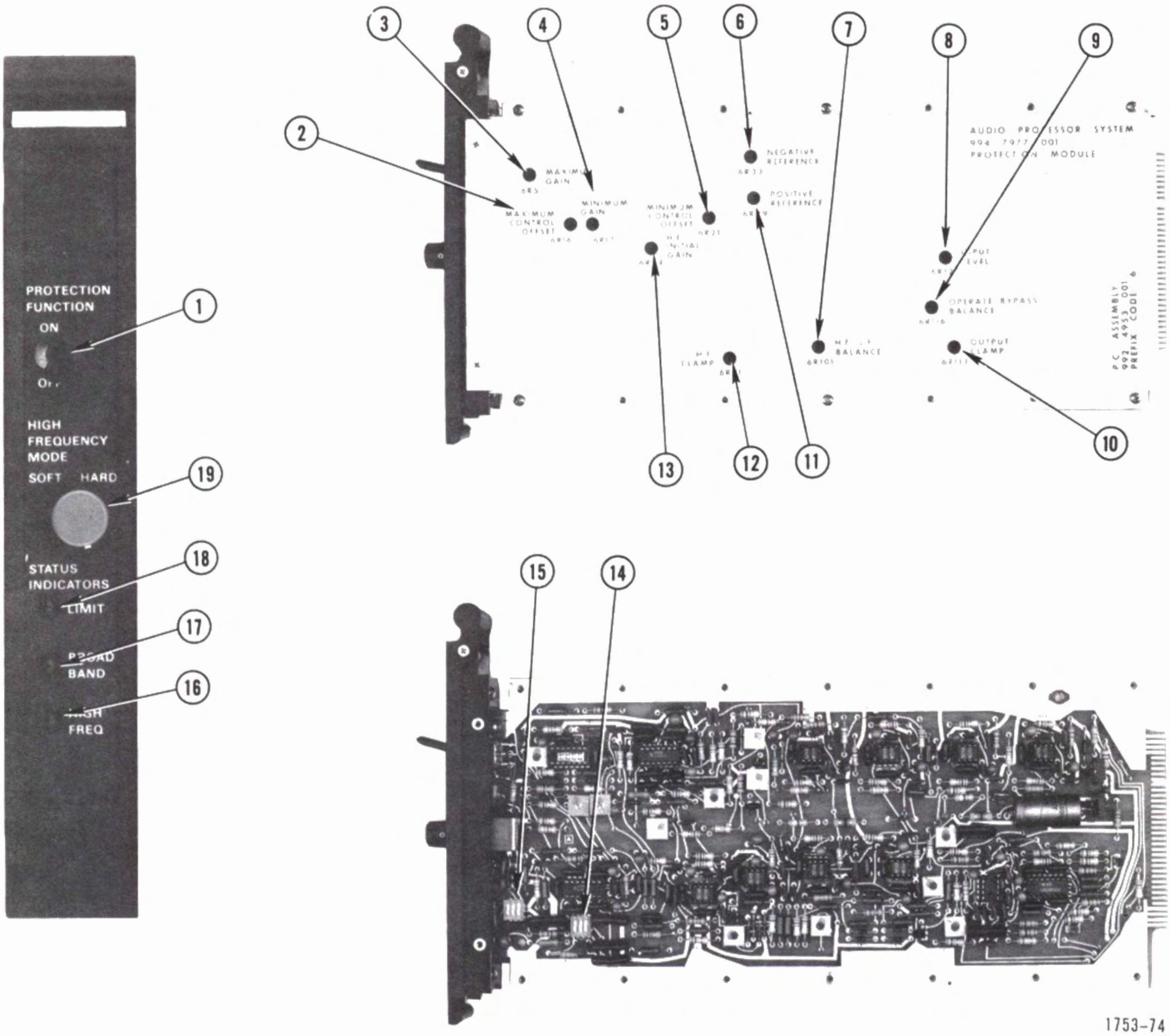

Figure 3-1. FM Protection Module Controls and Indicators

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Table 3-1. FM Protection Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	PROTECTION FUNCTION ON/OFF, 6S2	ON Position: Limits audio components to prevent instantaneous overmodulation due preemphasis of high frequencies. OFF Position: Bypasses the protection circuitry.
2	MAXIMUM CONTROL OFFSET, 6R16	Adjusts dc output offset of the 4-quadrant multiplier with 10 vdc control voltage input.
3	MAXIMUM GAIN, 6R5	Adjusts maximum gain of the 4-quadrant multiplier.
4	MINIMUM GAIN, 6R17	Trims the 4-quadrant multiplier gain with 0.625 vdc control voltage input.
5	MINIMUM CONTROL OFFSET, 6R21	Adjusts dc output offset of multiplier buffer to zero with 0.625 vdc control voltage input.
6	NEGATIVE REFERENCE, 6R33	Adjusts the negative reference voltage to balance the detector circuit for symmetrical limiting.
7	H.F./L.F. BALANCE, 6R101	Adjusts the relative proportions of high and low frequencies in output.
8	INPUT LEVEL, 6R127	Adjusts the signal input level.
9	OPERATE/BYPASS BALANCE, 6R116	Adjusts the output signal to 1 volt peak in either the protection or bypass mode.
10	OUTPUT CLAMP, 6R113	Adjusts the output level at which signal clipping begins.
11	POSITIVE REFERENCE, 6R29	Adjusts the positive reference voltage to balance the detector for symmetrical limiting.
12	H.F. CLAMP, 6R91	Adjusts the level at which high frequency clipping begins.

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Table 3-1. FM Protection Module Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
13	H.F. INITIAL GAIN, 6R64	Adjusts dc control voltage input to 4-quadrant multiplier to establish quiescent high frequency gain before clipping or limiting.
14	DE-EMPHASIS, 6S3	Determines the de-emphasis curve selected as follows: 6S3 SECTION CURVE: 1 / 2 / 3 Flat: Open / Open / Open 25 uSec: Closed / Open / Open 50 uSec: Closed / Closed / Open 75 uSec: Closed / Closed / Closed
15	PRE-EMPHASIS, 6S1	Determines the pre-emphasis curve selected as follows: 6S1 SECTION CURVE: 1 / 2 / 3 Flat: Open / Open / Open 25 uSec: Closed / Open / Open 50 uSec: Closed / Closed / Open 75 uSec: Closed / Closed / Closed
16	STATUS INDICATORS HIGH FREQ, 6DS1	LED, glows when high frequency clipping occurs.
17	BROADBAND, 6DS2	LED, glows when broadband clipping occurs.
18	LIMIT, 6DS3	LED, glows when limiting occurs.
19	HIGH FREQUENCY MODE/ SOFT/HARD, 6R96	Determines the proportions of high frequency limiting and clipping in the output. CCW (SOFT) provides the most limiting, least clipping, and least distortion. CW Rotation provides the most clipping and most distortion.

SECTION IV

PRINCIPLES OF OPERATION

4-1. CIRCUIT DESCRIPTION.

4-2. Signal input from the limiter module is routed to the protection circuits through INPUT LEVEL control 6R127 to a preemphasis network where 25, 50, or 75 microseconds preemphasis may be selected by switch 6S1. The signal is then split into two bands at 450 Hz by lowpass and high pass filters 6U7A and 6U7C. The high frequency band is applied to four-quadrant multiplier 6U1, where limiting takes place, and to a clamp circuit, 6U8, in parallel. HIGH FREQUENCY MODE control 6R96 is used to adjust or balance the amount of clipped signal and limited signal which are fed to summing amplifier 6U1D. The resultant high frequency signal (output of 6U10) is then summed with the low frequency signal through H.F./L.F. BALANCE control 6R101. A final broadband clamp circuit, 6U11, eliminates any peaks caused by summation that might result in overmodulation. PROTECTION FUNCTION switch 6S2 then selects either the protected signal or the unprotected signal and applies it to the deemphasis network and output amplifier, 6U7. For discussion purposes, the circuit is divided into four sections: band splitting, high frequency limiting, high frequency clipping, and broadband clipping, as shown in figure 4-1.

4-3. BAND SPLITTING SECTION.

4-4. The signal enters the module through INPUT LEVEL control 6R127 and attenuator 6R125 and 6R126 and is applied to 6U7D at a level of 1 volt peak. The ac gain of 6U7D established by 6R69, 6R68, and capacitors 6C62, 6C63, and 6C64. Each of the three capacitors provides 25 microseconds preemphasis; by adding them in parallel through switch 6S1, 25, 50, or 75 microseconds preemphasis can be selected. 6U7A and 6U7C work in combination to divide the signal into two bands at 450 Hz. At 450 Hz the impedance of 6C73 is equal to the resistance of 6R76 and the signal level is reduced to one half the output of 6U7D at the noninverting input of 6U7A. As frequency increases, 6C73 impedance decreases and less signal is fed to 6U7A. The output of 6U7A is subtracted from the broadband signal by 6U7C, whose output is the high frequency signal with 3 dB cutoff at 450 Hz. The output of 6U7C is ac coupled simultaneously through 6C78 to the high frequency limiter (6U1) and the high frequency clipping circuit (6U8). The output of 6U7A is ac coupled through 6C123 to summing amplifier 6U11.

4-5. HIGH,FREQUENCY LIMITING SECTION.

4-6. High frequency limiting is controlled by four-quadrant multiplier 6U1, which operates in the two-quadrant mode in the same manner as the AGC and limiter multipliers. Input to 6U1 is attenuated 17 dB by 6R1 and 6R2 to 1 volt peak maximum at 15 kHz to avoide overdriving the multiplier. Quiescent gain of the multiplier circuit, primarily determined by 6R23, is 27 dB. DC control voltage input to the multiplier is applied through voltage controlled current source 6U2D to the X input of 6U1. The

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input to 6U2D before limiting is +10 vdc. An increase in the high frequency signal level above the limiting threshold results in a decrease in dc control voltage and a corresponding decrease in multiplier gain. MINIMUM GAIN potentiometer 6R17 trims the gain of the circuit for small values of control voltage; MAXIMUM CONTROL OFFSET potentiometer adjusts dc output offset of the multiplier with +10 vdc control voltage; and MINIMUM CONTROL OFFSET potentiometer adjusts the output dc offset of buffer 6U2C to zero with 0 vdc control voltage. 6R9 and 6R10 are collector load resistors for the multiplier output circuit. The output of 6U1 is applied to differential amplifier 6U2C, which buffers the signal and feeds it to limiting peak detector and also to the high frequency clipping circuit where it is summed with the clipped signal.

4-6. PEAK DETECTOR CIRCUIT. The output of 6U2C is ac coupled through 6C120 to peak detector buffer 6U2A where it is amplified 20 dB. The peak detector circuit (6U3 and 6U5) is balanced for symmetrical clipping by voltage divider 6R29, 6R40, 6R43, and 6R33. Potentiometers 6R49 and 6R33 are adjusted to establish at +10 vdc reference at the inverting input of 6U3 and a -10 vdc reference at the inverting input of 6U5. This causes the 6U3 output to be -10 vdc and 6U5 output to be +10 vdc which cancel each other for a net voltage of zero at the junction of 6R40 and 6R43. Thus, any signal peak at the 6U3 input in excess of +1.3 volts will appear at the output as a positive pulse. Similarly, any signal peak at the input of 6U5 in excess of -1.3 volts will appear at the output as a negative pulse.

4-7. The pulses from 6U3 and 6U5 are applied to rectifiers 6U4 and 6U6. Positive pulses at the inverting input of 6U4 will drive the output negative and cut off Darlington transistor 6Q1; the same pulse at the noninverting input of 6U6 will drive its output positive and 6Q2 will conduct. For negative pulses, 6Q1 conducts and 6Q2 is cut off. 6R54 and 6R55 limit base current for 6Q1 and 6Q2, respectively; 6R56 is the collector load for both. The Darlington transistor in the feedback loop of each operational amplifier provides large current drive for charging 6C57 and also reduces emitter base voltage variations with collector voltage.

4-8. Capacitor 6C57 is charged by pulses from 6Q1 through 6CR4, 6L1, and 6R57, and by pulses from 6Q2 through 6CR6, 6L2, and 6R58. A 10.11 volt (0.1 dB) signal peak at the inputs of 6U3 and 6U5 will produce a 4.5 volt pulse across 6C57, resulting in a 50:1 limiting ratio. The discharge path for 6C57 is through 6R61, 6R63, and 6R64. 6R57 and 6R58 limit surge currents in the Darlingtons, and 6L1 and 6L2 minimize limiter control voltage overshoot.

4-9. The voltage across 6C57 is summed with -10 vdc from voltage divider 6R64, 6R63, and 6R61. With no limiting, the voltage across 6C57 is zero and the output of 6U2B is approximately +10 vdc. As limiting takes place, the voltage across 6C57 goes positive and the output of 6U2B decreases. Current (about 2.1 mA) through 6R65 establishes the quiescent control voltage of +10 vdc. As the output of 6U2B goes more negative, current through 6R65 increases and the control voltage through 6R19 to the multiplier gain controller drops.

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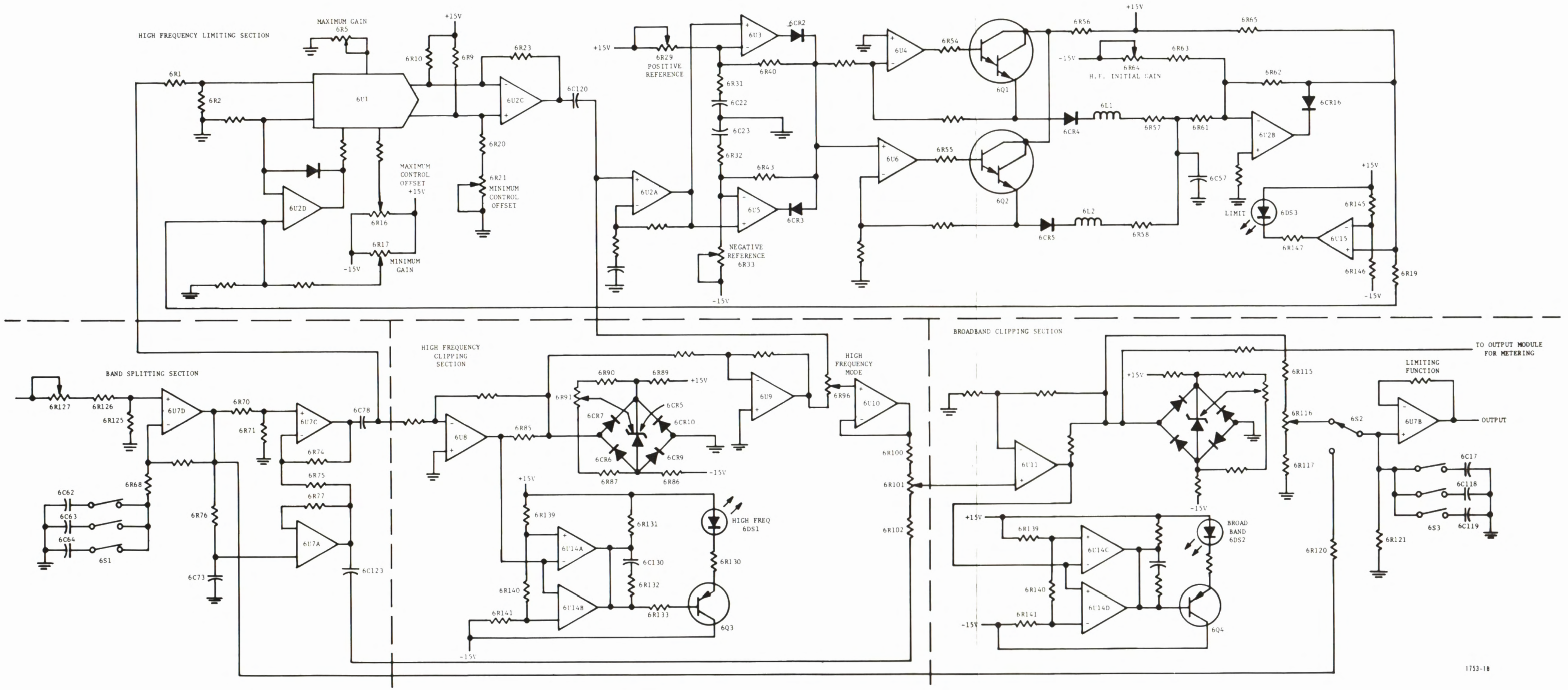


FIGURE 4-1.
FM PROTECTION MODULE
BLOCK DIAGRAM

4-10. LIMITING INDICATOR CIRCUIT. The noninverting input of comparator 6U15 is held at +10 vdc (in the absence of limiting) by the control voltage circuit. The inverting input is held at +9.35 vdc by divider 6R45, 6R46; therefore, in this condition, the output is high. Should the control voltage drop below +9.35 vdc, 6U15 output will switch to the low state and 6DS3 will conduct and glow, providing an indication that limiting is taking place.

4-11. HIGH FREQUENCY CLIPPING SECTION.

4-12. The high frequency signal is ac coupled to the clamp circuits through 6C78. The clamp circuit on the output of 6U8 accomplishes clipping. Diode 6CR8 is a programmable zener whose avalanch voltage is determined by the voltage applied to its control lead. This control voltage is derived from potentiometer 6R91. Normally 6R91 is adjusted for +6.5 vdc across 6CR8. Negative voltages at the 6CR6, 6CR7 junction 6.5 volts will cause conduction through 6CR6, 6CR8, and 6CR10; and positive voltage greater than 6.5 volts will cause conduction through 6CR7, 6CR8, and 6CR9. Thus, the signal is clamped at $\pm$6.5 volts.

4-13. CLIPPING INDICATION CIRCUIT. Comparators 6U14A and 6U14B form an OR circuit which monitors the clamp circuit and provides an indication when clipping takes place. Voltage divider 6R139, 6R140, 6R141 establishes references of +10.6 vdc at the noninverting input of comparator 6U14A, and -10.6 vdc at the inverting input of 6U14B. This holds the outputs (wire ORed together) high with 6Q3 cut off.

4-14. The voltage at the junction of 6R85, 6CR7, and 6CR is held at +6.5 volts by 6CR8. Below clipping threshold the output of 6U8 will be 10.2 volts or less. The output of 6U8 is fed simultaneously to the inverting input of 6U14A and the noninverting input of 6U14B. A positive peak at the inputs in excess of 10.6 volts will cause the outputs to switch (controlled by 6U14A) low, and a negative peak exceeding 10.6 volts at the input will also cause the outputs to switch low (controlled by 6U14B). In the low state, the base-emitter junction of 6Q3 is forward biased, conduction takes place and HIGH FREQ indicator 6DS1 illuminates. At the same time capacitor 6C130 charges to 15 volts. When the comparator again goes high, the capacitor discharges through 6R133 and delays the turn off 6Q3, providing a slight increase in the brightness of 6DS1 on short peaks.

4-15. The output of the clamp circuit is fed to current buffer 6U9 where it is attenuated 16.2 dB. The clipped signal and the limited signal from 6U2 are summed in summing amplifier 6U10 through HIGH FREQUENCY MODE potentiometer 6R96. The adjustment of 6R96 determines the proportionate amount of clipped signal and limited signal which appears in the output of 6U10. The high frequency signal from 6U10 and the low frequency signal from 6U7A are summed in resistors 6R100, 6R101, and 6R102 to reconstruct the broadband signal. H.F./L.F. BALANCE potentiometer provides a fine adjustment of the high frequency/low frequency balance.

WARNING: Disconnect primary power prior to servicing.

4-16. BROADBAND CLIPPING SECTION.

4-17. The broadband signal is applied to a clamp circuit which is essentially identical to the high frequency clamp circuit (see paragraph 4-11), the only difference being the circuit gain. 6 dB of additional gain if required at this point to compensate for the 6 dB loss that occurred in the high frequency clamp.

4-18. CLIPPING INDICATION CIRCUIT. Broadband clipping indication is provided in a circuit which is identical to the high frequency clipping indication circuit (see paragraph 4-13), in fact, a single voltage divider (6R139, 6R140, 6R141) provides reference voltages for both circuits. Corresponding components in each circuit perform identical functions.

4-19. OUTPUT CIRCUIT. The output of the broadband clamp circuit, 6U11, is applied to attenuator 6R115, 6R116, 6R117 where the output is adjusted with 6R116 for 1 volt peak when the LIMITING FUNCTION switch 6S2 selects either the protected signal or the unprotected signal from 6U7D. Voltage follower 6U7B buffers the output and provides deemphasis. Capacitors 6C117, 6C118, and 6C119 in combination with 6R121 provide deemphasis of 25, 50, or 75 microseconds selectable by switch 6S3.

1753 500

SECTION V

MAINTENANCE AND TROUBLESHOOTING

5-1. GENERAL.

5-2. This section describes the maintenance and troubleshooting procedures for the FM protection module. As shown in figure 5-1, reference designators are printed on the printed circuit board. In addition, certain parts significant to the discussions which follow are flagged. In the text and on the schematic (figure 5-2), the reference designators shown on the printed circuit board are prefixed with the number "6". For general repair and cleaning techniques and a list of recommended test equipment, refer to Technical Manual 888 1753 001, Volume I, Section V.

5-3. ADJUSTMENT PROCEDURES.

5-4. The procedures which follow require access to components on the printed circuit board; therefore, the module cover must be removed and the module installed with an extender card. Remove eight cross-recessed screws and lift off the cover. Care should be taken that the module be properly supported on the front panel and inserted straight into the extender card connector.

5-5. 6R91 H.F. CLAMP ADJUSTMENT. Connect an accurate dc voltmeter to the junction of 6R89 and 6R90. Adjust H.F. CLAMP 6R91 control for +2.9 ±0.05 vdc with respect to ground.

5-6. 6R113 OUTPUT CLAMP ADJUSTMENT. Connect an accurate dc voltmeter to the junction of 6R118 and 6R119. Adjust OUTPUT CLAMP 6R113 control for +2.9 vdc with respect to ground.

5-7. 6R127 INPUT LEVEL AND 6R101 H.F./L.F. BALANCE ADJUSTMENT.

a. Connect the vertical input of an oscilloscope to the junction of 6CR11 and 6CR12.

b. Apply a 100 Hz audio signal to the MSP 100 input terminal.

c. Set the LIMITER FUNCTION switch to ON and adjust the signal level until the limiter meter reads upscale.

d. Adjust INPUT LEVEL 6R127 control until the signal is clipped, then back off to just below the threshold of clipping.

e. Reduce the input signal level and set all COMPRESSION FUNCTION, EXPANSION FUNCTION, and LIMITER FUNCTION switches to OFF. Set the PROTECTION FUNCTION switch to ON.

f. Increase the input signal level until clipping begins.

WARNING: Disconnect primary power prior to servicing.

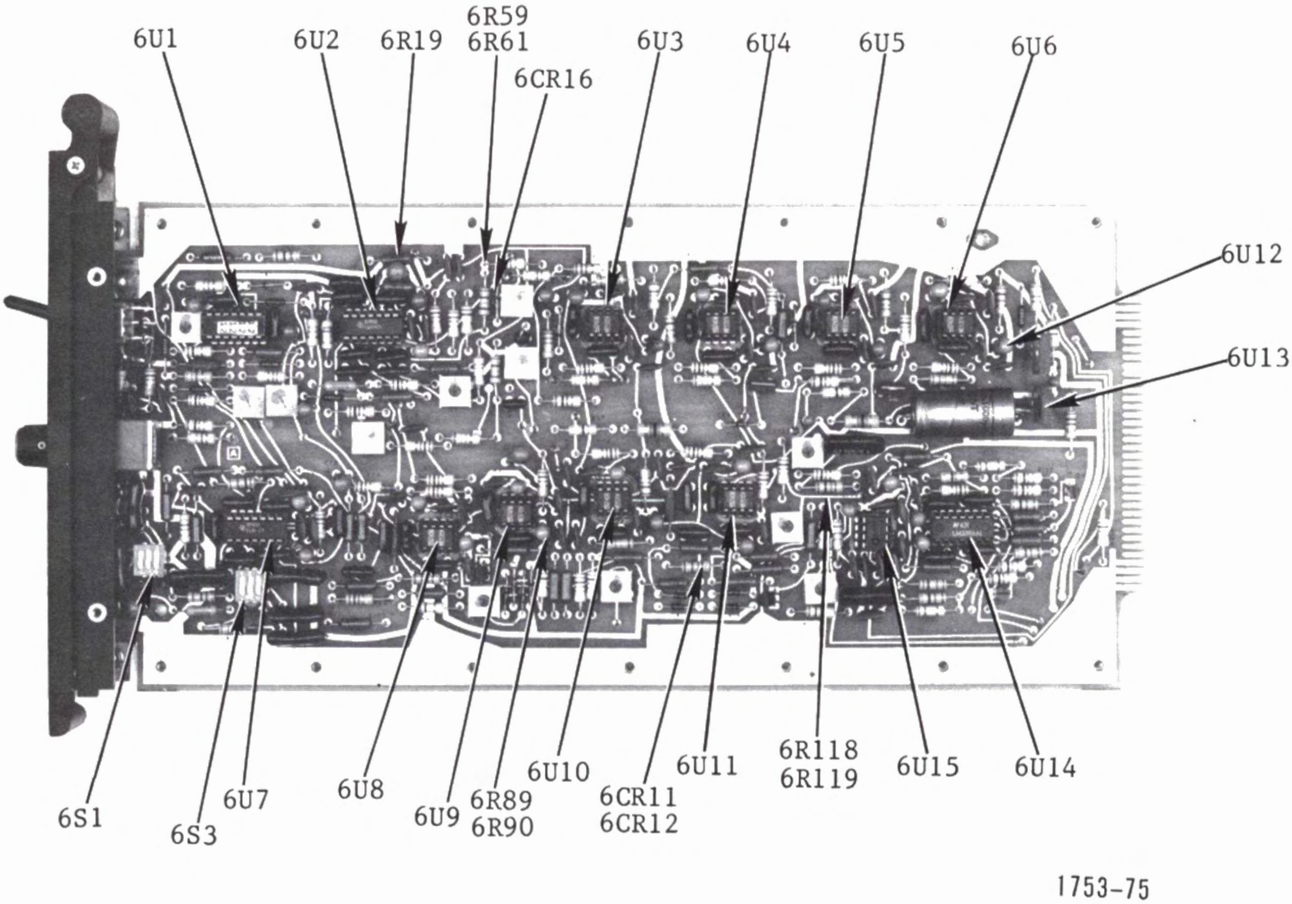
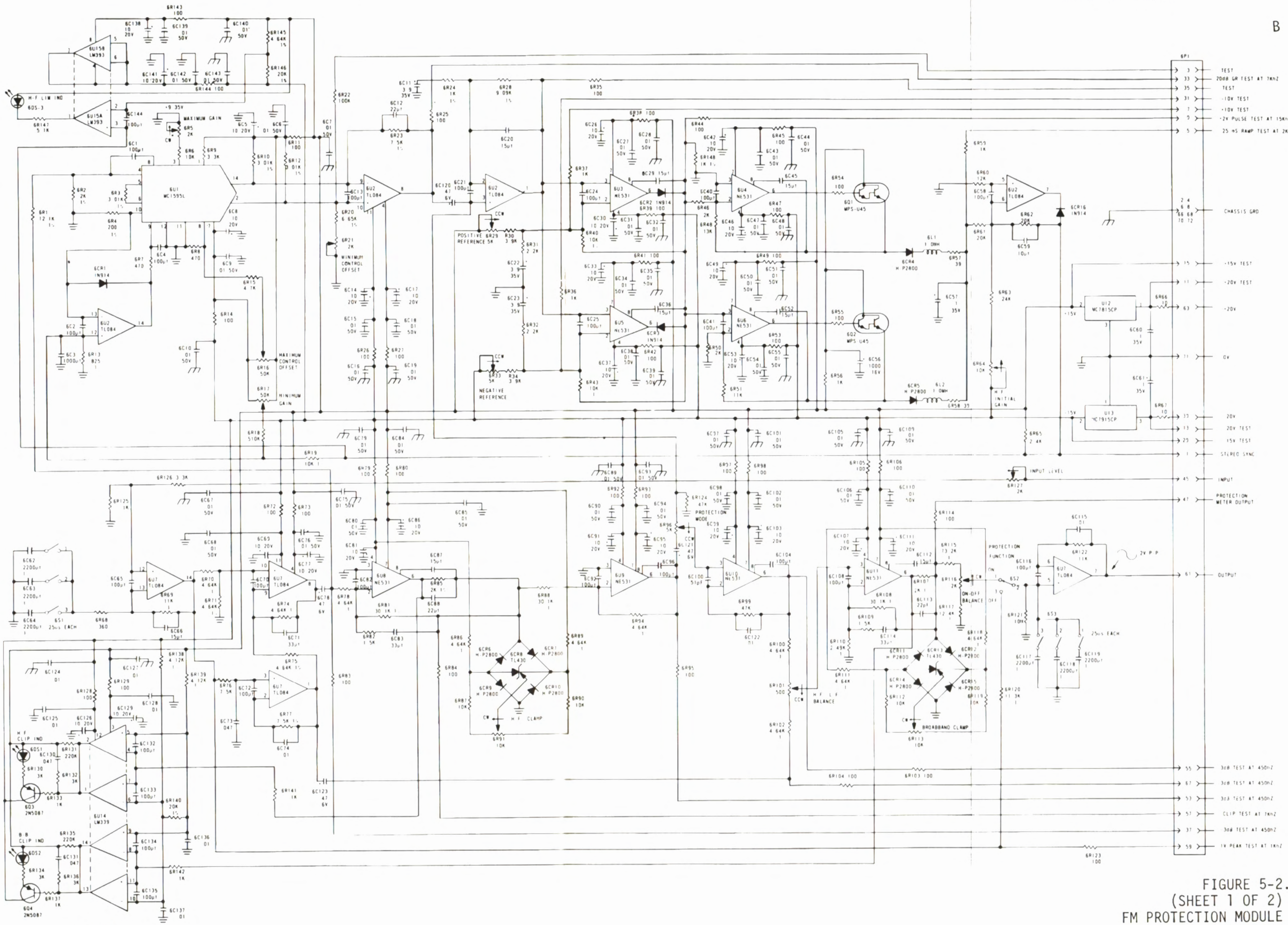


Figure 5-1. FM Protection Module Parts Layout

1753 500

WARNING: Disconnect primary power prior to servicing.

B



4 ALL INDUCTANCE IN uH
3 ALL CAPACITANCE IN uF
2 ALL RESISTANCE IN OHMS
1 ALL 1% RESISTORS ARE 1/4WATT. ALL OTHERS ARE 1/2WATT 5% UNLESS OTHERWISE NOTED
NOTES

FIGURE 5-2.
(SHEET 1 OF 2)
FM PROTECTION MODULE
SCHEMATIC
852 8340 001

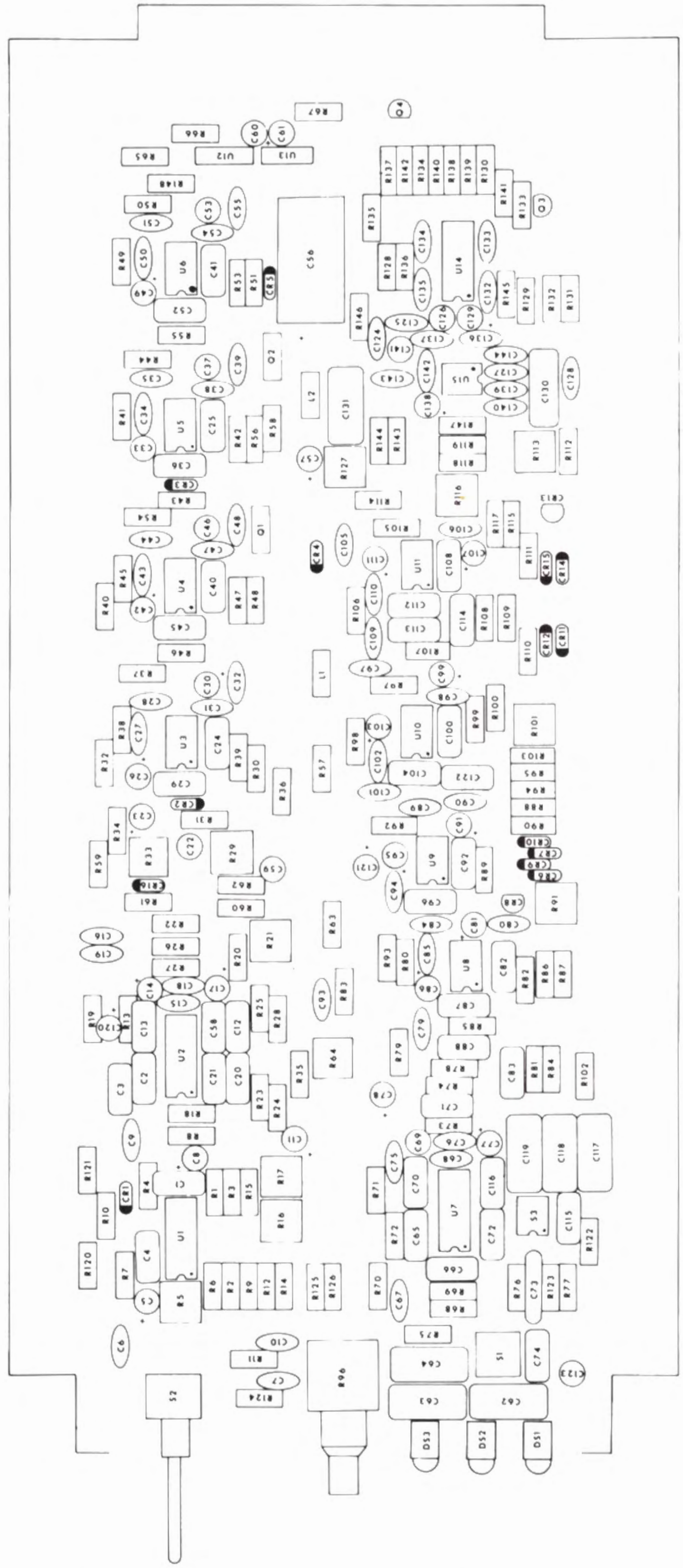


FIGURE 5-2. (SHEET 2 OF 2) PROTECTION BOARD
COMPONENT LOCATION - 843 2191 001

WARNING: Disconnect primary power prior to servicing.

g. Reduce the input signal level 20 dB and connect an ac voltmeter to the MSP 100 output terminal.

h. Switch the input signal frequency alternately from 100 Hz to 10 kHz, making sure that the input level does not change. Adjust 6R101 until the voltmeter reading does not change more than 0.1 dB when the frequency is switched.

j. Set the LIMITER FUNCTION switch to ON and repeat steps a. through d.

5-8. 6R116 OPERATE/BYPASS BALANCE ADJUSTMENT.

a. Set the LIMITER FUNCTION switch to ON.

b. Apply a 100 Hz audio signal to the MSP 100 input terminals. Adjust the signal level until the limiter meter reads slightly upscale. Connect an ac voltmeter to the output terminals.

c. Switch the PROTECTION FUNCTION switch alternately ON and OFF, and adjust OPERATE/BYPASS 6R116 control for the same output with the switch in either position.

5-9. 6R29 POSITIVE REFERENCE AND 6R33 NEGATIVE REFERENCE ADJUSTMENT.

a. Set the LIMITER FUNCTION switch to ON, and apply a 10 kHz audio signal to the MSP 100 input terminals. Adjust the signal level for slight limiter meter deflection.

b. Connect an oscilloscope vertical input to the junction of 6CR11 and 6CR12.

c. With the HIGH FREQUENCY MODE (front panel) control in the SOFT position, adjust POSITIVE REFERENCE 6R29 control until clipping occurs, then back off to just below the threshold of clipping.

NOTE

It may be necessary to adjust NEGATIVE REFERENCE 6R33 control CW if the signal stays significantly below the clipping threshold.

d. Move the oscilloscope vertical input probe to the junction of 6R59 and 6R61.

e. Set the oscilloscope coupling control to AC and adjust the vertical gain for a convenient display.

f. Adjust NEGATIVE REFERENCE 6R33 control until the oscilloscope displays ramps of equal amplitude occurring at 50 microsecond intervals.

1753 500

WARNING: Disconnect primary power prior to servicing.

5-10. 6R64 H.F. INITIAL GAIN ADJUSTMENT. With no audio input, adjust H.F. INITIAL GAIN 6R64 for +10.0 ±0.05 vdc at the junction of 6CR16 and 6R62 with respect to ground.

5-11. MULTIPLIER 6U1 ADJUSTMENTS. The MAXIMUM GAIN 6R5, MINIMUM GAIN 6R17, MAXIMUM CONTROL OFFSET 6R116, and MINIMUM CONTROL OFFSET 6R21 controls interact with each other and must be set up as a system.

a. With no audio input, check the adjustment of H.F. INITIAL GAIN 6R64 (paragraph 5-10). Adjust as necessary.

b. Jumper a 110-ohm resistor between ground and the junction of 6R19 and 6R65.

c. Connect a voltmeter to pin 8 of 6U2, and adjust MINIMUM CONTROL OFFSET 6R21 control for a 0.00 ±0.05 vdc reading on the voltmeter.

d. Remove the 110-ohm resistor (step b.) and adjust MAXIMUM CONTROL OFFSET 6R116 control for a 0.00 ±0.05 vdc reading on the voltmeter.

e. Repeat steps c. and d. until 0.00 vdc is obtained under both conditions.

f. Set all COMPRESSION FUNCTION, EXPANSION FUNCTION, and LIMITER FUNCTION switches to OFF. Set the PROTECTION FUNCTION switch to ON.

g. Connect the vertical input of an oscilloscope to the junction of 6CR11 and 6CR12.

h. Apply a 100 Hz audio signal to the MSP 100 input terminal. Adjust the signal level until clipping just begins as indicated on the oscilloscope, then reduce the signal amplitude 20 dB.

j. Switch the signal frequency to 10 kHz (maintain constant signal level).

k. Jumper a 110-ohm resistor between ground and the junction of 6R19 and 6R65.

l. With an ac voltmeter, alternately measure the signal at pin 4 of 6U1 and pin 8 of 6U2. Adjust MINIMUM GAIN 6R17 control for 27 dB gain from pin 4 of 6U1 to pin 8 of 6U2.

m. Remove the 110-ohm resistor (step k.), and adjust MAXIMUM GAIN 6R5 for a gain of 27 dB from pin 4 of 6U1 to pin 8 of 6U2.

n. Repeat steps h. through m. until correct gain tracking is achieved.

p. Repeat steps b. through e. until correct offset is achieved.

5-12. TROUBLESHOOTING.

5-13. If the system does not perform properly, and the problem has been traced to the FM protection module, figures 5-3 and 5-4 can be used as guides in troubleshooting.

1753 500

CONTROL POSITIONS:
LIMITER MODULE
LIMITER FUNCTION - ON
FM PROTECTION MODULE
HIGH FREQUENCY MODE - SOFT (FULL CW)
PRE-EMPHASIS 61 - AT LEAST ONE POSITION CLOSED

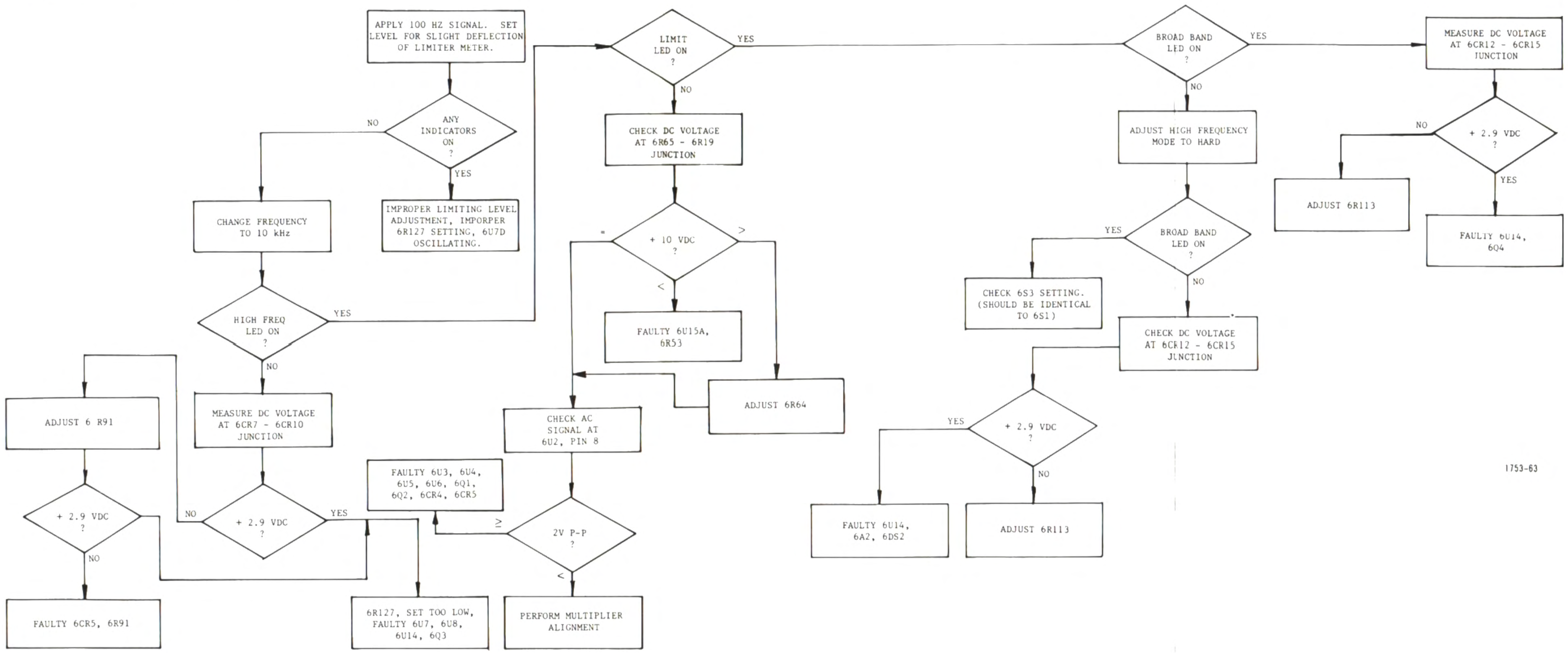


FIGURE 5-3.
FM PROTECTION MODULE
TROUBLESHOOTING CHART

Table 5-1. Power Supply Decoupling Networks

DEVICE	POSITIVE SUPPLY +15 ±0.6 VDC		NEGATIVE SUPPLY -15 ±0.6 VDC	
	PIN	COMPONENTS	PIN	COMPONENTS
6U1	1	6R11, 6C5, 6C6, 6C7	7	6R14, 6C8, 6C9, 6C10
6U2	4	6R27, 6C17, 6C18, 6C19	11	6R26, 6C14, 6C15, 6C16
6U3	7	6R38, 6C26, 6C27, 6C28	4	6R39, 6C30, 6C31, 6C32
6U4	7	6R45, 6C42, 6C43, 6C44	4	6R47, 6C46, 6C47, 6C48
6U5	7	6R41, 6C33, 6C34, 6C35	4	6R42, 6C37, 6C38, 6C39
6U6	7	6R49, 6C49, 6C50, 6C51	4	6R53, 6C53, 6C54, 6C55
6U7	4	6R73, 6C75, 6C76, 6C77	11	6R72, 6C67, 6C68, 6C69
6U8	7	6R80, 6C84, 6C85, 6C86	4	6R77, 6C79, 6C80, 6C81
6U9	7	6R93, 6C93, 6C94, 6C95	4	6R92, 6C89, 6C90, 6C91
6U10	7	6R98, 6C101, 6C102, 6C103	4	6R97, 6C97, 6C98, 6C99
6U11	7	6R106, 6C109, 6C110, 6C111	4	6R105, 6C105, 6C106, 6C107
6U12	1	6R66, 6C60		
6U13			3	6R67, 6C61
6U14	3	6R129, 6C127, 6C128, 6C129	12	6R128, 6C124, 6C125, 6C126
6U15	8	6R143, 6C138, 6C139, 6C140	4	6R144, 6C141, 6C142, 6C143

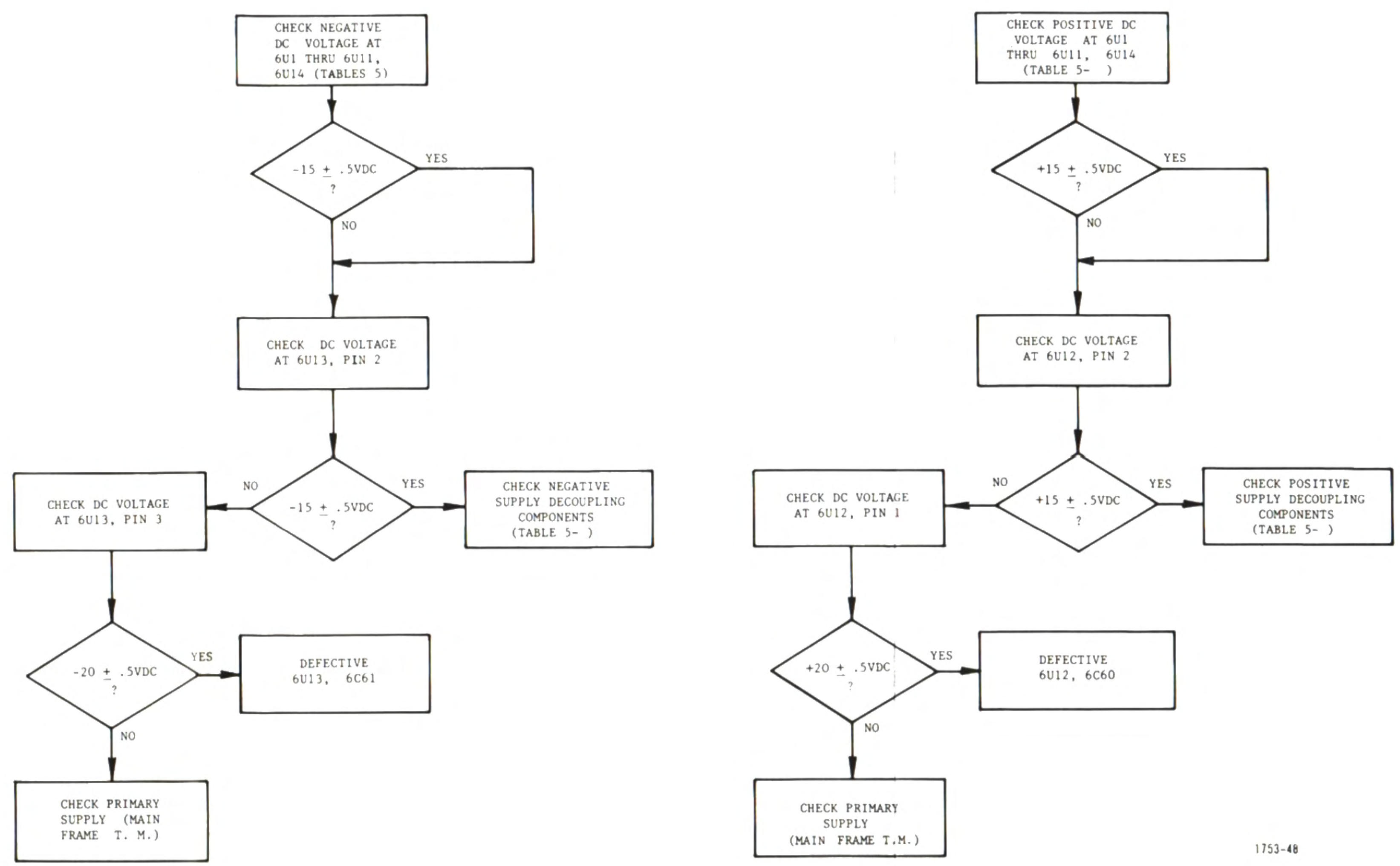


FIGURE 5-4.
FM PROTECTION MODULE
POWER SUPPLY
TROUBLESHOOTING CHART

SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This section provides a description, reference designator, and order number for replaceable electrical parts, assemblies, and selected mechanical parts necessary for proper maintenance of the FM protection module. Table 6-1 lists the parts from the protection module assembly and table 6-2 lists all parts for the printed circuit board assembly.

6-3. REPLACEABLE PARTS SERVICE.

6-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Service Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

6-5. TECHNICAL ASSISTANCE.

6-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Department during normal working hours. Emergency technical service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Serivce Department or address correspondence to Field Service Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301. The Harris factory may also be contacted through a TWX faciltiy (910-246-3312) or a TELEX service (40-4347).

WARNING: Disconnect primary power prior to servicing.

Table 6-1. FM Protection Module Assembly - 994 7977 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	358 2064 000	Insert, Red	1
	992 4953 001	Protection Module Printed Circuit Board Assembly (Refer to table 6-2)	1
	598 0341 000	Toggle Boot, Black	1
	650 0271 000	Knob	1

1753 500

WARNING: Disconnect primary power prior to servicing.

Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1,C2	500 0759 000	Capacitor, 100 pF, 500V	2
C3	500 0844 000	Capacitor, 1000 pF, 500V	1
C4	500 0759 000	Capacitor, 100 pF, 500V	1
C5	526 0048 000	Capacitor, 10 uF, 20V	1
C6,C7	516 0375 000	Capacitor, 0.01 uF, 50V	2
C8	526 0048 000	Capacitor, 10 uF, 20V	1
C9,C10	516 0375 000	Capacitor, 0.01 uF, 50V	2
C11	526 0350 000	Capacitor, 3.9 uF, 35V	1
C12	500 0809 000	Capacitor, 22 pF, 500V	1
C13	500 0759 000	Capacitor, 100 pF, 500V	1
C14	526 0048 000	Capacitor, 10 uF, 20V	1
C15,C16	516 0375 000	Capacitor, 0.01 uF, 50V	1
C17	526 0048 000	Capacitor, 10 uF, 20V	1
C18,C19	516 0375 000	Capacitor, 0.01 uF, 50V	2
C20	500 0806 000	Capacitor, 15 pF, 500V	1
C21	500 0759 000	Capacitor, 100 pF, 500V	1
C22,C23	526 0350 000	Capacitor, 3.9 uF, 35V	2
C24,C25	500 0759 000	Capacitor, 100 pF, 500V	2
C26	526 0048 000	Capacitor, 10 uF, 20V	1
C27,C28	516 0375 000	Capacitor, 0.01 uF, 50V	2
C29	500 0806 000	Capacitor, 15 pF, 500V	1
C30	526 0048 000	Capacitor, 10 uF, 20V	1
C31,C32	516 0375 000	Capacitor, 0.01 uF, 50V	2

Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C33	526 0048 000	Capacitor, 10 uF, 20V	1
C34,C35	516 0375 000	Capacitor, 0.01 uF, 50V	2
C36	500 0806 000	Capacitor, 15 pF, 500V	1
C37	526 0048 000	Capacitor, 10 uF, 20V	1
C38,C39	516 0375 000	Capacitor, 0.01 uF, 50V	2
C40,C41	500 0759 000	Capacitor, 100 pF, 500V	2
C42	526 0048 000	Capacitor, 10 uF, 20V	1
C43,C44	516 0375 000	Capacitor, 0.01 uF, 50V	2
C45	500 0806 000	Capacitor, 15 pF, 500V	1
C46	526 0048 000	Capacitor, 10 uF, 20V	1
C47,C48	516 0375 000	Capacitor, 0.01 uF, 50V	2
C49	526 0048 000	Capacitor, 10 uF, 20V	1
C50,C51	516 0375 000	Capacitor, 0.01 uF, 50V	2
C52	500 0806 000	Capacitor, 15 pF, 500V	1
C53	526 0048 000	Capacitor, 10 uF, 20V	1
C54,C55	516 0375 000	Capacitor, 0.01 uF, 50V	2
C56	522 0391 000	Capacitor, 1000 uF, 15V	1
C57	526 0050 000	Capacitor, 1 uF, 35V	1
C58	500 0759 000	Capacitor, 100 pF, 500V	1
C59	500 0804 000	Capacitor, 10 pF, 500V	1
C60,C61	526 0050 000	Capacitor, 1 uF, 35V	2
C62,C63,C64	500 0781 000	Capacitor, 2200 pF, 500V	3

1753 500

WARNING: Disconnect primary power prior to servicing.

Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C65	500 0759 000	Capacitor, 100 pF, 500V	1
C66	500 0806 000	Capacitor, 15 pF, 500V	1
C67,C68	516 0375 000	Capacitor, 0.01 uF, 50V	2
C69	526 0048 000	Capacitor, 10 uF, 20V	1
C70	500 0759 000	Capacitor, 100 pF, 500V	1
C71	500 0813 000	Capacitor, 33 pF, 500V	1
C72	500 0759 000	Capacitor, 100 pF, 500V	1
C73	508 0412 000	Capacitor, 0.047 uF, 50V	1
C74,C75,C76	516 0375 000	Capacitor, 0.01 uF, 50V	3
C77	526 0048 000	Capacitor, 10 uF, 20V	1
C78	526 0101 000	Capacitor, 47 uF, 6V	1
C79,C80	516 0375 000	Capacitor, 0.01 uF, 50V	2
C81	526 0048 000	Capacitor, 10 uF, 20V	1
C82	500 0759 000	Capacitor, 100 pF, 500V	1
C83	500 0813 000	Capacitor, 33 pF, 500V	1
C84,C85	516 0375 000	Capacitor, 0.01 uF, 50V	2
C86	526 0048 000	Capacitor, 10 uF, 20V	1
C87	500 0806 000	Capacitor, 15 pF, 500V	1
C88	500 0809 000	Capacitor, 22 pF, 500V	1
C89,C90	516 0375 000	Capacitor, 0.01 uF, 50V	2
C91	526 0048 000	Capacitor, 10 uF, 20V	1
C92	500 0759 000	Capacitor, 100 pF, 500V	1

WARNING: Disconnect primary power prior to servicing.

Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C93,C94	516 0375 000	Capacitor, 0.01 uF, 50V	2
C95	526 0048 000	Capacitor, 10 uF, 20V	1
C96	500 0759 000	Capacitor, 100 pF, 500V	1
C97,C98	516 0375 000	Capacitor, 0.01 uF, 50V	2
C99	526 0048 000	Capacitor, 10 uF, 20V	1
C100	500 0819 000	Capacitor, 51 pF, 500V	1
C101,C102	516 0375 000	Capacitor, 0.01 uF, 50V	2
C103	526 0048 000	Capacitor, 10 uF, 20V	1
C104	500 0759 000	Capacitor, 100 pF, 500V	1
C105,C106	516 0375 000	Capacitor, 0.01 uF, 50V	2
C107	526 0048 000	Capacitor, 10 uF, 20V	1
C108	500 0759 000	Capacitor, 100 pF, 500V	1
C109,C110	516 0375 000	Capacitor, 0.01 uF, 50V	2
C111	526 0048 000	Capacitor, 10 uF, 20V	1
C112	500 0806 000	Capacitor, 15 pF, 500V	1
C113	500 0809 000	Capacitor, 22 pF, 500V	1
C114	500 0813 000	Capacitor, 33 pF, 500V	1
C115	516 0375 000	Capacitor, 0.01 uF, 50V	1
C116	500 0759 000	Capacitor, 100 pF, 500V	1
C117,C118,C119	500 0781 000	Capacitor, 2200 pF, 500V	3
C120,C121	526 0101 000	Capacitor, 47 uF, 6V	2
C122	516 0375 000	Capacitor, 0.01 uF, 50V	1
C123	526 0101 000	Capacitor, 47 uF, 6V	1
C124,C125	516 0375 000	Capacitor, 0.01 uF, 50V	2

1753 500

WARNING: Disconnect primary power prior to servicing.

Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C126	526 0048 000	Capacitor, 10 uF, 20V	1
C127,C128	516 0375 000	Capacitor, 0.01 uF, 50V	2
C129	526 0048 000	Capacitor, 10 uF, 20V	1
C130,C131	508 0412 000	Capacitor, 0.047 uF, 50V	2
C132 thru C135	500 0759 000	Capacitor, 100 pF, 500V	4
C136,C137	516 0375 000	Capacitor, 0.01 uF, 50V	2
C138	526 0048 000	Capacitor, 10 uF, 20V	1
C139,C140	516 0375 000	Capacitor, 0.01 uF, 50V	2
C141	526 0048 000	Capacitor, 10 uF, 20V	1
C142,C143	516 0375 000	Capacitor, 0.01 uF, 50V	2
C144	500 0759 000	Capacitor, 100 pF, 500V	1
CR1,CR2,CR3	384 0205 000	Diode, 1N914	3
CR4 thru CR7	384 0321 000	Diode, HP 2800	4
CR8	382 0520 000	Diode, Zener, TL430	1
CR9 thru CR12	384 0321 000	Diode, HP2800	4
CR13	382 0520 000	Diode, Zener, TL430	1
CR14,CR15	384 0321 000	Diode, HP2800	2
CR16	384 0205 000	Diode, 1N914	1
DS1,DS2,DS3	384 0662 000	Diode, LED, Red	3
L1,L2	494 0419 000	Inductor, 1 MHy	2
Q1,Q2	380 0179 000	Transistor, MPS-U45	2
Q3,Q4	380 0112 000	Transistor, 2N5087	2

WARNING: Disconnect primary power prior to servicing.

Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R1	548 1401 000	Resistor, 12.1k ohm, 1/4W, 1%	1
R2	548 0279 000	Resistor, 2.0k ohm, 1/4W, 1%	1
R3	548 0312 000	Resistor, 3.01k ohm, 1/4W, 1%	1
R4	548 0278 000	Resistor, 200 ohm, 1/4W, 1%	1
R5	550 0813 000	Potentiometer, 2k ohm	1
R6	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R7,R8	540 1115 000	Resistor, 470 ohm, 1/2W, 5%	2
R9	540 1165 000	Resistor, 3.3k ohm, 1/2W, 5%	1
R10	548 0312 000	Resistor, 3.01k ohm, 1/4W, 1%	1
R11	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R12	548 0312 000	Resistor, 3.01k 1hm, 1/4W, 1%	1
R13	548 0559 000	Resistor, 825 ohm, 1/4W, 1%	1
R14	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R15	540 1114 000	Resistor, 4.7k ohm, 1/2W, 5%	1
R16,R17	550 0797 000	Potentiometer, 50k ohm	2
R18	540 1319 000	Resistor, 510k ohm, 1/2W, 5%	1
R19	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R20	548 1358 000	Resistor, 6.65k ohm, 1/4W, 1%	1
R21	550 0813 000	Potentiometer, 2k ohm	1
R22	540 1159 000	Resistor, 100k ohm, 1/4W, 5%	1
R23	548 0607 000	Resistor, 7.5k ohm, 1/4W, 1%	1
R24	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1

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Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R25,R26,R27	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	3
R28	548 1402 000	Resistor, 9.09k ohm, 1/4W, 1%	1
R29	550 0623 000	Potentiometer, 5k ohm	1
R31,R32	540 1182 000	Resistor, 2.2k ohm, 1/2W, 5%	2
R33	550 0623 000	Potentiometer, 5k ohm	1
R34	540 1137 000	Resistor, 3.9k ohm, 1/2W, 5%	1
R35	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R36,R37	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	2
R38,R39	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R40	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R41,R42	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R43	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R44,R45	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R46	540 1104 000	Resistor, 2k ohm, 1/2W, 5%	1
R47	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R48	540 1194 000	Resistor, 13k ohm, 1/2W, 5%	1
R49	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R50	540 1104 000	Resistor, 2k ohm, 1/2W, 5%	1
R51	540 1208 000	Resistor, 11k ohm, 1/2W, 5%	1
R53,R54,R55	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	3
R56	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1

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Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R57,R58	540 1224 000	Resistor, 39 ohm, 1/2W, 5%	2
R59	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R60	540 1171 000	Resistor, 12k ohm, 1/2W, 5%	1
R61,R62	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	2
R63	540 1143 000	Resistor, 24k ohm, 1/2W, 5%	1
R64	550 0626 000	Potentiometer, 10k ohm	1
R65	540 1193 000	Resistor, 2.4k ohm, 1/2W, 5%	1
R66,R67	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	2
R68	540 1180 000	Resistor, 360 ohm, 1/2W, 5%	1
R69	548 0282 000	Resistor, 11k ohm, 1/4W, 1%	1
R70,R71	548 1357 000	Resistor, 4.64k ohm, 1/4W, 1%	2
R72,R73	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R74,R75	548 1357 000	Resistor, 4.64k ohm, 1/4W, 1%	2
R76	540 1154 000	Resistor, 7.5k ohm, 1/2W, 5%	1
R77	548 0607 000	Resistor, 7.5k ohm, 1/4W, 1%	1
R78	548 1357 000	Resistor, 4.64k ohm, 1/4W, 1%	1
R79,R80	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R81	548 0416 000	Resistor, 30.1k ohm, 1/4W, 1%	1
R82	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	1
R83,R84	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R85	548 0279 000	Resistor, 2.0k ohm, 1/4W, 1%	1
R86	548 1357 000	Resistor, 4.64k ohm, 1/4W, 1%	1
R87	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1

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Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R88	548 0416 000	Resistor, 30.1k ohm, 1/4W, 1%	1
R89	548 1357 000	Resistor, 4.64k ohm, 1/4W, 1%	1
R90	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R91	550 0626 000	Potentiometer, 10k ohm	1
R92,R93	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R94	548 1357 000	Resistor, 4.64k ohm, 1/4W, 1%	1
R95	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R96	550 0932 000	Potentiometer, 5k ohm, 2W	1
R97,R98	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R99	540 1122 000	Resistor, 47k ohm, 1/2W, 5%	1
R100	548 1357 000	Resistor, 4.64k ohm, 1/4W, 1%	1
R101	550 0625 000	Potentiometer, 500 ohm	1
R102	548 1357 000	Resistor, 4.64k ohm, 1/4W, 1%	1
R103 thru R106	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	4
R107	548 0279 000	Resistor, 2.0k ohm, 1/4W, 1%	1
R108	548 0416 000	Resistor, 30.1k ohm, 1/4W, 1%	1
R109	540 1129 000	Resistor, 1.5k ohm, 1/2W, 5%	1
R110	548 1403 000	Resistor, 2.49k ohm, 1/4W, 1%	1
R111	548 1357 000	Resistor, 4.64k ohm, 1/4W, 1%	1
R112	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R113	550 0626 000	Potentiometer, 10k ohm	1
R114	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1

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Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R115	548 1406 000	Resistor, 73.2k ohm, 1/4W, 1%	1
R116	550 0813 000	Potentiometer, 2k ohm	1
R117	548 1405 000	Resistor, 12.4k ohm, 1/4W, 1%	1
R118	548 1357 000	Resistor, 4.64k ohm, 1/4W, 1%	1
R119	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R120	548 1404 000	Resistor, 11.3k ohm, 1/4W, 1%	1
R121	540 1322 000	Resistor, 10 Megohm, 1/2W, 5%	1
R122	540 1208 000	Resistor, 11k ohm, 1/2W, 5%	1
R123	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R124	540 1122 000	Resistor, 47k ohm, 1/2W, 5%	1
R125	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R126	540 1165 000	Resistor, 3.3k ohm, 1/2W, 5%	1
R127	550 0813 000	Potentiometer, 2k ohm	1
R128,R129	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R130	540 1138 000	Resistor, 3k ohm, 1/2W, 5%	1
R131	540 1212 000	Resistor, 220k ohm, 1/2W, 5%	1
R132	540 1138 000	Resistor, 3k ohm, 1/2W, 5%	1
R133	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R134	540 1138 000	Resistor, 3k ohm, 1/2W, 5%	1
R135	540 1212 000	Resistor, 220k ohm, 1/2W, 5%	1
R136	540 1138 000	Resistor, 3k ohm, 1/2W, 5%	1
R137	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R138,R139	548 1391 000	Resistor, 4.12k ohm, 1/4W, 1%	2

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Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R140	548 0997 000	Resistor, 20k ohm, 1/4W, 5%	1
R141,R142	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	2
R143,R144	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R145	548 1357 000	Resistor, 4.64k ohm, 1/4W, 1%	1
R146	548 0997 000	Resistor, 20k ohm, 1/4W, 1%	1
R147	540 1105 000	Resistor, 5.1k ohm, 1/2W, 1%	1
R148	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
S1	604 0853 000	Switch, Mini Dip 3PST	1
S2	604 0854 000	Switch, DPST	1
S3	604 0853 000	Switch, Mini Dip 3PST	1
U1	382 0480 000	Integrated Circuit, MC1595L	1
U2	382 0519 000	Integrated Circuit, TL084CN	1
U3 thru U6	382 0219 000	Integrated Circuit, NE531V	4
U7	382 0519 000	Integrated Circuit, TL084CN	1
U8 thru U11	382 0219 000	Integrated Circuit, NE531V	4
U12	382 0359 000	Integrated Circuit, MC7815CP	1
U13	382 0360 000	Integrated Circuit, MC7915CP	1
U14	382 0521 000	Integrated Circuit, LM339N	1
U15	382 0522 000	Integrated Circuit, LM393N	1
XU1,XU2	404 0505 000	Socket, 14 Pin	2
XU3 thru XU6	404 0504 000	Socket, 8 Pin	4
XU7	404 0505 000	Socket, 14 Pin	1

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Table 6-2. FM Protection Module Printed Circuit Board - 992 4953 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
XU8 thru XU11	404 0504 000	Socket, 8 Pin	4
XU14	404 0505 000	Socket, 14 Pin	1
XU15	404 0504 000	Socket, 8 Pin	1
	843 1898 001	Printed Circuit Board	1

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AM PROTECTION MODULE
888 1753 501

TECHNICAL MANUAL

AM PROTECTION MODULE

994 8159 001

HARRIS CORPORATION

Broadcast Products Division

888 1753 501

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SAFETY NOTICE

WARNING: THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND UNDER CERTAIN CONDITIONS, COULD BE FATAL.

This manual is intended as general guidance for trained and qualified installation, operating, maintenance and service personnel who are familiar with and aware of the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

THE INSTALLATION, OPERATION, MAINTENANCE AND SERVICING OF THIS EQUIPMENT INVOLVES RISKS TO BOTH PERSONNEL AND EQUIPMENT, AND MUST BE PERFORMED ONLY BY PROPERLY TRAINED AND EXPERIENCED PERSONNEL EXERCISING DUE CARE. PERSONNEL MUST FAMILIARIZE THEMSELVES WITH SAFETY REQUIREMENTS, SAFE HANDLING AND OPERATING PRACTICE, AND RELATED FIRST-AID PROCEDURES (E.G., FOR ELECTRICAL BURNS AND ELECTRICAL SHOCK).

HARRIS CORPORATION Broadcast Equipment Division shall not be responsible for injury or damage resulting from improper installation, operation, maintenance or servicing, or from the use of improperly trained or inexperienced personnel in the performance of such tasks, or from the failure of persons engaged in such tasks to exercise due care.

As with all electronic equipment, care should be taken to avoid electrical shock in all circuits where substantial currents or voltages may be present, either through design or short circuit. Caution should also be observed in lifting and hoisting equipment, especially regarding large structures, during installation.

LIABILITY LIMITATION

The procedures outlined in this Manual are based on the information available at the time of publication and should permit the specified use with minimum risk. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

The manufacturer is specifically not liable for any damage or injury arising out of failure to follow the instructions in this Manual or failure to exercise due care and caution during installation, operation, maintenance and service of this equipment.

CAUTIONARY NOTICE

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Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

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SECTION I

GENERAL DESCRIPTION

1-1. GENERAL.

1-2. The AM protection module together with the limiter module provides asymmetry favoring positive peaks and absolute modulation control. Also included are a transient clipper circuit, an asymmetry detector, and an automatic polarity reversal circuit.

1-3. ELECTRICAL CHARACTERISTICS.

1-4. Electrical characteristics of the AM protection module are presented in table 1-1.

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Table 1-1. AM Protection Module Electrical Characteristics

FUNCTION	CHARACTERISTIC
Input Signal Level	5.3 volts, peak.
Output Signal Level	5.3 volts, peak.
Frequency Response	$\pm$0.5 dB, 20 Hz to 20 kHz.
Harmonic Distortion	0.15% or less, 20 Hz to 20 kHz at 5 volts, peak input.
Intermodulation Distortion	0.5% or less using SMPTE method.
Signal to Noise Ratio	80 dB or greater below 5.1 volts, peak.
Limiter Input/Output Ratio	10:0.3 minimum over a 20 Hz to 20 kHz bandwidth.
Protection Circuit	Asymmetrical detector driving limiter module gain controller with series transient output clipper.
Transient Clipping Level	Adjustable. Factory set within 0.3 dB of steady state output limit.
Polarity Reversal:	
Element	Analog switch.
Activation	Activates at 5% or greater asymmetry at 100% negative modulation, signal pause, and waveform zero crossing.
Power Input	$\pm$20 vdc supplied from main frame primary power regulators.

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SECTION II

INSTALLATION

2-1. GENERAL.

2-2. Installation of the AM protection module is covered in Technical Manual 888 1753 001, MSP 100 Audio Processor System, Section II.

NOTE

WHEN THE MSP-100 IS USED AS AN AM UNIT, IT IS IMPERATIVE THAT THE (•) CODED LEFT OUTPUT TERMINAL BE CONNECTED TO THE TRANSMITTER INPUT AUDIO TERMINAL THAT PRODUCES POSITIVE MODULATION.

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SECTION III

CONTROLS AND INDICATORS

3-1. GENERAL.

3-2. Figure 3-1 shows the AM protection module controls and indicators and table 3-1 describes the functions of each.

3-3. PAUSE SENSITIVITY SETTING.

3-4. The pause sensitivity section of the AM protection module must sense a reduction in program level of -10dB, -20dB, or -30dB from limiting threshold to activate the auto polarity reversal circuitry. Switch settings to achieve the desired sensitivity are listed below.

	S4-1	S4-2	S4-3
-10dB	open	open	closed
-20dB	open	closed	open
-30dB	closed	open	open

3-5. While auto polarity reversal switching occurs exactly at zero crossing, the resulting phase inversion and amplitude increase produces a barely audible discontinuity. This discontinuity is most noticeable at the -10dB pause level.

3-6. If average program level is relatively high, as in pop, rock, and country music formats, the -10dB pause level is ideal since it provides the maximum possible amount of positive asymmetrical modulation. However, if average program level is relatively low and there are numerous pauses, as in news, variety, and talk show formats, a -20dB or -30dB pause level may be more desirable. Experiment with your format to determine which switch setting gives the best results.

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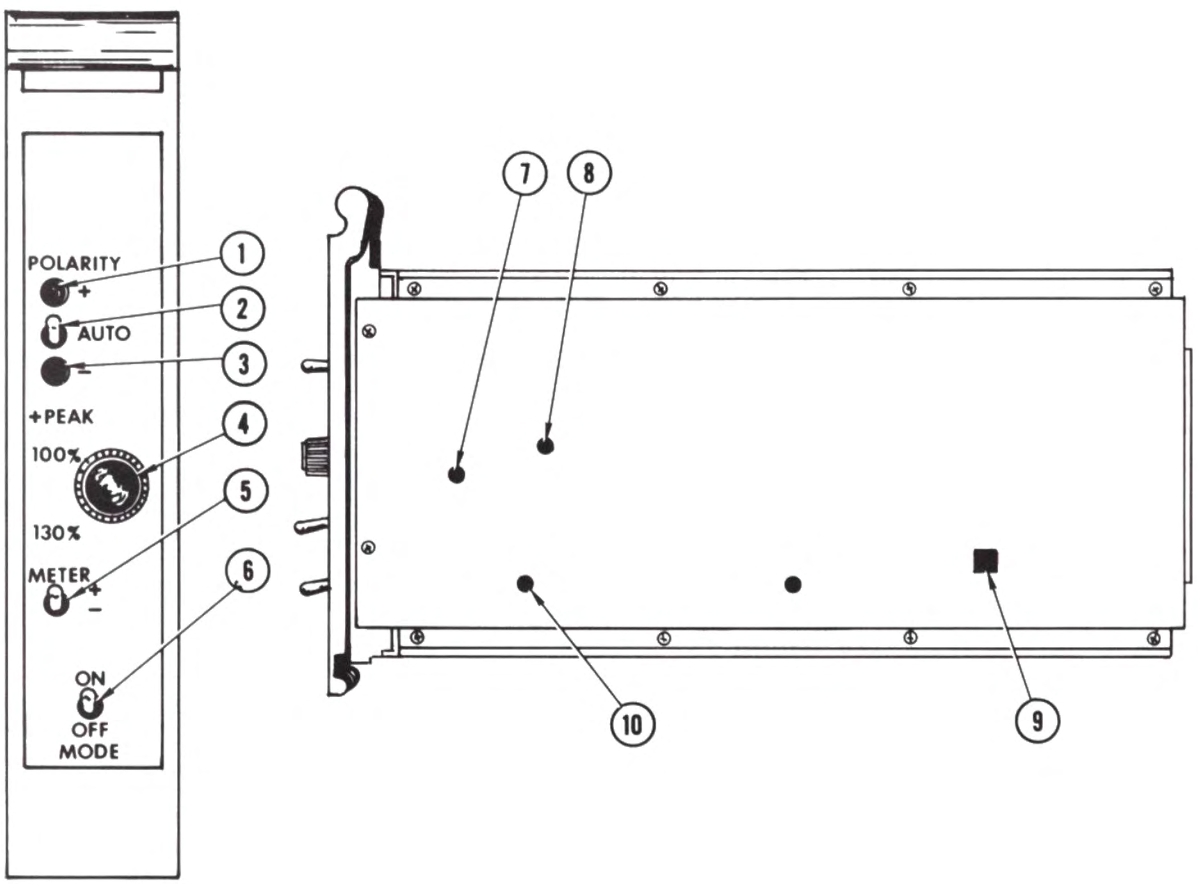

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Figure 3-1. AM Protection Module Controls and Indicators

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Table 3-1. AM Protection Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	POLARITY +	LED indicates AM protection and limiter modules are operating in the noninverting mode.
2	AUTO SWITCH	Allows selection of AM protection and limiter modules signal polarity either manually or automatically by the polarity reversal circuit.
3	POLARITY -	LED indicates AM protection and limiter modules are operating in the signal inverting mode.
4	+ PEAKS	Adjusts the degree of asymmetrical modulation.
5	PROGRAM METER +/-	Permits program meter display of relative modulation due to positive or negative peaks as selected.
6	MODE ON/OFF	Enables or disables the AM protection and limiter modules.
7	POS SYM 6R77	Permits adjustment for symmetrical positive and negative clipping when + PEAK control is in the 100% position.
8	POS CLIP 6R74	Permits adjustment of the level at which positive clipping occurs.
9	PAUSE SENSITIVITY	Permits selection of pause activation at signal levels of -10, -20, or -30db below limiting level.
10	NEG CLIP 6R83	Permits adjustment of the level at which negative clipping occurs.

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SECTION IV

PRINCIPLES OF OPERATION

4-1. CIRCUIT DESCRIPTION.

4-2. As shown in figure 4-1, the AM protection module circuit consists of five functional sections: 1) the auto polarity reversal section, 2) the zero crossing detector section, 3) the asymmetry detector sections, 4) the pause detector section, and 5) the series clipper and control section. The five sections are discussed in the following paragraphs.

4-3. SERIES CLIPPER AND CONTROL SECTION.

4-4. CONTROL CIRCUIT. The audio signal from the limiter module is applied simultaneously to the series clipper circuit, 6U1C, 6U1D, and 6U11A, and to the control circuit, 6U11B, 6U11C, and 6U11D. Voltage divider, 6R82, 6R83, 6R84, establishes negative bias voltages for 6U1D and 6U11C, and voltage divider, 6R76, 6R77, 6R79, establishes positive bias voltages for 6U1C and 6U11B. The voltage at the noninverting input of 6U11C is held at -5 vdc. When negative peaks exceed 5.1 volts, 6CR21 conducts and pulses which exceed 5.1 volts are amplified 20 dB. The resultant waveform at the junction of 6CR22 and 6R87 pulses from zero to some positive voltage. Similarly, the non-inverting input of 6U11B is biased at +5 vdc and positive peaks which exceed 5.1 volts are amplified and appear as pulses from zero to some negative voltage at the junction of 6CR19 and 6R89. 6CR23 provides a ground return path for 6R89 when 6CR19 is reversed biased.

4-5. Rotating the +PEAKS control, R1, towards 130% (less resistance) causes the voltage at the noninverting input of 6U11B to rise, raising the threshold of positive peak amplification, and allowing asymmetrical modulation. Differential amplifier, 6U11D, amplifies the difference of the two signals (positive and negative pulses) by 4 (12 dB) and produces a train of positive pulses. The pulses are routed to the limiter module through diode 6CR24 which isolates the limiter attack selection circuit from 6U11D when its output is low.

4-6. SERIES CLIPPER CIRCUIT. When the audio signal voltage (from the limiter module) at the anode of 6CR15 becomes more negative than one diode drop above the voltage at the output of 6U1D, 6CR15 ceases to conduct and the negative peak is clipped. Adjustment of NEG. CLIP control, 6R83, varies the bias voltage at the noninverting input of 6U1D (and thus the output voltage), providing a means for varying the level at which negative clipping occurs. Positive peak clipping is accomplished by 6CR16 in conjunction with 6U1C. POS. SYM. control, 6R77 is set for symmetrical detection by 6U11B and 6U11C(with +PEAKS control, 6R1, at 100%), then the positive clipping level is controlled by adjusting the gain of 6U1C with POS. CLIP control, 6R74. When the signal voltage at the cathode of 6CR16 exceeds one diode drop below the output voltage of 6U1C, 6CR16 ceases to conduct and the positive peak is clipped. Decreasing the resistance of +PEAKS control, 6R1 will increase the positive bias at the noninverting input of 6U1C and raise the threshold of clipping in 6CR16.

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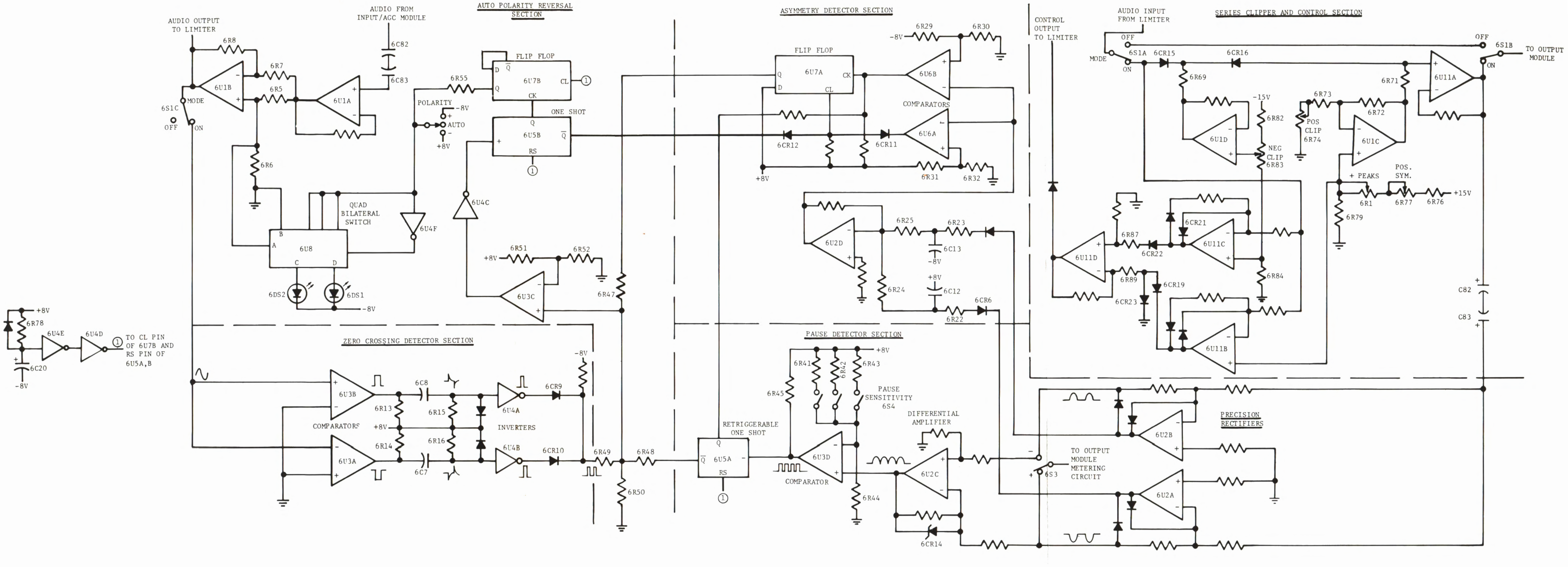

FIGURE 4-1. AM PROTECTION MODULE BLOCK DIAGRAM

4-7. PAUSE DETECTOR SECTION. The output of the series clipper circuit, buffered by voltage follower 6U11A, is routed to the precision rectifiers in the pause detector circuit. 6U2A passes only positive half cycles, and 6U2B passes only negative half cycles. The outputs of 6U2A and 6U2B are subtracted in differential amplifier 6U2C yielding a series of positive going pulses. These pulses are clamped at zero to +5.6 volts by zener diode 6CR14 to prevent overdrive of 6U3D which is powered by ±8 vdc.

4-8. Positive pulses from 6U2C are applied to comparator, 6U3D. The switching threshold of 6U3D is determined by the setting of PAUSE SENSITIVITY switch, 6S4. By closing various combinations of this switch, the threshold can be set from +0.1 vdc to about +1.3 vdc. With no input signal, the output of 6U3D is held low by the bias voltage at its inverting input. Whenever the pulses from 6U2C exceed the threshold set by 6S4, the output of 6U3D goes high and remains high until the pulse input drops below the threshold, at which time 6U3D switches low again. The result is a train of rectangular pulses which are applied to retriggerable one shot, 6U5A. The output pulse width of 6U5A is approximately 50 milliseconds unless another trigger pulse occurs at its input, in which case the output pulse will be extended an additional 50 milliseconds. As long as trigger pulses from 6U3D are received at 50 millisecond (or shorter) intervals, the Q output of 6U5A will remain high and the $\overline{Q}$ output will remain low. When the audio signal ceases, 6U5A will time out, the Q output will go low, and the $\overline{Q}$ output will go high, indicating a pause in the program.

4-9. ASYMMETRY DETECTOR SECTION.

4-10. The outputs of 6U2A and 6U2B are applied to an averaging circuit at the input of inverting amplifier 6U2D through diodes, 6CR5 and 6CR6. Negative signal peaks are averaged by 6R23, 6C13, and 6R25, and positive peaks are averaged by 6R22, 6C12, and 6R24. The positive and negative voltages are summed at the inverting input of 6U2D and amplified by 3 (9 dB). With a symmetrical audio signal, the voltage will cancel and the output of 6U2D will be zero. If the negative peaks are of higher amplitude than the positive peaks, the output of 6U2D will go negative; conversely, higher level positive peaks will drive the 6U2D output positive, thus an indication of the type and degree of signal asymmetry is provided.

4-11. Comparator 6U6B is held low by the negative threshold established by 6R29 and 6R30; 6U6A is held high by the positive threshold at its non-inverting input established by 6R31 and 6R32. During positively asymmetrical input conditions the output of 6U6A goes low, holding the Q output of 6U7A low. During negatively asymmetrical input conditions the output of 6U6B goes high, driving the Q output of 6U7A high. Also, the output of 6U6B is anded with the Q output of 6U5A, disabling the asymmetry detector during pauses. If negative asymmetry exceeding 5% is detected and sometime later a pause occurs, the auto polarity reversal circuiting will activate. 6U7A is cleared after polarity reversal. If negative asymmetry exceeding 5% has been detected and positive asymmetry exceeding 10% is detected before a pause occurs, the Q output of 6U7A will again go low.

4-12. ZERO CROSSING DETECTOR SECTION.

4-13. The program signal is applied simultaneously to comparators 6U3A and 6U3B. When the audio signal crosses the zero volt threshold in the positive direction, 6U3A output will go low and 6U3B output will go high; when the audio signal crosses zero in the negative direction, 6U3A and 6U3B change states. The result is rectangular output pulses on alternate half cycles of the audio signal. These rectangular pulses are differentiated by 6R13, 6C8 and 6R15, and 6R14, 6C7, and 6R16. The result is a series of voltage spikes at the inputs of inverters 6U4A and 6U4B, occurring at the instant of signal zero crossing. The positive going spikes have no effect on the inverters, but the negative going spikes result in positive output pulses of short duration at the junction of 6CR9 and 6CR10 each time the audio signal crosses zero.

4-14. AUTO POLARITY REVERSAL SECTION.

4-15. Comparator 6U3C is connected as an AND gate; its output will be high only if the pause detector output (through 6R48), the zero crossing detector output (through 6R49), and the asymmetry detector output (through 6R47) are all positive simultaneously. If any one of the three detectors goes low, 6U3C also switches low.

4-16. The output pulse from 6U3C is inverted by 6U4C and applied to one shot 6U5B which is triggered on the low to high transition. When 6U5B is triggered, its $\overline{Q}$ output goes low inhibiting flip flop 6U7A and its Q output goes high toggling flip flop 6U7B. To prevent polarity reversal at an audio rate under worst case signal conditions, the pulse duration of 6U5B is set at 70 milliseconds.

4-17. Flip flop 6U7B drives bilateral switch, 6U8 through isolation resistor, 6R55, when the POLARITY switch, 6S2, is in the AUTO position. With 6S2 in either the + or - position, auto polarity reversal is inhibited. Sections A and B of 6U8 are cross connected to minimize even order harmonic distortion components. Polarity reversal is accomplished in 6U8 and 6U1B. When section A of 6U8 is closed, 6U1B becomes an inverting amplifier, with section A of 6U8 open, 6U1B is a noninverting amplifier. Section C of 6U8 illuminates 6DS2 when polarity inversion exists, and section D which is driven via inverter 6U4F, illuminates 6DS1 when polarity is not inverted.

4-18. AUTOMATIC RESET.

4-19. Inverters 6U4D and 6U4E provide automatic reset for 6U5A, 6U5B, and 6U7B when power is initially applied to the system. 6C20 is initially discharged placing a low logic level at the clear input of 6U7B and the reset inputs of 6U5A and 6U5B which resets the detector circuits. 6C20 charges towards the positive supply when power is applied. When the voltage at the input of inverter 6U4E reaches the trip point, 6U4E and 6U4D change states, enabling 6U5A, 6U5B, and 6U7B.

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SECTION V

MAINTENANCE AND TROUBLESHOOTING

5-1. GENERAL.

5-2. This section describes the maintenance and troubleshooting procedures for the AM protection module. Locations of parts are shown on figure 5-1. In the text and on the block diagram (figure 4-1), reference designators shown are prefixed with the number "6". If the system malfunctions, and the problem is traced to the protection module, figure 7-2 may be used as a guide for troubleshooting. For general repair and cleaning techniques and a list of recommended test equipment, refer to Technical Manual 888 1753 001 Volume I, Section V.

5-3. MODULE ADJUSTMENTS.

5-4. Before attempting to adjust the AM protection module, assure that all limiter module adjustments have been properly made. Refer to Section V of the limiter module technical manual, 888 1753 400, for adjustment procedures. Adjust the AM protection module as follows:

a. Remove the limiter module and install the AM protection module using a card extender.

b. Connect an audio signal generator set at 1 kHz and 6 volts, peak (4.25 volts RMS, +15 dBm) to pin 45 with common connected to pin 71.

5-5. POSITIVE SYMMETRY (6R77) ADJUSTMENT.

a. Rotate +PEAKS, 6R1, fully CCW (100%) and connect an oscilloscope vertical input to pin 14 of 6U11.

b. Adjust the audio signal generator for 5-volt peak-to-peak pulses on the oscilloscope.

c. Adjust 6R77 for equal amplitude pulses at 500 uSec intervals.

5-6. NEGATIVE CLIP (6R83) ADJUSTMENT.

a. Remove the audio signal generator and apply a normal program signal to the MSP-100 input.

b. Install the limiter module. Set the LIMITER FUNCTION and PROTECTION FUNCTION switches to ON. Set the limiter ATTACK TIME to MANUAL and FAST (CCW).

c. Measure the peak negative output at pin 61 of the AM protection module with a dc-coupled oscilloscope.

d. Set the limiter ATTACK TIME to SLOW (CW) and adjust 6R83 until the peak negative output is within 0.2 volt of the amplitude observed in step c.

5-7. POSITIVE CLIP (6R74) ADJUSTMENT (100%).

a. Verify that the +PEAKS control, 6R1, is fully CCW (100%).

b. Set the limiter ATTACK TIME switches to MANUAL and FAST (CCW).

c. Measure the peak positive output at pin 61 of the AM protection module with a dc-coupled oscilloscope.

d. Set the limiter ATTACK TIME to slow (CW) and adjust 6R74 until the positive peaks are within 0.2 volt of the amplitude observed in step c.

e. Recheck the adjustment of 6R83 (paragraph 5-6).

5-8. POSITIVE CLIP (6R74) ADJUSTMENT (125%).

a. Verify that the +PEAKS control, 6R1, is fully CW (130%).

b. Set the limiter ATTACK TIME switches to MANUAL and FAST (CCW).

c. Measure the peak positive output at pin 61 of the AM protection module with a dc-coupled oscilloscope.

d. Set the limiter ATTACK TIME to slow (CW) and adjust 6R74 until the positive peaks are 125% of the amplitude observed in step c.

e. Recheck the adjustment of 6R83 (paragraph 5-6).

5-9. TROUBLESHOOTING.

5-10. Problems in the AM protection module are most likely to occur in either the series clipper and control section or the polarity reversal section. If the system does not perform properly and the trouble is traced to the AM protection module, use the information in Section IV and figures 7-1 and 7-2 as guides in troubleshooting. A thorough visual inspection should first be performed. Discolored or charred parts indicate heat damage. Feeling a component (with power on) can detect excessive heat dissipation. Finally, look for broken conductors, whiskers, and cold solder joints on the PC board.

WARNING: Disconnect primary power prior to servicing.

SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This section provides a description, reference designator, and order number for replaceable electrical parts, assemblies, and mechanical parts necessary for proper maintenance of the AM protection module.

6-3. REPLACEABLE PARTS SERVICE.

6-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Service Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Harris Broadcast Products Division, Harris Corporation, Box 4290, Quincy, Illinois 62301.

6-5. TECHNICAL ASSISTANCE.

6-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Department during normal working hours. Emergency technical service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, Harris Broadcast Products Division, Harris Corporation, Box 4290, Quincy, Illinois 62301. The Harris factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

Table 6-1. Replaceable Parts List Index

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Table 6-2. AM Protection Module, 2A5 - 994 8159 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	992 5148 001	AM Protection Module Printed Circuit Board (Refer to Table 6-3)	1

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Table 6-3. AM Protection Module Printed Circuit Board - 992 5148 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1 thru C4	500 0759 000	Capacitor, 100 pF, 500V	4
C5	500 0819 000	Capacitor, 51 pF, 500V	1
C6	526 0049 000	Capacitor, 6.8 uF, 35V	1
C7	500 0759 000	Capacitor, 100 pF, 500V	1
C8,C9	500 0845 000	Capacitor, 0.002 uF, 500V	2
C10	500 0819 000	Capacitor, 51 pF, 500V	1
C11	500 0759 000	Capacitor, 100 pF, 500V	1
C12,C13	526 0350 000	Capacitor, 3.9 uF, 35V	2
C14 thru C17	500 0759 000	Capacitor, 100 pF, 500V	4
C18	526 0331 000	Capacitor, 0.33 uF, 35V	1
C19,C20	526 0050 000	Capacitor, 1 uF, 35V	2
C21	516 0375 000	Capacitor, 0.01 uF, 50V	1
C22	526 0048 000	Capacitor, 10 uF, 20V	1
C23,C24	516 0375 000	Capacitor, 0.01 uF, 50V	2
C25	526 0048 000	Capacitor, 10 uF, 20V	1
C26,C27	516 0375 000	Capacitor, 0.01 uF, 50V	2
C28	526 0048 000	Capacitor, 10 uF, 20V	1
C29,C30	516 0375 000	Capacitor, 0.01 uF, 50V	2
C31	526 0048 000	Capacitor, 10 uF, 20V	1
C32,C33	516 0375 000	Capacitor, 0.01 uF, 50V	2
C34	526 0048 000	Capacitor, 10 uF, 20V	1
C35,C36	516 0375 000	Capacitor, 0.01 uF, 50V	2
C37	526 0048 000	Capacitor, 10 uF, 20V	1
C38,C39	516 0375 000	Capacitor, 0.01 uF, 50V	2

Table 6-3. AM Protection Module Printed Circuit Board - 992 5148 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C40	526 0048 000	Capacitor, 10 uF, 20V	1
C41,C42	516 0375 000	Capacitor, 0.01 uF, 50V	2
C43	526 0048 000	Capacitor, 10 uF, 20V	1
C44,C45	516 0375 000	Capacitor, 0.01 uF, 50V	2
C46	526 0048 000	Capacitor, 10 uF, 20V	1
C47,C48	516 0375 000	Capacitor, 0.01 uF, 50V	2
C49	526 0048 000	Capacitor, 10 uF, 20V	1
C50,C51	516 0375 000	Capacitor, 0.01 uF, 50V	2
C52	526 0048 000	Capacitor, 10 uF, 20V	1
C53,C54	516 0375 000	Capacitor, 0.01 uF, 50V	2
C55	526 0048 000	Capacitor, 10 uF, 20V	1
C56	516 0375 000	Capacitor, 0.01 uF, 50V	1
C57	500 0759 000	Capacitor, 100 pF, 500V	1
C58	500 0806 000	Capacitor, 15 pF, 500V	1
C59 thru C62	500 0759 000	Capacitor, 100 pF, 500V	4
C63,C64	500 0818 000	Capacitor, 51 pF, 500V	2
C65	526 0048 000	Capacitor, 10 uF, 20V	1
C66,C67	500 0818 000	Capacitor, 51 pF, 500V	2
C68	526 0048 000	Capacitor, 10 uF, 20V	1
C69	500 0759 000	Capacitor, 100 pF, 500V	1
C70	500 0803 000	Capacitor, 5 pF, 500V	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-3. AM Protection Module Printed Circuit Board - 992 5148 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C71	526 0049 000	Capacitor, 6.8 uF, 35V	1
C72	516 0375 000	Capacitor, 0.01 uF, 50V	1
C73	526 0048 000	Capacitor, 10 uF, 20V	1
C74,C75	516 0375 000	Capacitor, 0.01 uF, 50V	2
C76	526 0048 000	Capacitor, 10 uF, 20V	1
C77	516 0375 000	Capacitor, 0.01 uF, 50V	1
C78 thru C81	526 0050 000	Capacitor, 1 uF, 35V	4
C82,C83,C85,C86	526 0033 000	Capacitor, 47 uF, 20V	4
CR1 thru CR13	384 0205 000	Diode, 1N914	13
CR14	386 0078 000	Diode, 1N4734A, Zener	1
CR15,CR16	384 0321 000	Diode, HP2800	2
CR17 thru CR24	384 0205 000	Diode, 1N914	8
CR25 thru CR28	384 0431 000	Diode, 1N4001	4
DS1,DS2	384 0664 000	Diode, LED, Yellow	2
R1	550 0932 000	Potentiometer, 5k ohm	1
R2	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R3	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R4	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R5	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R6	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R7	548 0282 000	Resistor, 11k ohm, 1/4W, 1%	1
R8	548 1402 000	Resistor, 9.09k ohm, 1/4W,1%	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-3. AM Protection Module Printed Circuit Board - 992 5148 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R9	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R10	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R11	540 1105 000	Resistor, 5.1k ohm, 1/2W, 5%	1
R12	548 1401 000	Resistor, 12.1k ohm, 1/4W, 1%	1
R13 thru R16	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	4
R17	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R18	540 1105 000	Resistor, 5.1k ohm, 1/2W, 5%	1
R19	548 1401 000	Resistor, 12.1k ohm, 1/4W, 1%	1
R20,R21	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R22,R23	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	2
R24,R25	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	2
R26	540 1142 000	Resistor, 240k ohm, 1/2W, 5%	1
R27	540 1185 000	Resistor, 39k ohm, 1/2W, 5%	1
R28	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R29	548 0745 000	Resistor, 49.9k ohm, 1/4W, 1%	1
R30	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R31	548 1401 000	Resistor, 12.1k ohm, 1/4W, 1%	1
R32	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R33	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R34,R35	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	2
R36,R37,R38,R39	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	4
R40	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1

WARNING: Disconnect primary power prior to servicing.

Table 6-3. AM Protection Module Printed Circuit Board - 992 5148 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R41	540 1152 000	Resistor, 75k ohm, 1/2W, 5%	1
R42	540 1143 000	Resistor, 24k ohm, 1/2W, 5%	1
R43	540 1105 000	Resistor, 5.1k ohm, 1/2W, 5%	1
R44	540 1137 000	Resistor, 3.9k ohm, 1/2W, 5%	1
R45	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R46 thru R49	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	4
R50	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R51	540 1185 000	Resistor, 39k ohm, 1/2W, 5%	1
R52	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R53	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R54	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R55	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R56	540 1205 000	Resistor, 1.2k ohm, 1/2W, 5%	1
R57,R58	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R59 thru R62	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	4
R63,R64	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R65,R66	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	2
R67,R68	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R69	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R70,R71	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	2
R72	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R73	540 1143 000	Resistor, 24k ohm, 1/2W, 5%	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-3. AM Protection Module Printed Circuit Board - 992 5148 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R74	550 0881 000	Potentiometer, 100k ohm, PC	1
R75	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R76	540 1105 000	Resistor, 5.1k ohm, 1/2W, 5%	1
R77	550 0626 000	Potentiometer, 10k ohm	1
R78	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R79	540 1154 000	Resistor, 7.5k ohm, 1/2W, 5%	1
R80	548 0313 000	Resistor, 4.99k, 1/4W, 1%	1
R81	548 0745 000	Resistor, 49.9k ohm, 1/4W, 1%	1
R82	540 1207 000	Resistor, 4.3k ohm, 1/2W, 5%	1
R83	550 0623 000	Potentiometer, 5k ohm, PC	1
R84	540 1114 000	Resistor, 4.7k ohm, 1/2W, 5%	1
R85	548 0313 000	Resistor, 4.99k ohm, 1/4W, 1%	1
R86,R87	548 0745 000	Resistor, 49.9k ohm, 1/4W, 1%	2
R88	548 0320 000	Resistor, 200k ohm, 1/4W, 1%	1
R89	548 0745 000	Resistor, 49.9k ohm, 1/4W, 1%	1
R90	548 0320 000	Resistor, 200k ohm, 1/4W, 1%	1
R91,R92	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R96	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R97,R98,R99,R100	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	4
R101 thru R104	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	4
R105 thru R108	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	4
R109	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
S1	604 0855 000	Switch, 3 PDT, Toggle	1

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Table 6-3. AM Protection Module Printed Circuit Board - 992 5148 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
S2	604 0873 000	Switch, SPDT, CEN/OFF	1
S3	604 0856 000	Switch, SPDT, Toggle	1
S4	604 0853 000	Switch, 3 PST, DIP	1
U1,U2	382 0519 000	Integrated Circuit, TL084CN	2
U3	382 0521 000	Integrated Circuit, LM339AN	1
U4	382 0419 000	Integrated Circuit, MM74C14N	1
U5	382 0366 000	Integrated Circuitm MC14528BP	1
U6	382 0522 000	Integrated Circuit, LM393N	1
U7	382 0495 000	Integrated Circuit, MM74C74N	1
U8	382 0523 000	Integrated Circuit, MC14066BP	1
U9	382 0273 000	Integrated Circuit, MC7808CP	1
U10	382 0385 000	Integrated Circuit, MC7908CP	1
U11	382 0519 000	Integrated Circuit, TL084CN	1
U12	382 0359 000	Integrated Circuit, MC7815CP	1
U13	382 0360 000	Integrated Circuit, MC7915CP	1
XU1 thru XU4	404 0505 000	Socket, Integrated Circuit, 14 Pin	4
XU5	404 0506 000	Socket, Integrated Circuit, 16 Pin	1
XU6	404 0504 000	Socket, Integrated Circuit, 8 Pin	1
XU7,XU8	404 0505 000	Socket, Integrated Circuit, 14 Pin	2
XU11	404 0505 000	Socket, Integrated Circuit, 14 Pin	1
	843 2472 001	Printed Board	1

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SECTION VII

DRAWINGS

7-1. GENERAL.

7-2. The following diagrams are contained in this section as an aid to maintenance.

Figure	Title	Number
7-1	AM Protection Module Parts Locations	829 3366 001
7-2	AM Protection Module Schematic Diagram	852 8504 001

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WARNING: Disconnect primary power prior to servicing.

A

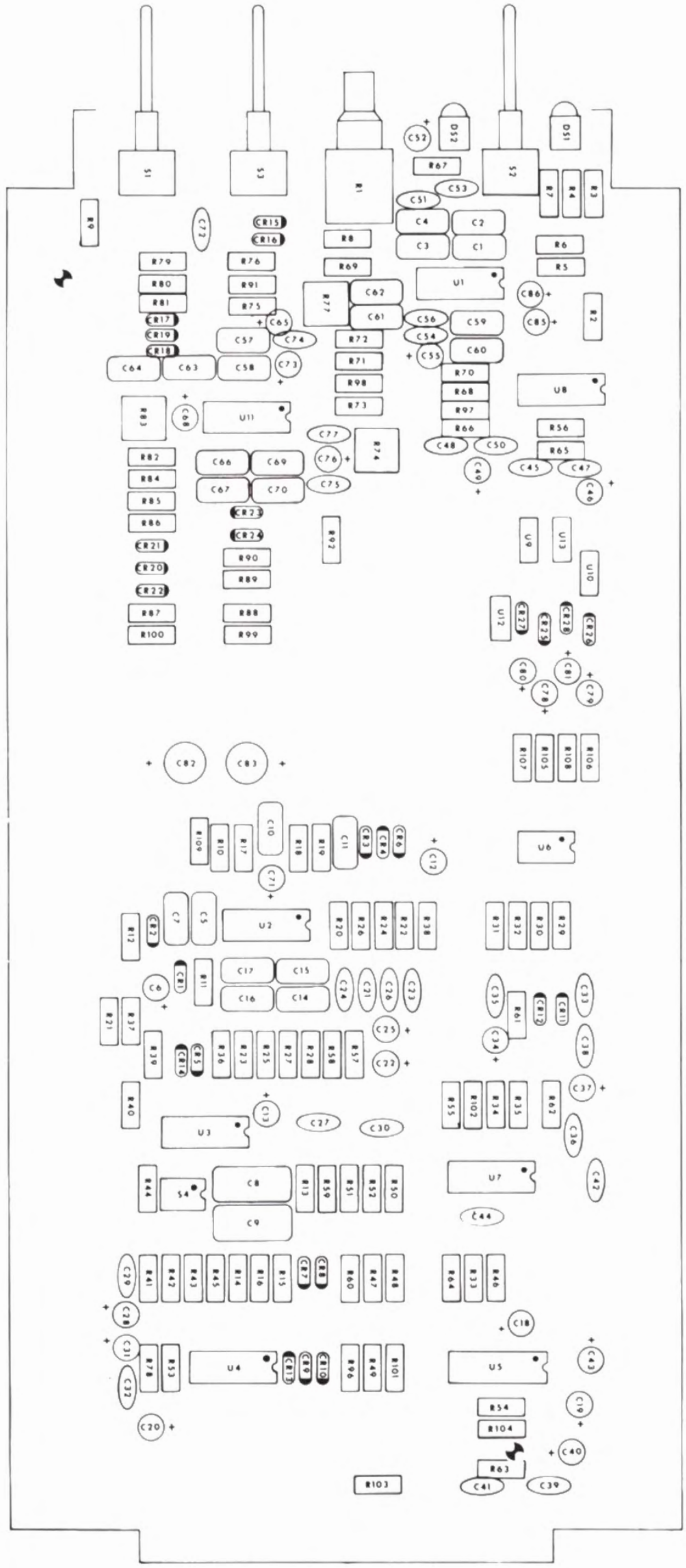

Figure 7-1. AM Protection Module Parts Location - 829 3366 001

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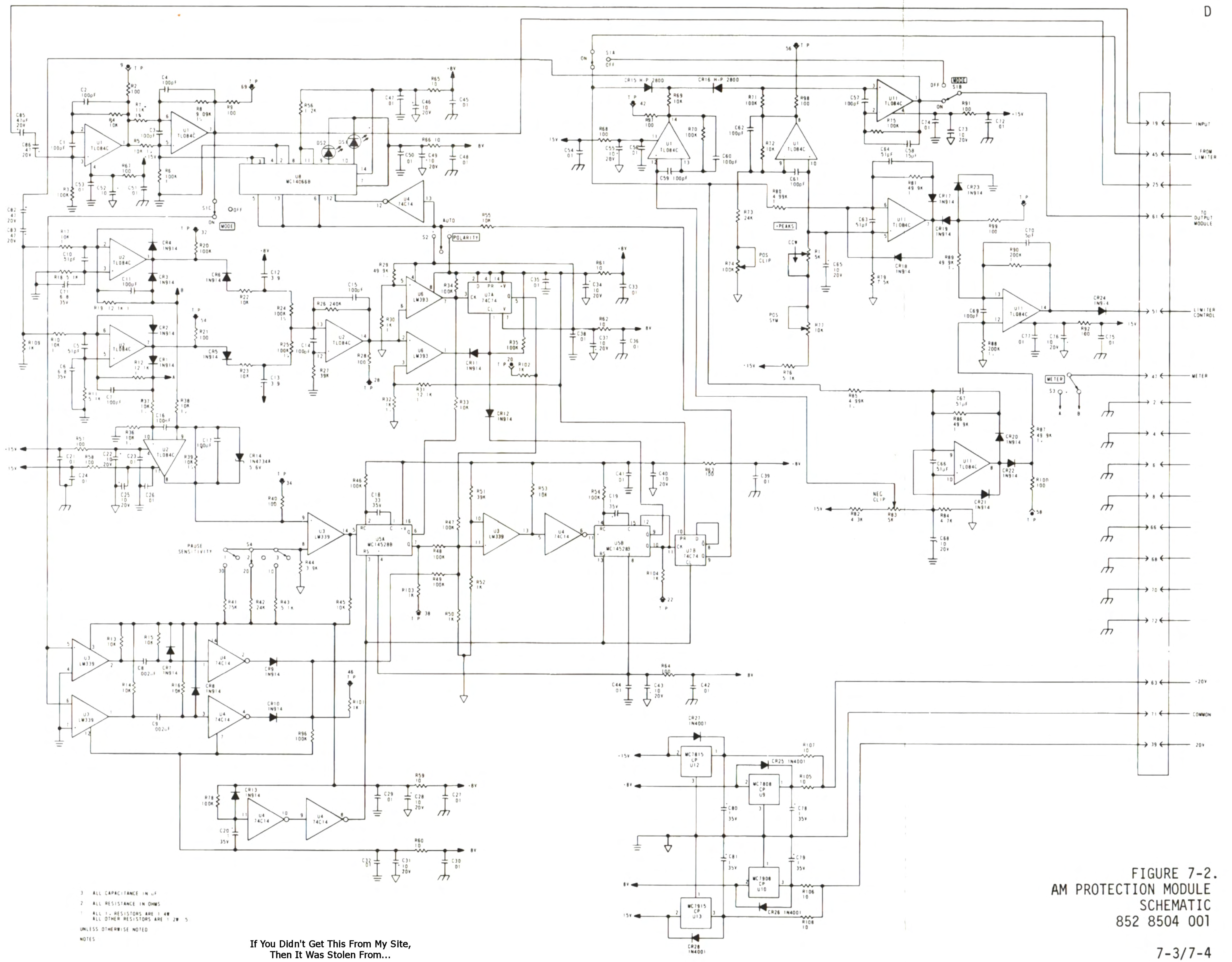
WARNING: Disconnect primary power prior to servicing.



3. ALL CAPACITANCE IN uF
2. ALL RESISTANCE IN OHMS
1. ALL 1% RESISTORS ARE 1/4W
ALL OTHER RESISTORS ARE 1/2W 5%
UNLESS OTHERWISE NOTED
NOTES

FIGURE 7-2.
AM PROTECTION MODULE
SCHEMATIC
852 8504 001

OUTPUT MODULE
888 1753 600

TECHNICAL MANUAL

OUTPUT MODULE

994 7979 001

HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1753 600

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LIST OF EFFECTIVE PAGES

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WARNING: Disconnect primary power prior to servicing.

SAFETY NOTICE

WARNING: THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND UNDER CERTAIN CONDITIONS, COULD BE FATAL.

This manual is intended as general guidance for trained and qualified installation, operating, maintenance and service personnel who are familiar with and aware of the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

THE INSTALLATION, OPERATION, MAINTENANCE AND SERVICING OF THIS EQUIPMENT INVOLVES RISKS TO BOTH PERSONNEL AND EQUIPMENT, AND MUST BE PERFORMED ONLY BY PROPERLY TRAINED AND EXPERIENCED PERSONNEL EXERCISING DUE CARE. PERSONNEL MUST FAMILIARIZE THEMSELVES WITH SAFETY REQUIREMENTS, SAFE HANDLING AND OPERATING PRACTICE, AND RELATED FIRST-AID PROCEDURES (E.G., FOR ELECTRICAL BURNS AND ELECTRICAL SHOCK).

HARRIS CORPORATION Broadcast Equipment Division shall not be responsible for injury or damage resulting from improper installation, operation, maintenance or servicing, or from the use of improperly trained or inexperienced personnel in the performance of such tasks, or from the failure of persons engaged in such tasks to exercise due care.

As with all electronic equipment, care should be taken to avoid electrical shock in all circuits where substantial currents or voltages may be present, either through design or short circuit. Caution should also be observed in lifting and hoisting equipment, especially regarding large structures, during installation.

LIABILITY LIMITATION

The procedures outlined in this Manual are based on the information available at the time of publication and should permit the specified use with minimum risk. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

The manufacturer is specifically not liable for any damage or injury arising out of failure to follow the instructions in this Manual or failure to exercise due care and caution during installation, operation, maintenance and service of this equipment.

CAUTIONARY NOTICE

Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

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WARNING: Disconnect primary power prior to servicing.

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WARNING: Disconnect primary power prior to servicing.

LIST OF ILLUSTRATIONS

1753 600

SECTION I

GENERAL DESCRIPTION

1-1. EQUIPMENT PURPOSE.

1-2. There are two identical output modules in the Audio Procesor System, one each for right and left channels. The module provides balanced, 600 ohm outputs for driving external circuits, power for the AGC meter modules, and drive for the output meter module. Output capability is +18 dBm.

1-3. TECHNICAL CHARACTERISTICS.

1-4. Table 1-1 lists the technical characteristics of the module.

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Table 1-1. Electrical Characteristics

FUNCTION	CHARACTERISTIC
Input Signal Level	1.0 volt RMS
Frequency Response	20 Hz to 20 kHz, ±0.25 dB at +10 dBm output.
Total Harmonic Distortion	0.25% or less, 20 Hz to 20 kHz at +10 dBm output.
Intermodulation Distortion	0.25% or less, 60 Hz and 7 kHz mixed 4:1 at +10 dBm output.
Noise	90 dB or greater below +10 dBm output with a 30 Hz to 15 kHz bandwidth.
Maximum Output Level	+18 dBm, infinitely adjustable with coarse and fine adjustments for precise settings.
Output Impedance	600 ohms, balanced (normal operation). May be used unbalanced or with 150-ohm systems (see T.M. 888 1753 001, Volume I, Section II).
Output Monitoring	Meter drive circuit provided for accurate monitoring of modulation.
Power	Internal, ±15 vdc, regulated. ±20 vdc supplied from main frame primary power supply.

1753 600

WARNING: Disconnect primary power prior to servicing.

SECTION II

INSTALLATION

2-1. GENERAL.

2-2. Installation of the output module is covered in Technical Manual 888 1753 001, MSP 100 Audio Processor, Volume I, Section II, Installation.

1753 600

WARNING: Disconnect primary power prior to servicing.

SECTION III

CONTROLS AND INDICATORS

3-1. GENERAL.

3-2. Figure 3-1 shows all of the user controls and indicators on the output module, and table 3-1 describes the function of each and its affect on module operation.

1753 600

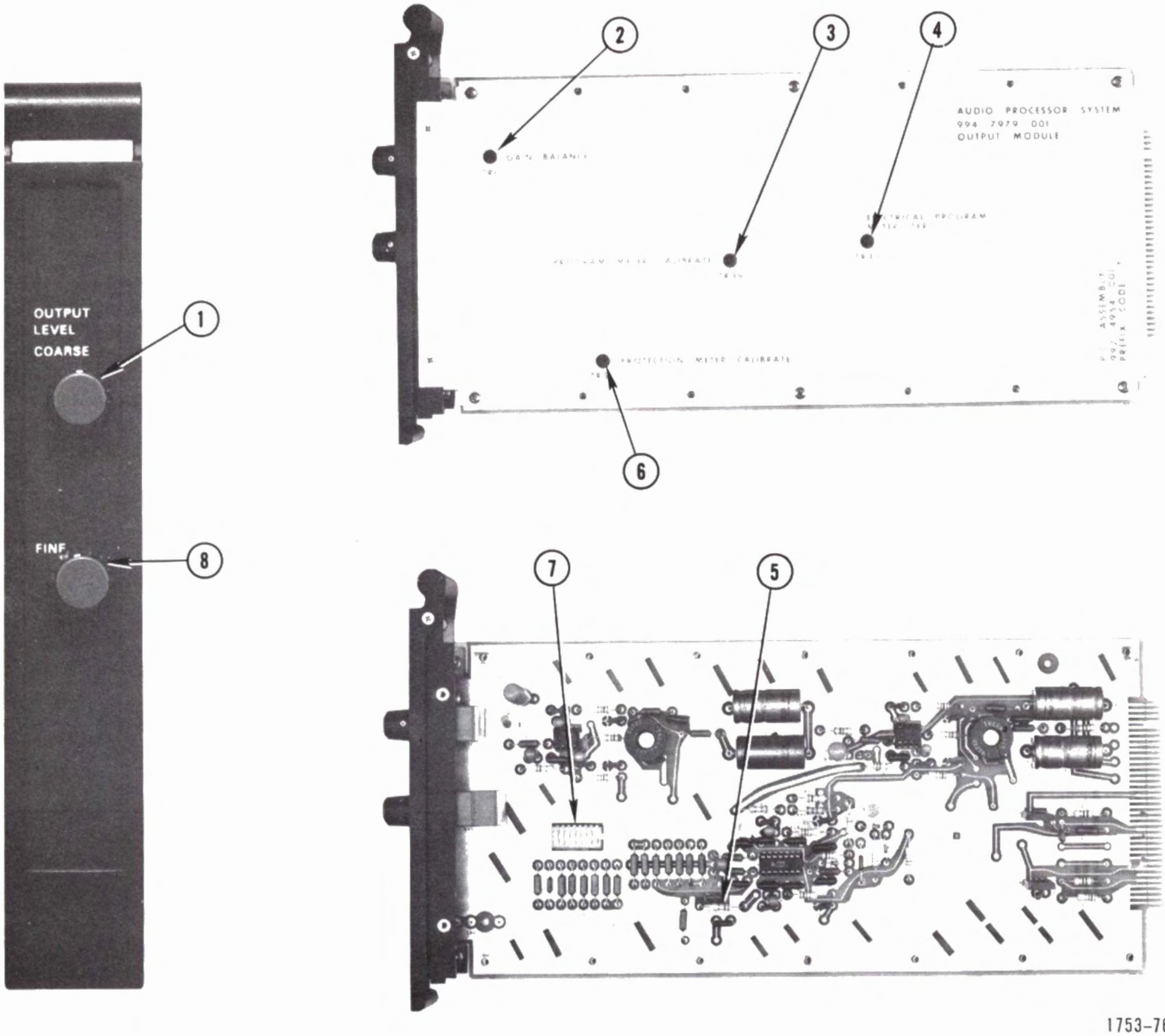


Figure 3-1. Output Module Controls and Indicators

1753 600

WARNING: Disconnect primary power prior to servicing.

Table 3-1. Output Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	OUTPUT LEVEL/COARSE	Adjusts output signal level of the output amplifier.
2	GAIN BALANCE, 7R1	Adjusts the gain of the non-inverting input amplifier over a 1.4 dB range to provide a balanced output.
3	PROGRAM METER CALIBRATE, 7R39	Adjusts the gain of the meter amplifier providing meter full scale calibration.
4	ELECTRICAL PROGRAM METER ZERO, 7R43	Adjusts the positive dc offset voltage to the program meter circuit.
5	JUMPER PLUG, 7P2	Determines the source of signal for the program meter circuit. When J1 and J2 are connected, output level of the output module is metered. When J2 and J3 are connected, protection module relative modulation is displayed on the program meter.
6	PROTECTION METER CALIBRATE, 7R52	Adjusts the program meter full scale indication when monitoring the protection module.
7	METER SENSITIVITY, 7S1	Selects program meter sensitivity to display 100% modulation for the specified output levels (dBm) as follows: CLOSED POSITION — dBm OUTPUT FOR 100% MODULATION 1 — +4 2 — +8 3 — +10 4 — +12 5 — +14 6 — +16 7 — +18 When 7P2 connects J2 and J3, position 8 is closed and all others are open to display relative modulation from the protection module.

1753 600

WARNING: Disconnect primary power prior to servicing.

Table 3-1. Output Module Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
8	OUTPUT LEVEL/FINE, 7R49	Trims the COARSE output signal level adjustment (3.5 dB range).

1753 600

WARNING: Disconnect primary power prior to servicing.

SECTION VI

PRINCIPLES OF OPERATION

4-1. CIRCUIT DESCRIPTION.

4-2. The output module consists of two basic sections: the output amplifier section and the meter drive and calibration section. As shown in figure 4-1, the output amplifier section accepts the single-ended audio signal from the protection module and converts it to a balanced differential signal suitable for driving a 600 ohm line. The meter drive and calibration section converts the signal back to single-ended, rectifies it and transforms it to a level suitable for driving the program meter in the output meter module. An additional input is also provided to monitor the output from the protection module.

4-3. OUTPUT AMPLIFIER SECTION.

4-4. The audio signal from the protection module output buffers enters the output module through FINE OUTPUT LEVEL potentiometer, 7R49, and COARSE OUTPUT LEVEL potentiometer, 7R50 where the system output level is set with 7R50 and trimmed 3.5 dB by 7R49. The circuit consisting of 7U1, 7U2, 7U3, 7U4, and associated components performs the conversion from single ended to balanced differential operation. Operational amplifier, 7U1, and current booster, 7U2, form a noninverting amplifier with low impedance, high current output. 7U3 and 7U4 form an inverting amplifier with similar characteristics. The gain of the 7U3, 7U4 amplifier is set at 10 (20 dB) by resistors 7R4 and 7R11. The gain of the 7U1, 7U2 amplifier is set by the ratio of the sum of 7R1, 7R2, and 7R10 to the sum of 7R1 and 7R2. GAIN BALANCE potentiometer, 7R1 is provided so that the amplifier gain can be adjusted to exactly 10 to provide an accuratley balanced output signal. The final result is two low impedance outputs of the same amplitude, 180 degrees out of phase.

4-5. Series resistors 7R14 and 7R15 establish system output impedance of 600 ohms, and 7R16 and 7R17 isolate the outputs from ground. Capacitor pairs 7C25, 7C26 and 7C28, 7C29, connected back to back provide complete nonpolarized dc output isolation for +10 dBm output (2.45 volts RMS).

4-6. METER DRIVE AND CALIBRATION SECTION.

4-7. The outputs of 7U2 and 7U4 are applied to differential amplifier, 7U5A, through 11.75 dB pads 7R19, 7R20 and 7R22, 7R23. These pads prevent overdrive of 7U5A at maximum output. For +10 dBm system output, the output of 7U5A is 1.26 volts RMS. On the output of 7U5A is jumper plug, 7P2, which is used to route either the output amplifier signal, or the signal from the protection module to the metering circuit.

4-8. The selected signal is amplified by 7U5B whose gain is determined by 7R30 and the setting of switch 7S1 as shown in table 4-1.

Table 4-1. Amplifier 5U5B Gain Selection

SWITCH 7S1 POSITION CLOSED	U5B GAIN
1	16 dB
2	12 dB
3	10 dB
4	8 dB
5	6 dB
6	4 dB
7	2 dB
8	4.23 $\pm$1 dB

When position 8 of 7S1 is closed, gain is trimmed $\pm$1 dB by 7R52. This position is normally used to calibrate the meter when the protection module signal is being metered. For +10 dBm system output, the 7U5B output signal is normally 4 volts RMS.

4-9. 7U5C is a unity gain, negative half wave rectifier. Pulses from 7U5C are inverted by 7U5D and routed to the output meter module through isolation resistor 7R48. A slight positive dc offset required by the output meter module circuitry is provided by ELECTRICAL PROGRAM METER ZERO potentiometer, 7R43, which samples the forward voltage drop across 7CR2. 7R42 limits current thorugh 7CR2 and 7CR3, resulting in a constant voltage drop across the diodes. A portion of the voltage across 7CR2 is picked off by 7R43, attenuated by a factor of 0.5 by 7R45 and fed to the non-inverting input of 7U5D. This results in a positive dc offset voltage at the output of 7U5D which varies with the setting of 7R43.

1753 600

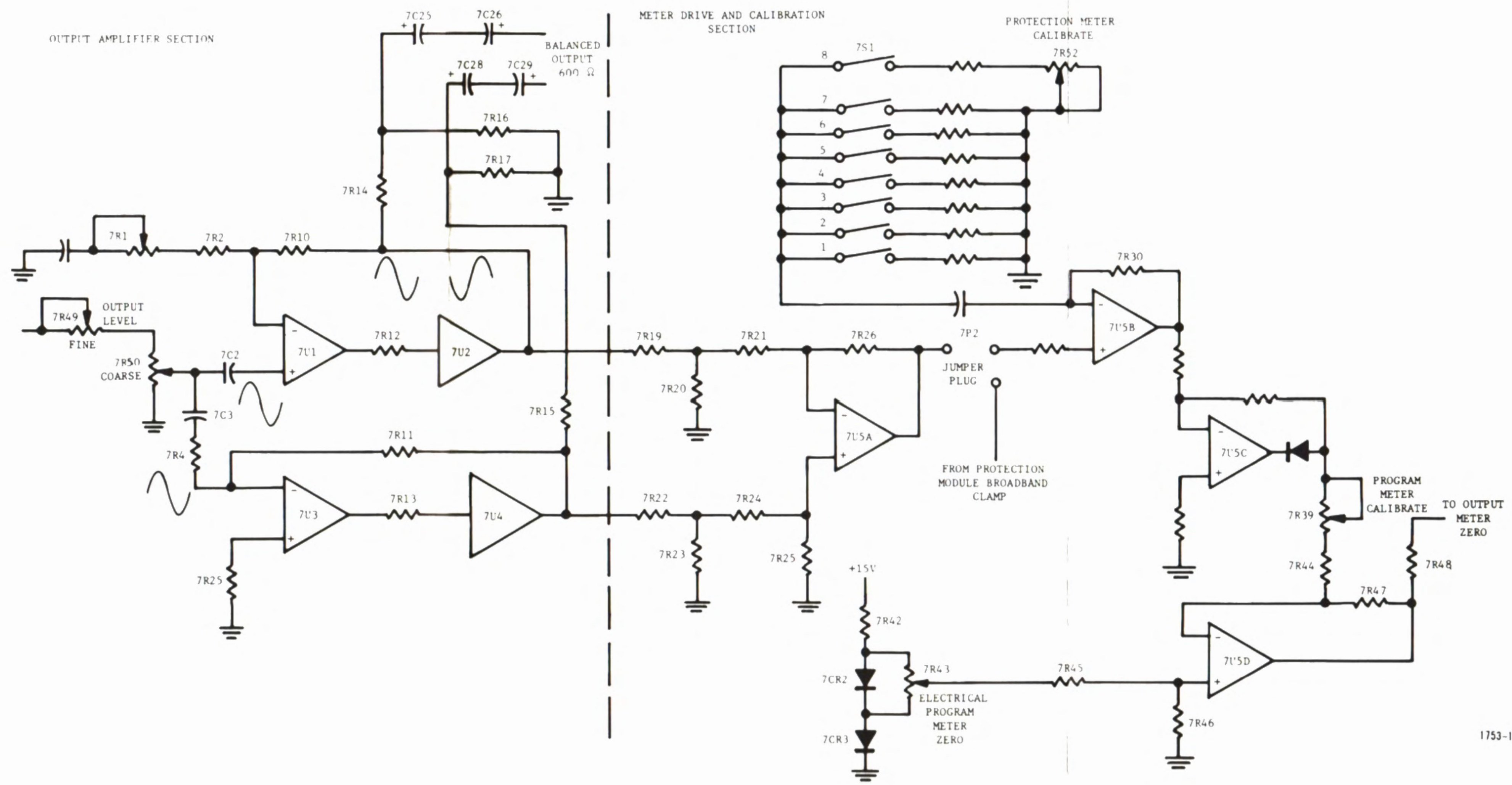


FIGURE 4-1.
OUTPUT MODULE
BLOCK DIAGRAM

SECTION V

MAINTENANCE AND TROUBLESHOOTING

5-1. GENERAL.

5-2. This section describes the maintenance and troubleshooting procedures for the output module. As shown in figure 5-1, reference designators are printed on the printed circuit board. In addition, certain parts, significant to the discussion which follow are flagged. In the text and on the schematic (figure 5-2), the reference designators are prefixed with the number "7". If the system malfunctions and the problem is traced to the output module, figures 5-3 and 5-4 can be used as guides in troubleshooting. For general repair and cleaning technique and a list of recommended test equipment, refer to Technical Manual 888 1753 001, Volume I, Section V.

5-3. MODULE ADJUSTMENTS.

5-4. Internal controls on the module are set at the factory before shipment. Should any adjustment of these controls be become necessary, such as following replacement of parts, the controls may be accessed through the access holes in the covers by using an extender card. The covers should not require removal except for troubleshooting or replacement of parts. When using the extender card, care should be taken that the module is properly supported at the front panel end, and is inserted straight into the extender card edge connector. If any parts are replaced and it becomes necessary to make measurements on the board, the module cover must be removed by removing eight cross-recessed screws.

5-5. ADJUSTMENT PROCEDURES.

5-6. ELECTRICAL PROGRAM METER ZERO ADJUSTMENT. With no audio input to the MSP 100, adjust ELECTRICAL PROGRAM METER ZERO control, 7R43, until the program meter pointer indicates zero on the meter scale.

NOTE

> Before adjusting the electrical meter zero, make certain that the meter is mechanically zeroed. This is done by adjusting the small plastic screw directly below the meter face with ac power turned off.

1753 600

5-7. PROGRAM METER CALIBRATE ADJUSTMENT. Set the following operational controls to the specified positions:

Protection Module	
PROTECTION FUNCTION	OFF
Control Module	
COMPRESSION FUNCTION (All 3 bands)	OFF
EXPANSION FUNCTION (All 3 bands)	OFF

WARNING: Disconnect primary power prior to servicing.

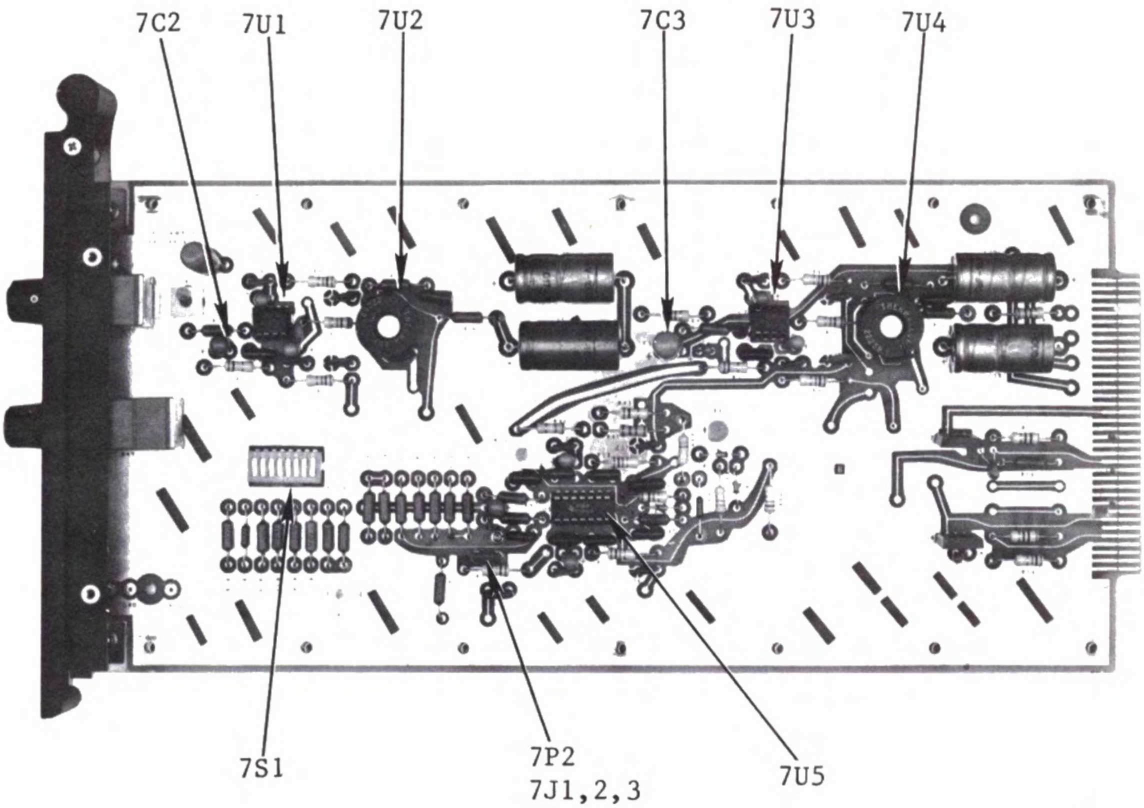
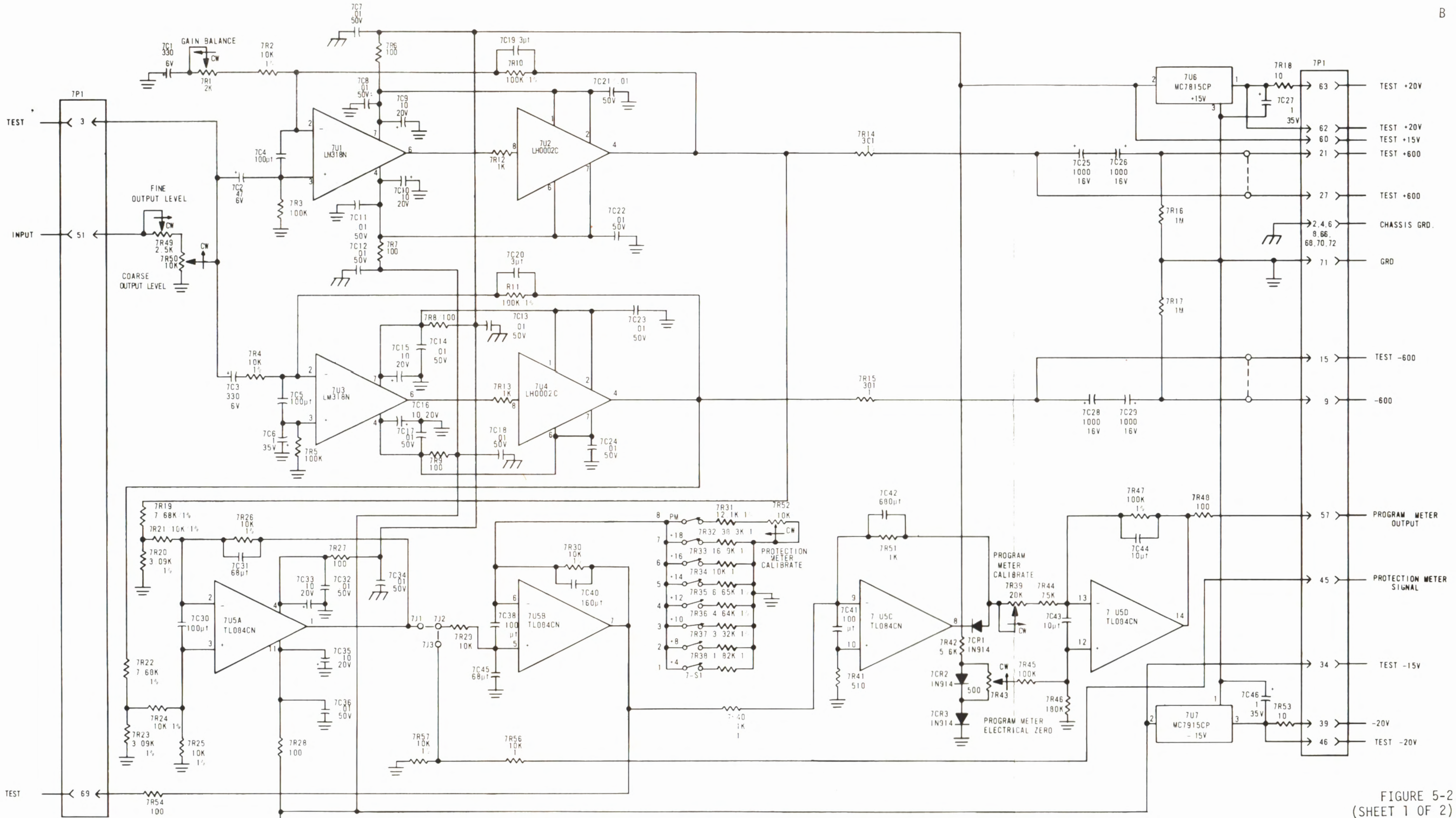


Figure 5-1. Output Module Parts Layout

1753 600

WARNING: Disconnect primary power prior to servicing.



3 ALL CAPACITANCE IN uF
2 ALL RESISTANCE IN OHMS
1 ALL 1% RESISTORS ARE 1/4W
ALL OTHER RESISTORS ARE 1/2W 5%
UNLESS OTHERWISE NOTED
NOTES

FIGURE 5-2.
(SHEET 1 OF 2)
OUTPUT MODULE
SCHEMATIC
843 1977 001

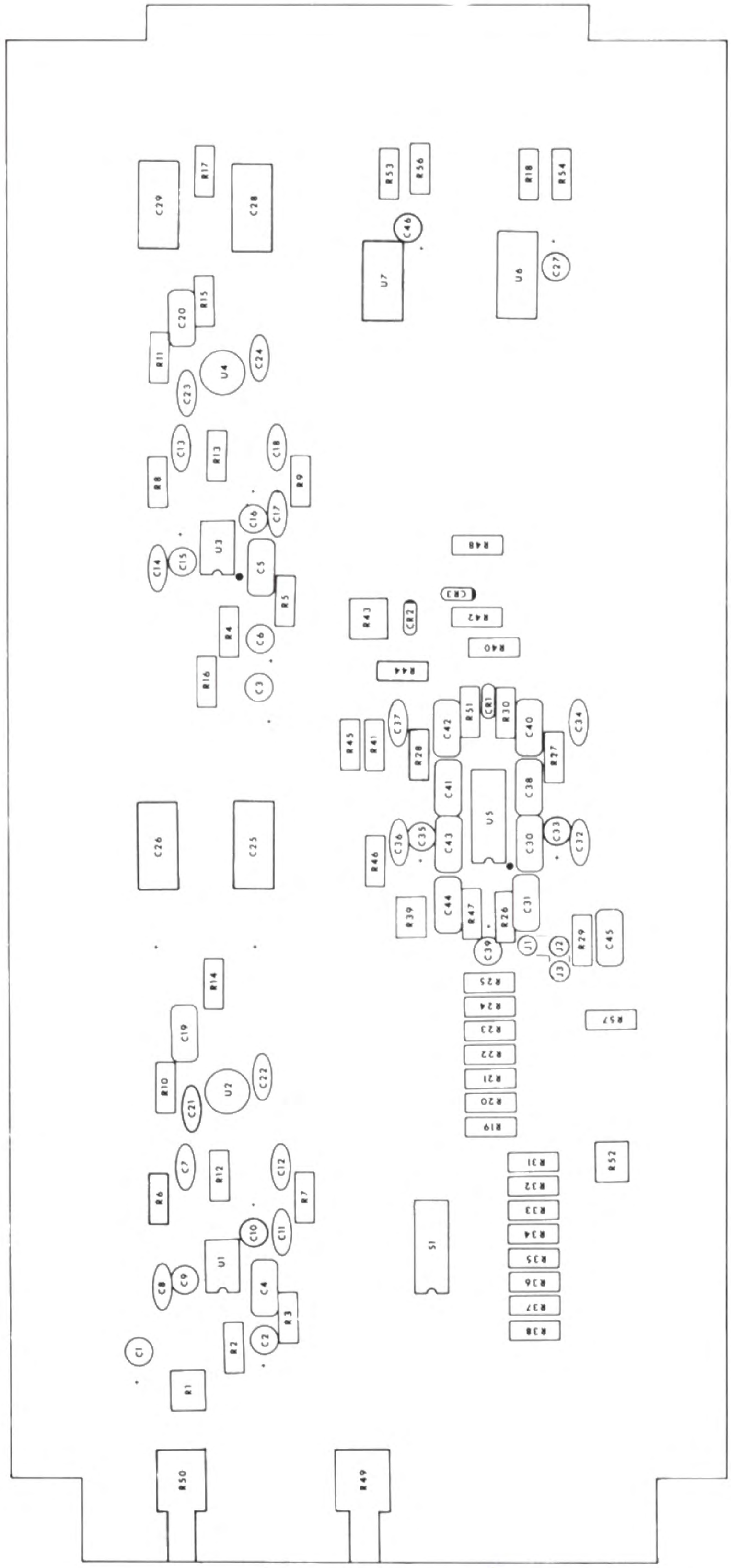


FIGURE 5-2. (SHEET 2 OF 2) OUTPUT AMP
COMPONENT LOCATION - 843 2214 001

WARNING: Disconnect primary power prior to servicing.

Limiter Module
LIMITER FUNCTION ON

Limiter Meter Module
METER/L BOTH R L

Program Meter Module
METER/L BOTH R L

a. On the output module PC board, close position 3 of 7S1 (all other elements open) and jumper J1 and J2 with jumper plug 7P2.

b. Connect a 600-ohm load to the MSP 100 output terminals. Connect a sine wave signal to the left input terminals and adjust the signal level for a mid scale reading on the limiter meter.

c. Connect an ac voltmeter across the output terminals and adjust OUTPUT LEVEL/COARSE and OUTPUT LEVEL/FINE controls on the output module front panel for a +10 dBm indication on the voltmeter.

d. Adjust PROGRAM METER CALIBRATE control, 7R39, until the program meter reads 100%.

5-8. PROTECTION METER CALIBRATE ADJUSTMENT. Set the following operational controls to the specified positions:

Limiter Module
LIMITER FUNCTION ON

Limiter Meter Module
METER/L BOTH R L

Program Meter Module
METER/L BOTH R L

FM Protection Module
PROTECTION FUNCTION ON
HIGH FREQUENCY MODE HARD

a. On the output module PC board, close element 8 of meter sensitivity switch 7S1 (all other elements open). Jumper J2 and J3 with jumper plug 7P2.

b. Connect a 600-ohm load to the MSP 100 output terminals. Connect a sine wave signal at 10 kHz to the left input terminals and adjust the signal level for a mid scale reading on the limiter meter.

c. Adjust PROTECTION METER CALIBRATE control, 7R52, until the program meter reads 100%.

5-9. GAIN BALANCE ADJUSTMENT.

a. Adjust the sine wave signal frequency to 1 kHz with level sufficient to cause some limiter meter deflection. Set the PROTECTION FUNCTION switch on the protection module to OFF.

b. Connect a 100k, 1% resistor to terminal 6 on input/output terminal strip 12TB1 on the rear of the MSP 100. Connect another 100k, 1% resistor to terminal 7. Twist the free ends of the two resistors together.

c. Connect an ac voltmeter across terminals 6 and 7 of 12TB1 and adjust OUTPUT LEVEL/COARSE and OUTPUT LEVEL/FINE controls on the output module front panel for a +10 dBm reading on the voltmeter.

d. Connect the voltmeter hot lead to the ends of the two 100k resistors that are twisted together. Connect the voltmeter ground lead termunal 8 of 12TB1.

e. Adjust GAIN BALANCE control, 7R1, on the output module for a minimum reading on the voltmeter.

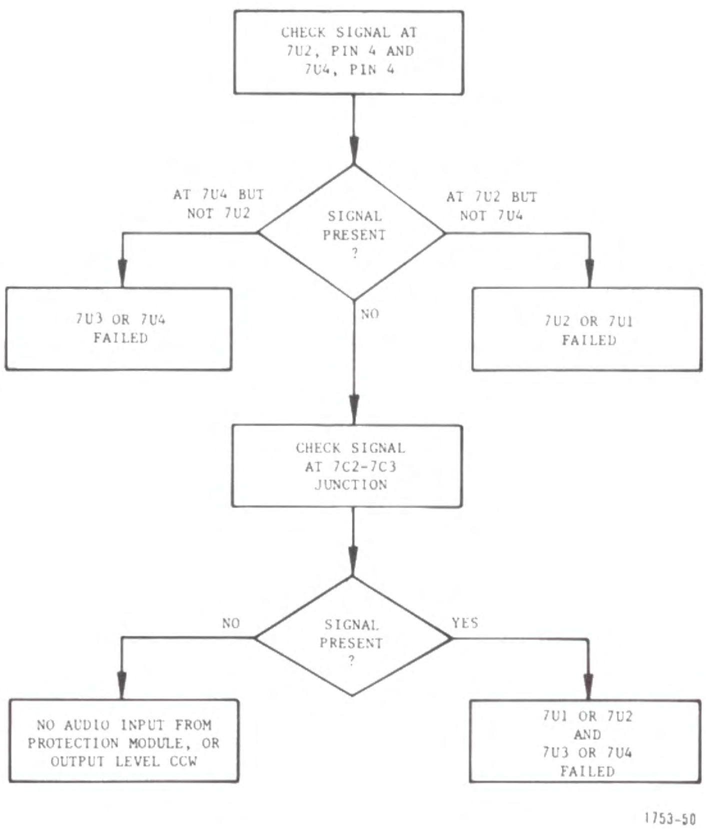
f. Remove the 100k resistors.

5-10. TROUBLESHOOTING.

5-11. Problems in the output module would fall into three categories: 1) output amplifier, 2) meter amplifier, and 3) power supply. Figures 5-3, 5-4, and 5-5 are included as aids in localizing such faults.

1753 600

WARNING: Disconnect primary power prior to servicing.



1753 600

Figure 5-3. Output Amplifier Troubleshooting Chart

WARNING: Disconnect primary power prior to servicing.

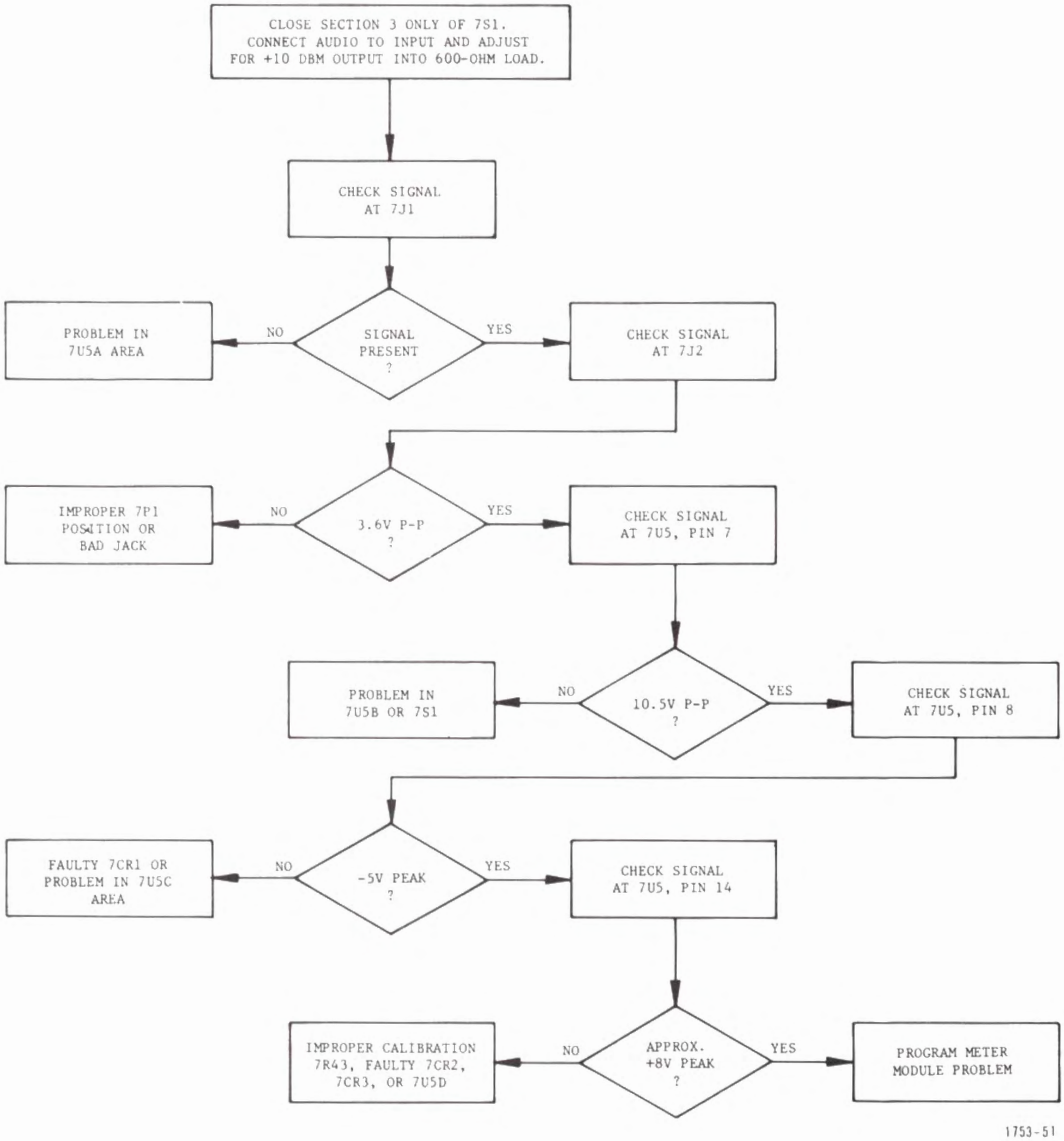


Figure 5-4. Program Meter Amplifier Troubleshooting Chart

1753 600

WARNING: Disconnect primary power prior to servicing.

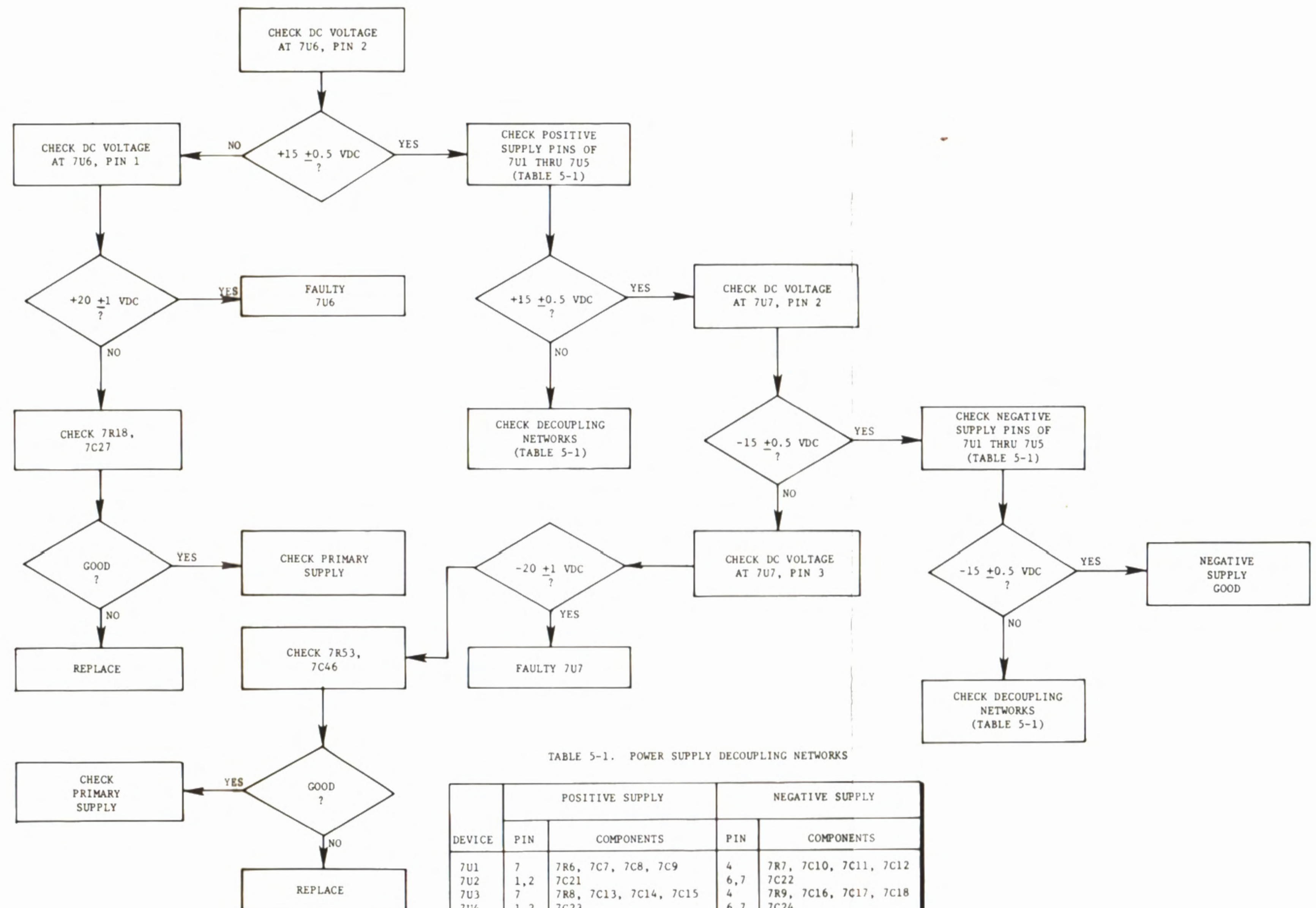


TABLE 5-1. POWER SUPPLY DECOUPLING NETWORKS

DEVICE	POSITIVE SUPPLY		NEGATIVE SUPPLY	
	PIN	COMPONENTS	PIN	COMPONENTS
7U1	7	7R6, 7C7, 7C8, 7C9	4	7R7, 7C10, 7C11, 7C12
7U2	1,2	7C21	6,7	7C22
7U3	7	7R8, 7C13, 7C14, 7C15	4	7R9, 7C16, 7C17, 7C18
7U4	1,2	7C23	6,7	7C24
7U5	4	7R27, 7C32, 7C33, 7C34	11	7R28, 7C35, 7C36, 7C37
7U6	1	7R18, 7C27		
7U7			3	7R53, 7C46

1753-60

FIGURE 5-5.
OUTPUT MODULE POWER SUPPLY
TROUBLESHOOTING CHART

SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This section provides a description, reference designator, and order number for replaceable electrical parts, assemblies and selected mechanical parts necessary for proper maintenance of the output module. Table 6-1 lists parts for the module assembly and table 6-2 lists the parts for the printed circuit board assembly.

6-3. REPLACEABLE PARTS SERVICE.

6-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Service Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

6-5. TECHNICAL ASSISTANCE.

6-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Department during normal working hours. Emergency technical service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290 Quincy, Illinois, 62301. The Harris factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

WARNING: Disconnect primary power prior to servicing.

Table 6-1. Output Module Assembly - 994 7979 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
	358 2063 000	Insert, Blue	1
	992 4954 001	Output Module Printed Circuit Board (Refer to table 6-2)	1
	650 0271 000	Knob	2

1753 600

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Table 6-2. Output Module Printed Circuit Board - 992 4954 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	526 0045 000	Capacitor, 330 mF, 6V	1
C2	526 0101 000	Capacitor, 47 mF, 6V	1
C3	526 0045 000	Capacitor, 330 mF, 6V	1
C4,C5	500 0759 000	Capacitor, 100 pF, 500V	2
C6	526 0050 000	Capacitor, 1 mF, 35V	1
C7,C8	516 0375 000	Capacitor, 0.01 mF, 50V	2
C9,C10	526 0048 000	Capacitor, 10 mF, 20V	2
C11 thru C14	516 0375 000	Capacitor, 0.01 mF, 50V	4
C15,C16	526 0048 000	Capacitor, 10 mF, 20V	2
C17,C18	516 0375 000	Capacitor, 0.01 mF, 50V	2
C19,C20	500 0802 000	Capacitor, 3 pF, 500V	2
C21 thru C24	516 0375 000	Capacitor, 0.01 mF, 50V	4
C25,C26	522 0391 000	Capacitor, 1000 mF, 16V	2
C27	526 0050 000	Capacitor, 1 mF, 35V	1
C28,C29	522 0391 000	Capacitor, 1000 mF, 16V	2
C30	500 0759 000	Capacitor, 100 pF, 500V	1
C31	500 0821 000	Capacitor, 68 pF, 500V	1
C32	516 0375 000	Capacitor, 0.01 mF, 50V	1
C33	526 0048 000	Capacitor, 10 mF, 20V	1
C34	516 0375 000	Capacitor, 0.01 mF, 50V	1
C35	526 0048 000	Capacitor, 10 mF, 20V	1
C36,C37	516 0375 000	Capacitor, 0.01 mF, 50V	2

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Output Module Printed Circuit Board - 992 4954 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C38	500 0759 000	Capacitor, 100 pF, 500V	1
C40	500 0821 000	Capacitor, 68 pF, 500V	1
C41	500 0759 000	Capacitor, 100 pF, 500V	1
C42	500 0840 000	Capacitor, 680 pF, 300V	1
C43,C44	500 0804 000	Capacitor, 10 pF, 500V	2
C45	500 0821 000	Capacitor, 68 pF, 500V	1
C46	526 0050 000	Capacitor, 1 mF, 35V	1
CR1,CR2,CR3	384 0205 000	Diode, 1N914	3
J1,J2,J3	404 0523 000	Jack	3
P1	610 0679 000	Plug	1
R1	550 0813 000	Potentiometer, 2k (Spectrol 63P)	1
R2	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R3	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R4	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R5	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R6 thru R9	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	4
R10,R11	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	2
R12,R13	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	2
R14,R15	548 0710 000	Resistor, 301 ohm, 1/4W, 1%	2
R16,R17	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	2

1753 600

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Output Module Printed Circuit Board - 992 4954 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R18	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R19	548 1359 000	Resistor, 7680 ohm, 1/4W, 1%	1
R20	548 0396 000	Resistor, 3090 ohm, 1/4W, 1%	1
R21	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R22	548 1359 000	Resistor, 7680 ohm, 1/4W, 1%	1
R23	548 0396 000	Resistor, 3090 ohm, 1/4W, 1%	1
R24,R25,R26	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	3
R27,R28	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R29	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R30	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R31	548 1401 000	Resistor, 12.1k ohm, 1/4W, 1%	1
R32	548 1368 000	Resistor, 38.3k ohm, 1/4W, 1%	1
R33	548 1365 000	Resistor, 16.9k ohm, 1/4W, 1%	1
R34	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R35	548 1358 000	Resistor, 6650 ohm, 1/4W, 1%	1
R36	548 1357 000	Resistor, 4640 ohm, 1/4W, 1%	1
R37	548 0556 000	Resistor, 3320 ohm, 1/4W, 1%	1
R38	548 1353 000	Resistor, 1870 ohm, 1/4W, 1%	1
R39	550 0760 000	Potentiometer, 20k ohm	1
R40	548 0318 000	Resistor, 1k ohm, 1/4W, 1%	1
R41	540 1112 000	Resistor, 510 ohm, 1/2W, 5%	1
R42	540 1183 000	Resistor, 5.6k ohm, 1/2W, 5%	1

1753 600

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Output Module Printed Circuit Board - 992 4954 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R43	550 0625 000	Potentiometer, 500 ohm (Spectrol 63P)	1
R44	540 1152 000	Resistor, 75k ohm, 1/2W, 5%	1
R45	540 1159 000	Resistor, 100k ohm, 1/2W, 5%	1
R46	540 1250 000	Resistor, 180k ohm, 1/2W, 5%	1
R47	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R48	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R49	550 0915 000	Potentiometer, 2.5k ohm, 2W	1
R50	550 0916 000	Potentiometer, 10k ohm, 2W	1
R51	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R52	550 0626 000	Potentiometer, 10k ohm, 1/4W	1
R53	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	1
R54	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R56,R57	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	2
S1	604 0851 000	Switch, Slide (Minidip) 8 SPST	1
U1	382 0472 000	Integrated Circuit, LM318N	1
U2	382 0172 000	Integrated Circuit, LH0002CH	1
U3	382 0472 000	Integrated Circuit, LM318N	1
U4	382 0172 000	Integrated Circuit, LH0002CH	
U5	382 0519 000	Integraged Circuit, TL084CN	1
U6	382 0359 000	Integrated Circuit, Regulator, +MC7815CP	1
U7	382 0360 000	Integrated Circuit, Regulator, -MC7915CP	1

1753 600

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Output Module Printed Circuit Board - 992 4954 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
XU1	404 0504 000	Socket, Integrated Circuit, 8 Pin	1
XU2	404 0304 000	Socket, Integrated Circuit, 8 Pin	1
XU3	404 0504 000	Socket, Integrated Circuit, 8 Pin	1
XU4	404 0304 000	Socket, Integrated Circuit, 8 Pin	1
XU5	404 0505 000	Socket, Integrated Circuit, 14 Pin	1
	843 1829 001	Printed Circuit Board	1

1753 600

WARNING: Disconnect primary power prior to servicing.

AGC METER MODULE
888 1753 700

TECHNICAL MANUAL

AGC METER MODULE

992 4955 001

HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1753 700

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LIST OF EFFECTIVE PAGES

TOTAL NUMBER OF PAGES IS AS FOLLOWS: 39

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WARNING: Disconnect primary power prior to servicing.

SAFETY NOTICE

WARNING: THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND UNDER CERTAIN CONDITIONS, COULD BE FATAL.

This manual is intended as general guidance for trained and qualified installation, operating, maintenance and service personnel who are familiar with and aware of the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

THE INSTALLATION, OPERATION, MAINTENANCE AND SERVICING OF THIS EQUIPMENT INVOLVES RISKS TO BOTH PERSONNEL AND EQUIPMENT, AND MUST BE PERFORMED ONLY BY PROPERLY TRAINED AND EXPERIENCED PERSONNEL EXERCISING DUE CARE. PERSONNEL MUST FAMILIARIZE THEMSELVES WITH SAFETY REQUIREMENTS, SAFE HANDLING AND OPERATING PRACTICE, AND RELATED FIRST-AID PROCEDURES (E.G., FOR ELECTRICAL BURNS AND ELECTRICAL SHOCK).

HARRIS CORPORATION Broadcast Equipment Division shall not be responsible for injury or damage resulting from improper installation, operation, maintenance or servicing, or from the use of improperly trained or inexperienced personnel in the performance of such tasks, or from the failure of persons engaged in such tasks to exercise due care.

As with all electronic equipment, care should be taken to avoid electrical shock in all circuits where substantial currents or voltages may be present, either through design or short circuit. Caution should also be observed in lifting and hoisting equipment, especially regarding large structures, during installation.

LIABILITY LIMITATION

The procedures outlined in this Manual are based on the information available at the time of publication and should permit the specified use with minimum risk. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

The manufacturer is specifically not liable for any damage or injury arising out of failure to follow the instructions in this Manual or failure to exercise due care and caution during installation, operation, maintenance and service of this equipment.

CAUTIONARY NOTICE

Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

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WARNING: Disconnect primary power prior to servicing.

LIST OF TABLES

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LIST OF ILLUSTRATIONS

WARNING: Disconnect primary power prior to servicing.

SECTION I

GENERAL DESCRIPTION

1-1. EQUIPMENT PURPOSE.

1-2. There are three identical AGC meter modules in the Audio Processor System, one each for the high frequency, mid frequency, and low frequency bands. The primary purpose of this module is to provide meter indications of the AGC action (compression and expansion) taking place in the system. The main circuit element for this function is the logarithmic amplifier which drives the meter. Each module contains two printed circuit boards, one for expansion and one for compression. Controls are also included for compression threshold, attack, recovery, and slope; and expansion threshold, attack, and recovery. A selector switch allows monitoring left, right, or both channels.

1-3. TECHNICAL CHARACTERISTICS.

1-4. Table 1-1 lists the electrical characteristics of the module.

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Table 1-1. Electrical Characteristics

FUNCTION	CHARACTERISTIC
Meter Indication	Indicates the amount of compression and expansion taking place in the input/AGC module. Monitors left, right, or both channels.
Meter Calibration Accuracy	Indication is relative rather than quantitative. Repeatability is within 3% of full scale.
Functions	Provisions for selecting compression and expansion attack and recovery time, compression and expansion threshold, and compression slope (ratio).
Power	±15 vdc supplied from the left output module.

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SECTION II

INSTALLATION

2-1. GENERAL.

2-2. Installation of the AGC meter module is covered in Technical Manual 888 1753 001, MSP 100 Audio Processor, Volume I, Section II, Installation.

SECTION III

CONTROLS AND INDICATORS

3-1. GENERAL.

3-2. Figure 3-1 shows all of the user controls and indicators provided on the AGC meter module and table 3-1 describes the function of each and its affect on module operation.

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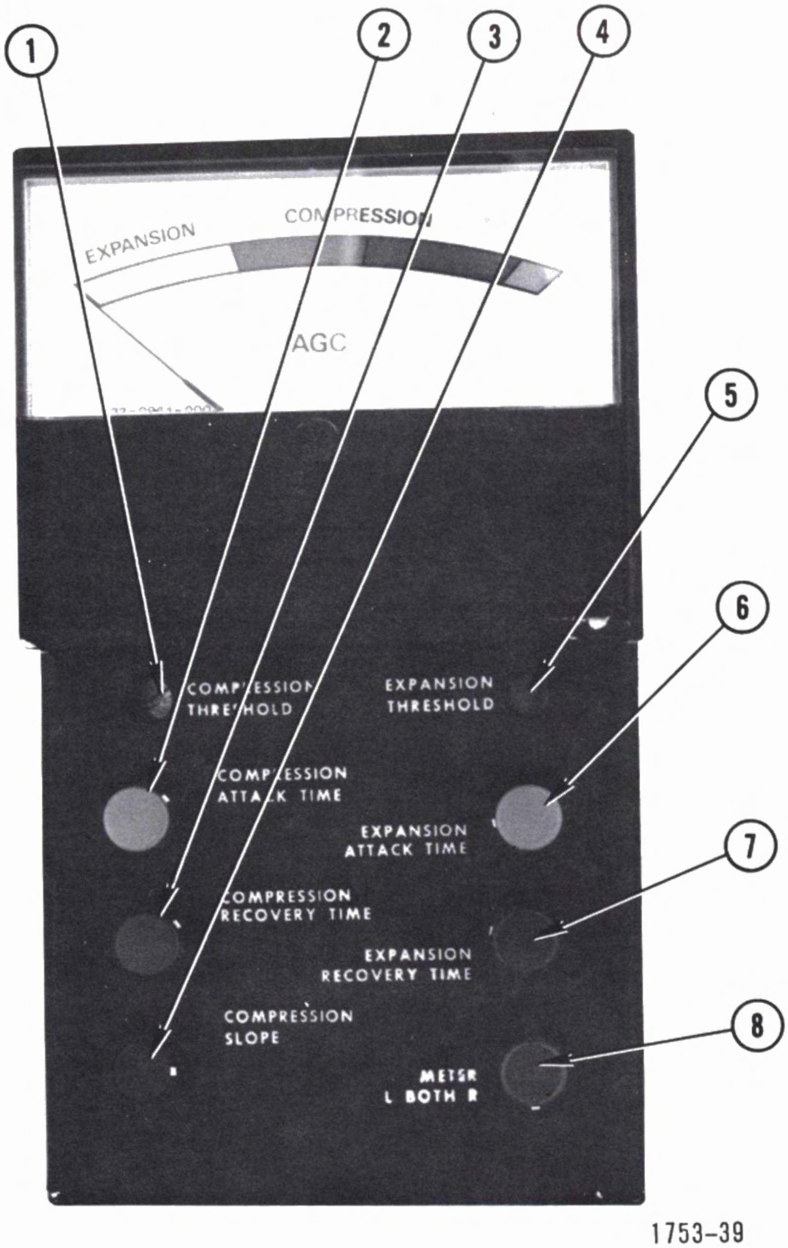

Figure 3-1. AGC Meter Module Controls and Indicators (Sheet 1 of 2)

1753 700

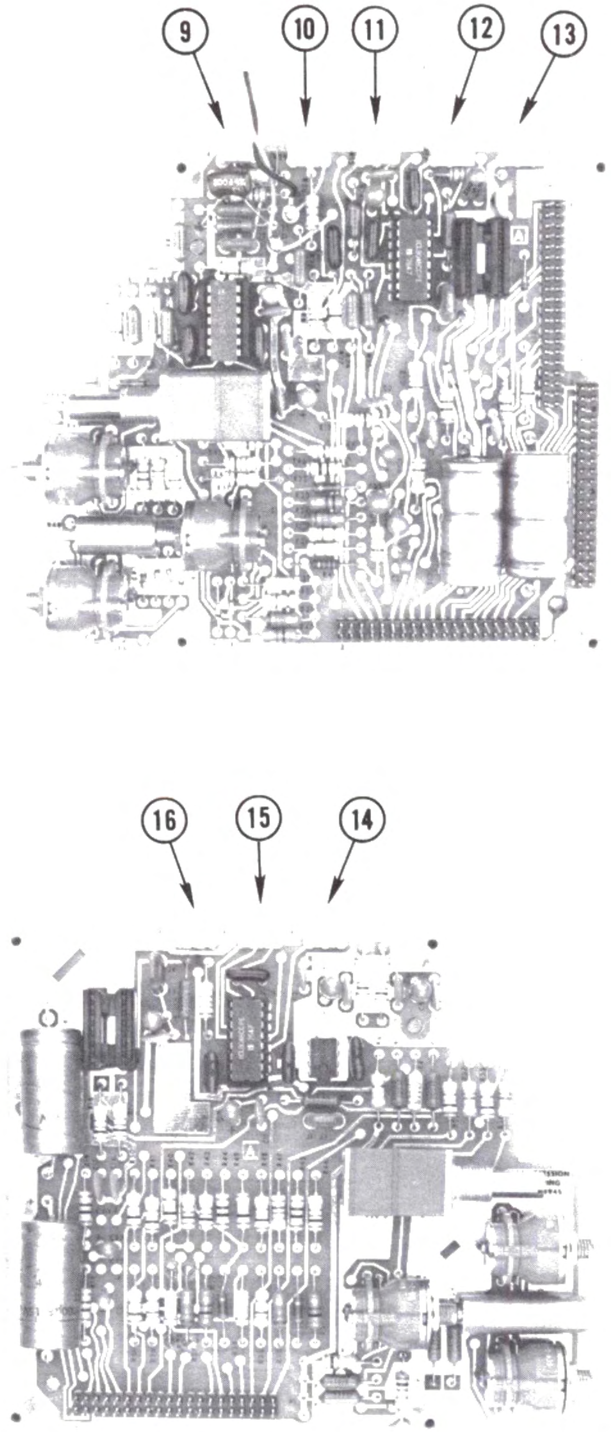

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Figure 3-1. AGC Meter Module Controls and Indicators (Sheet 2 of 2)

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WARNING: Disconnect primary power prior to servicing.

Table 3-1. AGC Meter Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	COMPRESSION THRESHOLD, 8R20	Adjusts the input level at which compression begins.
2	COMPRESSION ATTACK TIME, 8S2	Selects one of five attack time resistors to establish the manual attack time constant.
3	COMPRESSION RECOVERY TIME, 8S1	Selects one of five recovery time resistors to establish the manual recovery time constant.
4	COMPRESSION SLOPE, 8S3	Selects gain of the pulse stretcher in the control module (4 positions).
5	EXPANSION THRESHOLD, 9R30	Adjusts the input level at which expansion begins.
6	EXPANSION ATTACK TIME, 9S2	Selects one of five attack time resistors to establish the manual recovery time constant.
7	EXPANSION RECOVERY TIME, 9S1	Selects one of five recovery time resistors to establish the manual recovery time constant.
8	METER L/BOTH/R, 9S3	L Position: Selects left audio channel for metering. BOTH Position: Selects both left and right audio channels for metering (meter indication is the greater of the two). R Position: Selects right audio channel for metering.
9	BIAS ADJUSTMENT, 9R1	Adjusts -10 vdc bias voltage for the log amplifier circuits.
10	METER CURRENT ADJUSTMENT, 9R29	Adjusts current to the AGC meter for calibration.
11	OFFSET ADJUSTMENT, 9R15	Adjusts dc offset of log amplifier, 9U2.
12	OFFSET ADJUSTMENT, 9R17	Adjusts dc offset of log amplifier, 9U2.

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Table 3-1. AGC Meter Module Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
13	SCALE FACTOR ADJUSTMENT, 9R19	Adjusts the scale factor of log amplifier, 9U2.
14	OFFSET ADJUSTMENT, 8R11	Adjusts dc offset of log amplifier, 8U2.
15	OFFSET ADJUSTMENT, 8R12	Adjusts dc offset of log amplifier, 8U2.
16	SCALE FACTOR ADJUSTMENT, 8R15	Adjusts scale factor of log amplifier, 8U2.

WARNING: Disconnect primary power prior to servicing.

SECTION IV

PRINCIPLES OF OPERATION

4-1. CIRCUIT DESCRIPTION.

4-2. There are three identical AGC meter modules, one each for the high frequency band, the mid frequency band, and the low frequency band. Since their functions are identical, only the low frequency module will be described. The primary function of the module is to monitor the AGC action taking place in its particular band. Also included are the compression and expansion attack and recovery time circuits, the compression slope circuit. the compression and expansion threshold controls, and a switch which allows monitoring of either the left channel, the right channel, or both channels simultaneously.

4-3. LOGARITHMIC AMPLIFIER CIRCUIT.

4-4. There are two circuit boards within the module, one contains the expansion circuits and the other the compression circuits. Each board has a logarithmic amplifier. As shown in figure 4-1, switch 9S3 may be used to select the right channel (R), the left channel (L), or both channels (BOTH) for monitoring. Assuming 9S3 is in the L position, expansion control voltage from 3U4 in the control module (or a negative bias voltage from the EXPANSION FUNCTION switch, if in the OFF position) is fed to unity gain inverting amplifier 9U1B through diode 9CR1. The output of 9U1B is summed with a negative bias derived from voltage divider 9R1, 9R2, 9R3, in unity gain amplifier 9U1A. The output of 9U1A is applied to the input of 9U2. The output of 9U2 is the logarithm of its input multiplied by the scale factor set by SCALE FACTOR ADJUST potentiometer, 9R19. DC output offset of 9U2 is nulled out by 9R15 and 9R17.

4-5. The logarithmic expansion signal is summed with the logarithmic compression signal from amplifier 8U2 (on the compression PC board) in summing amplifier, 9U1C. The output of 9U1C drives the meter which is mounted on the front panel of the AGC meter module. The meter is calibrated for full scale indication with METER CURRENT ADJ. potentiometer, 9R29.

4-6. The compression signal from 2U4 in the control module is applied to 9S3 through diode 9CR5 and routed to inverting amplifier, 8U1 on the compression PC board. Here, a negative bias derived from voltage divider 9R1, 9R2, 9R3, is added to the compression control voltage. The output of 8U1 feeds logarithmic amplifier, 8U2. Operation of 8U2 is identical to that described for 9U2 (paragraph 4-4).

4-7. OTHER CIRCUITS.

4-8. The compression slope, and compression and expansion threshold circuits, and attack time and recovery time circuits are shown in figures 4-2, 4-3, and 4-4, respectively. For an explanation of the operation of these circuits, refer to Technical Manual 888 1753 300, Section IV.

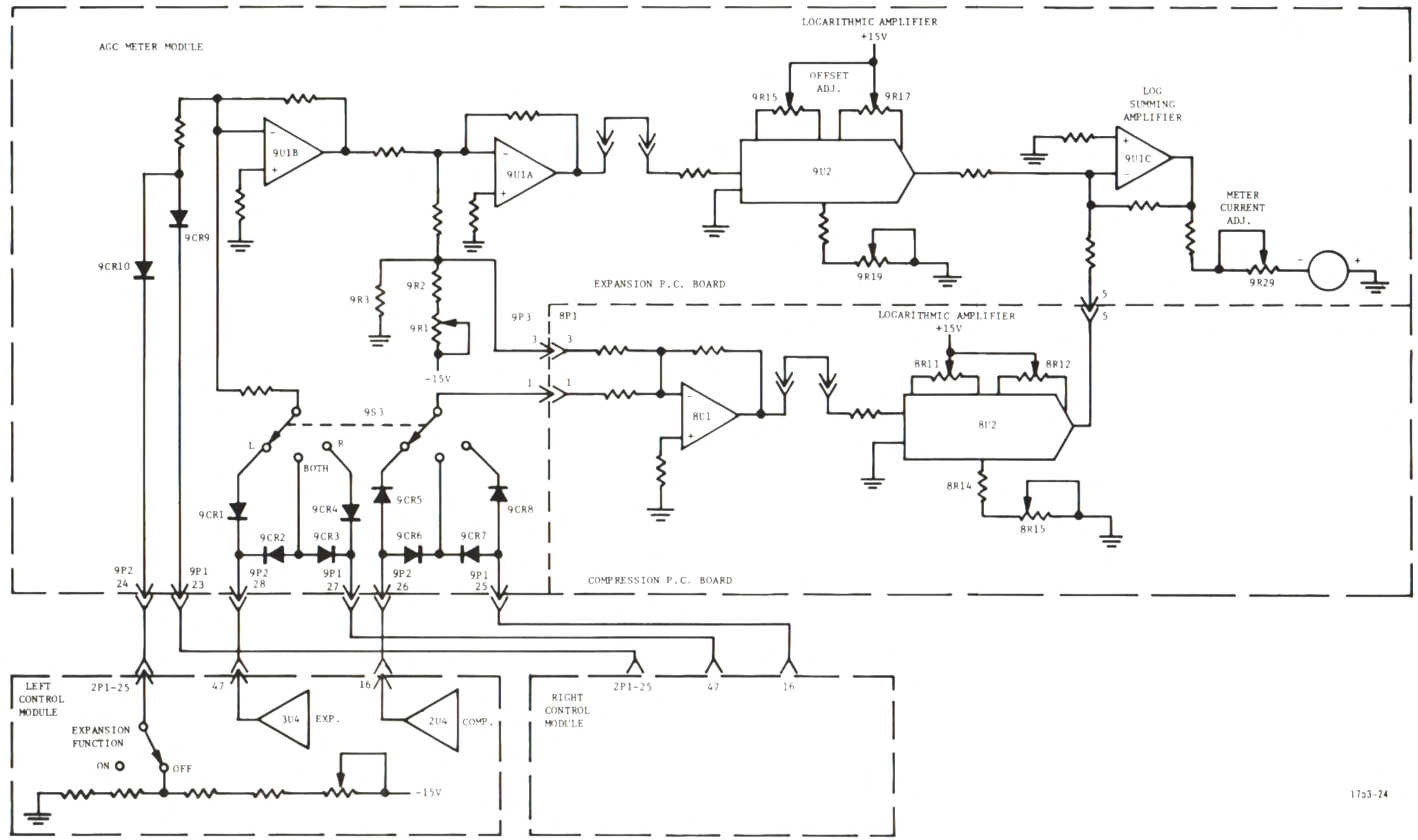

FIGURE 4-1.
AGC METER MODULE
LOGARITHMIC AMPLIFIER

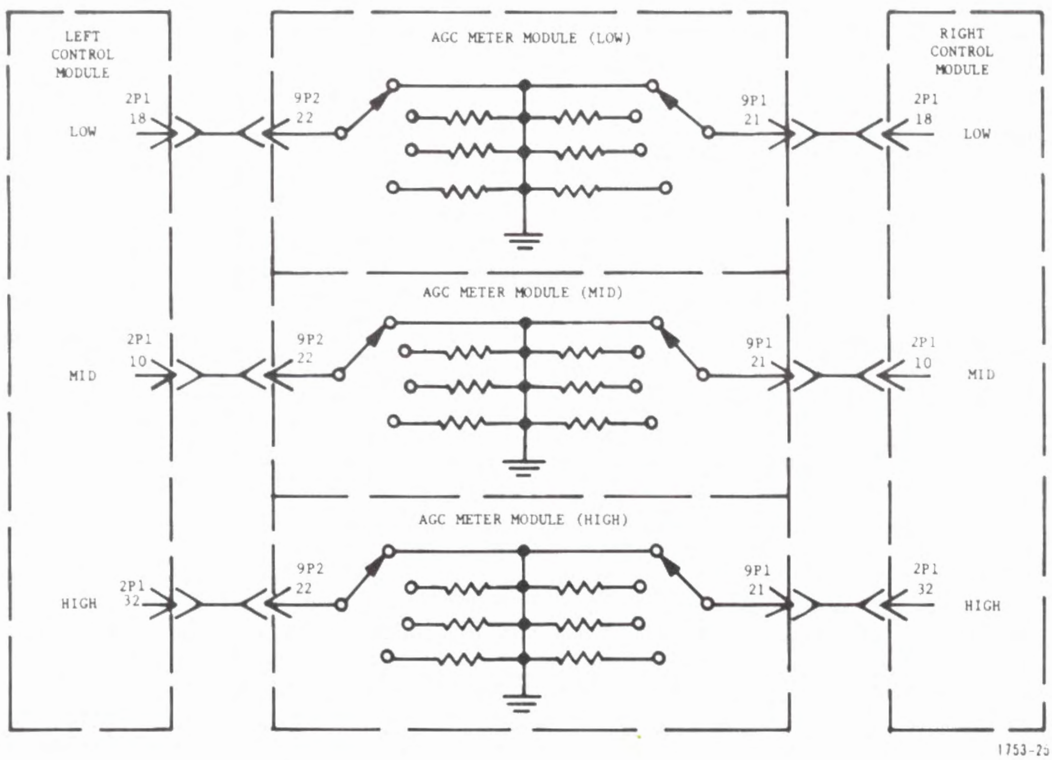

Figure 4-2. Compression Slope Circuits

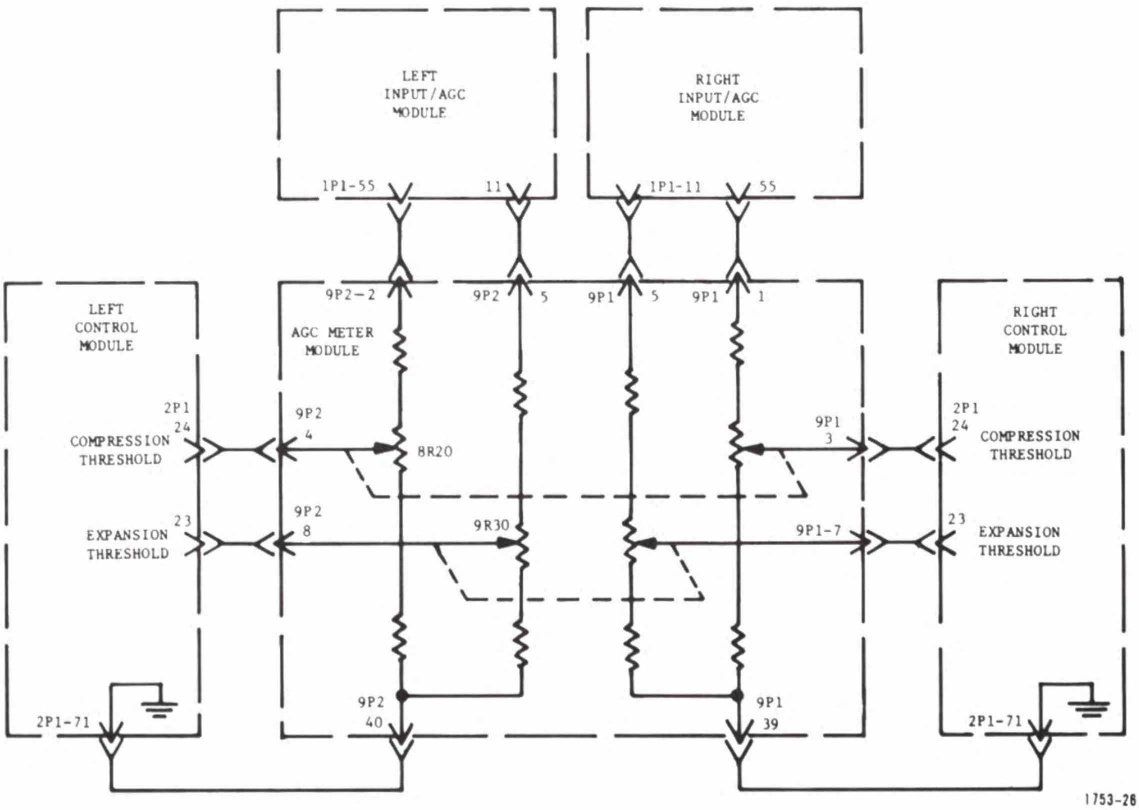

Figure 4-3. Compression and Expansion Threshold Circuits

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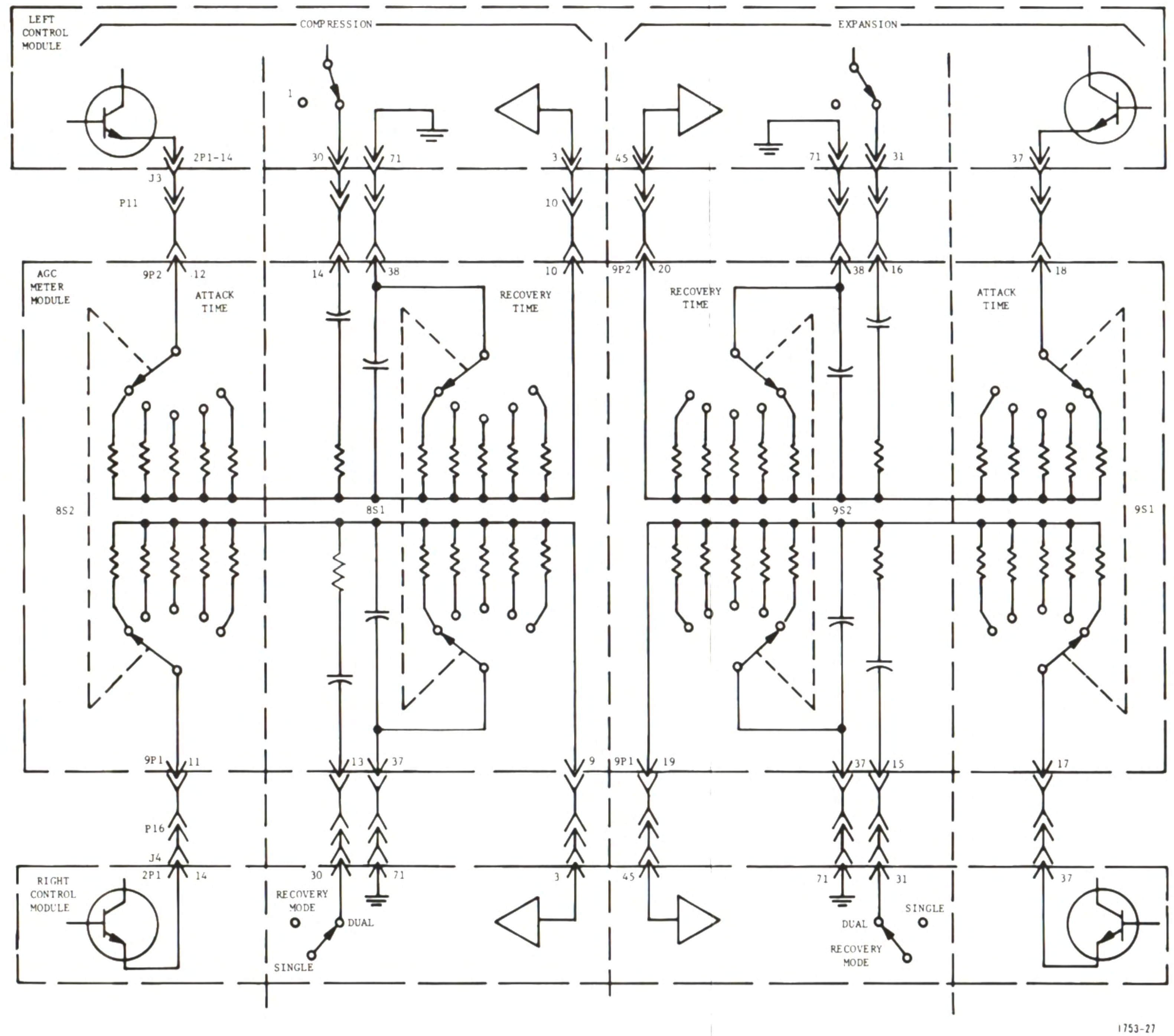

FIGURE 4-4.
COMPRESSION AND EXPANSION
ATTACK AND RECOVERY TIME CIRCUITS

SECTION V

MAINTENANCE AND TROUBLESHOOTING

5-1. GENERAL.

5-2. This section describes the maintenance and troubleshooting procedures for the AGC meter module. As shown in figure 5-1, reference designators are printed on the printed circuit board. In addition, certain parts significant to the discussions which follow are flagged. In the text and on the schematic (figure 5-2), the reference designators shown on the printed circuit boards are prefixed with the number "8" or "9", 8 for the compression board and 9 for the expansion board. For general repairs and cleaning techniques and a list of recommended test equipment, refer to Technical Manual 888 1753 001, Volume I, Section V.

5-3. ADJUSTMENT PROCEDURES.

5-4. To perform the following adjustments, it will be necessary to remove the compression and expansion boards from the module. Loosen (do not remove) three screws in the bottom of the module, slide the module rearward, and lift it out. Remove six knobs from the front panel. Remove four screws securing the standoffs on each side of the module, and carefully lift both PC boards out. Lay the boards on an insulating work surface on top of the main frame.

5-5. COMPRESSION PC ASSEMBLY. Refer to figure 5-1 for locations of parts. The COMPRESSION THRESHOLD control, 8R30, is factory set and should not normally be adjusted. Should adjustment be required for any reason such as following parts replacement, refer to Technical Manual 888 1753 001, Volume I, paragraph 3-21 for proper adjustment procedures.

5-6. Socket 8U3 contains test points used for alignment and troubleshooting purposes. The pins are refered to as 8U3-1 (pin 1), etc. The pins are numbered counterclockwise beginning from the bottom right-hand corner (marked 8U3-1 in figure 5-1).

NOTE

> All of the adjustments of paragraphs 5-7 through 5-9 must be completed when performing the following procedure.

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5-7. 8R11 Offset Adjustment.

a. Remove 8P2 and 8P3 from their sockets.

b. Jumper a 10k resistor between pins 2 and 7 of 8U2.

c. Adjust offset control, 8R11, for 0.0 $\pm$0.005 vdc at pin 7 of 8U2.

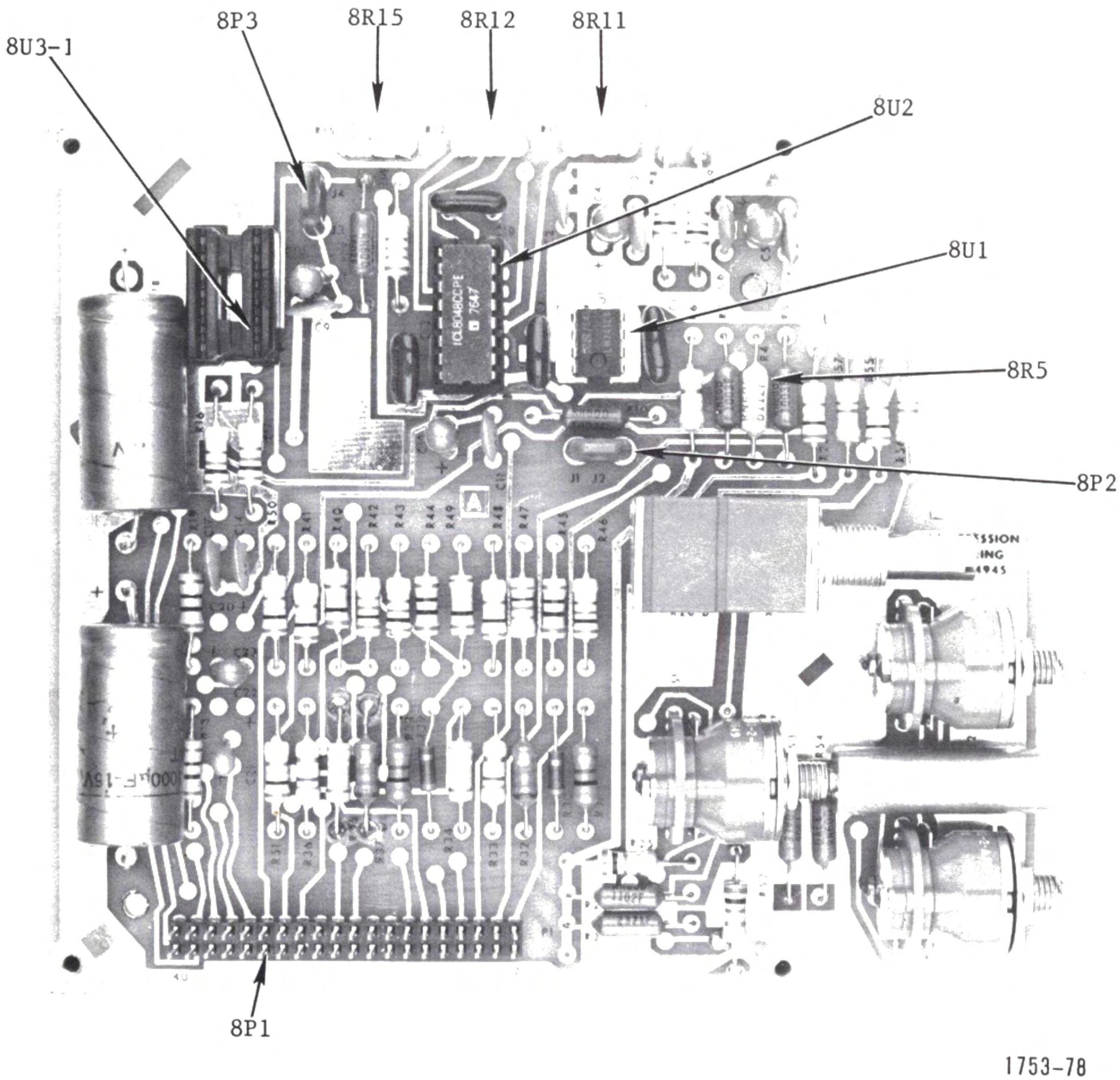

Figure 5-1. AGC Meter Module Parts Layout (Sheet 1 of 2)

1753 700

WARNING: Disconnect primary power prior to servicing.

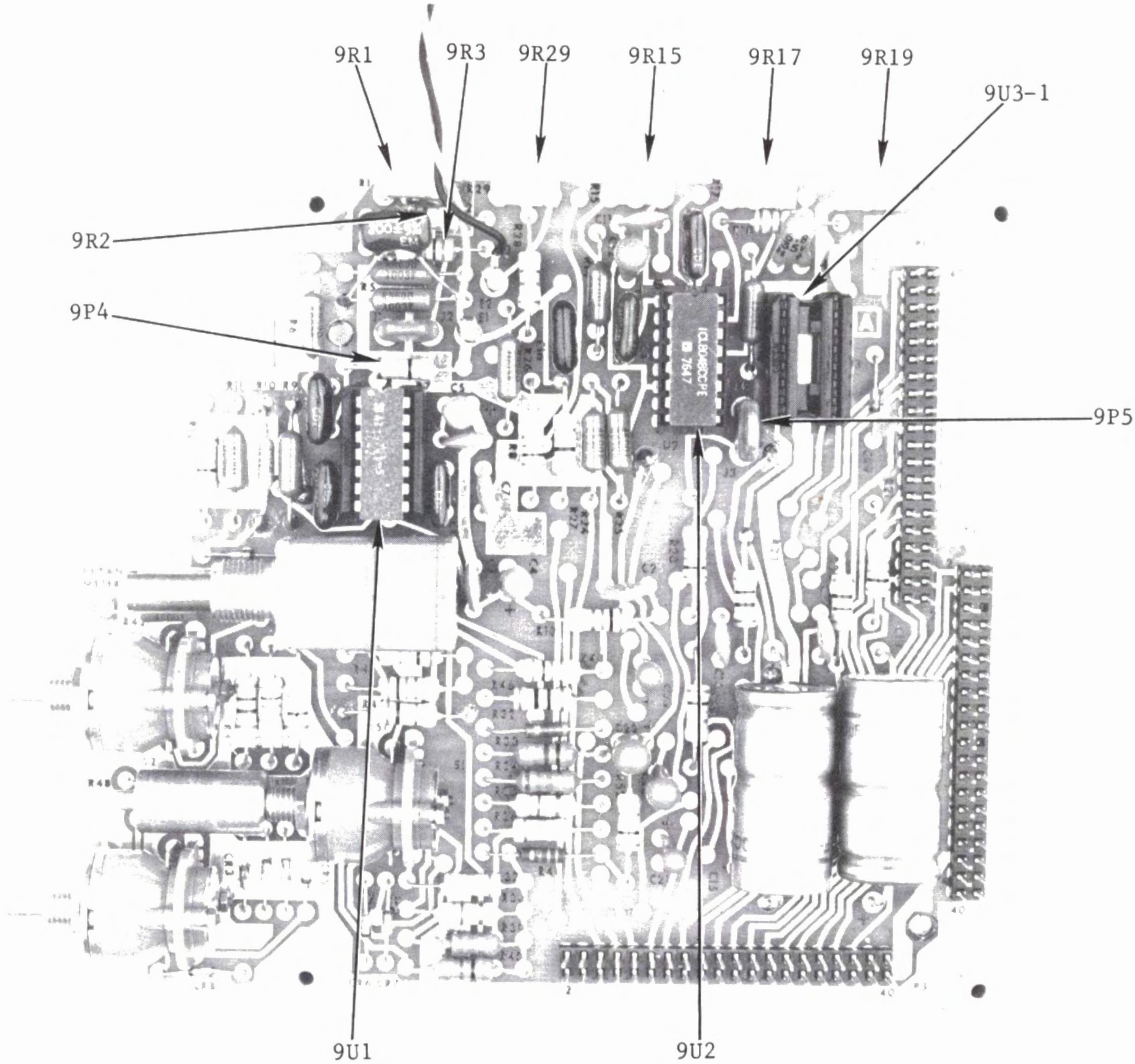

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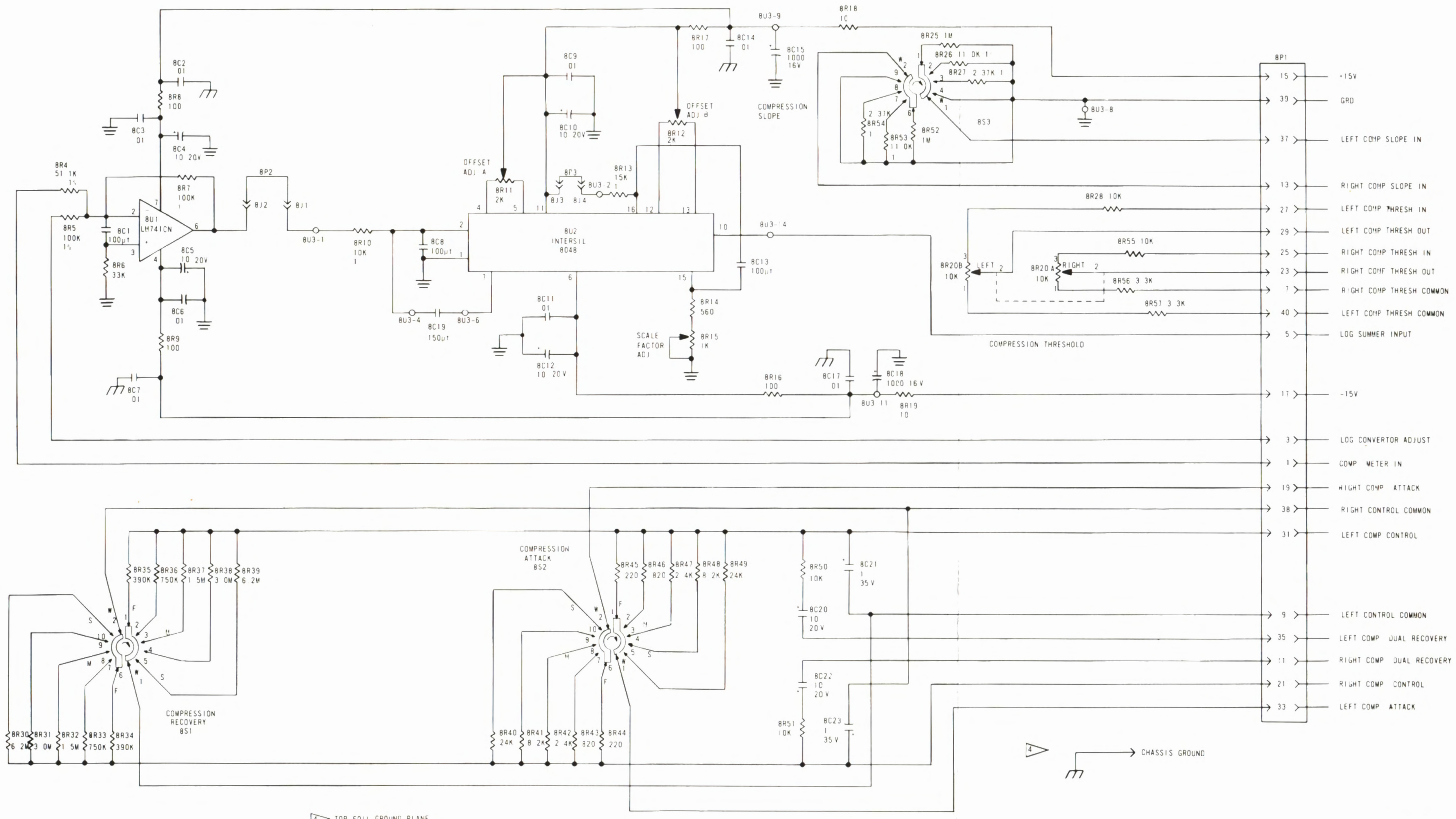
Figure 5-1. AGC Meter Module Parts Layout (Sheet 2 of 2)

1753 700

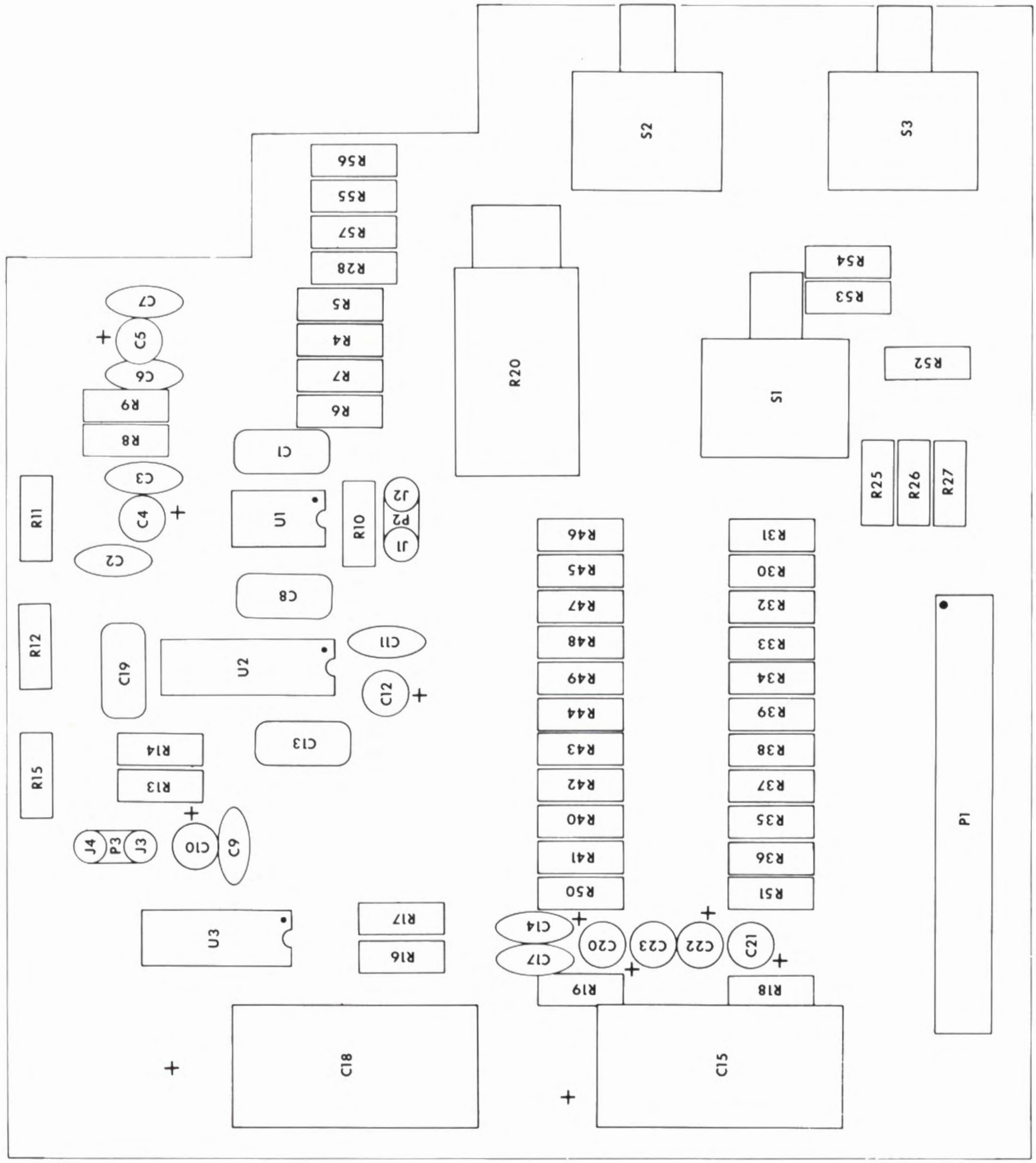
WARNING: Disconnect primary power prior to servicing.



4 TOP FOIL GROUND PLANE
3 ALL CAPACITANCE IN UF
2 ALL RESISTANCE IN OHMS
1 ALL 1 RESISTORS 1 4W
ALL OTHER RESISTORS 1 2W 5
UNLESS OTHERWISE NOTED
NOTES

FIGURE 5-2.
(SHEET 1 OF 2)
AGC METER MODULE
(COMPRESSION METERING)
SCHEMATIC
843 2079 001

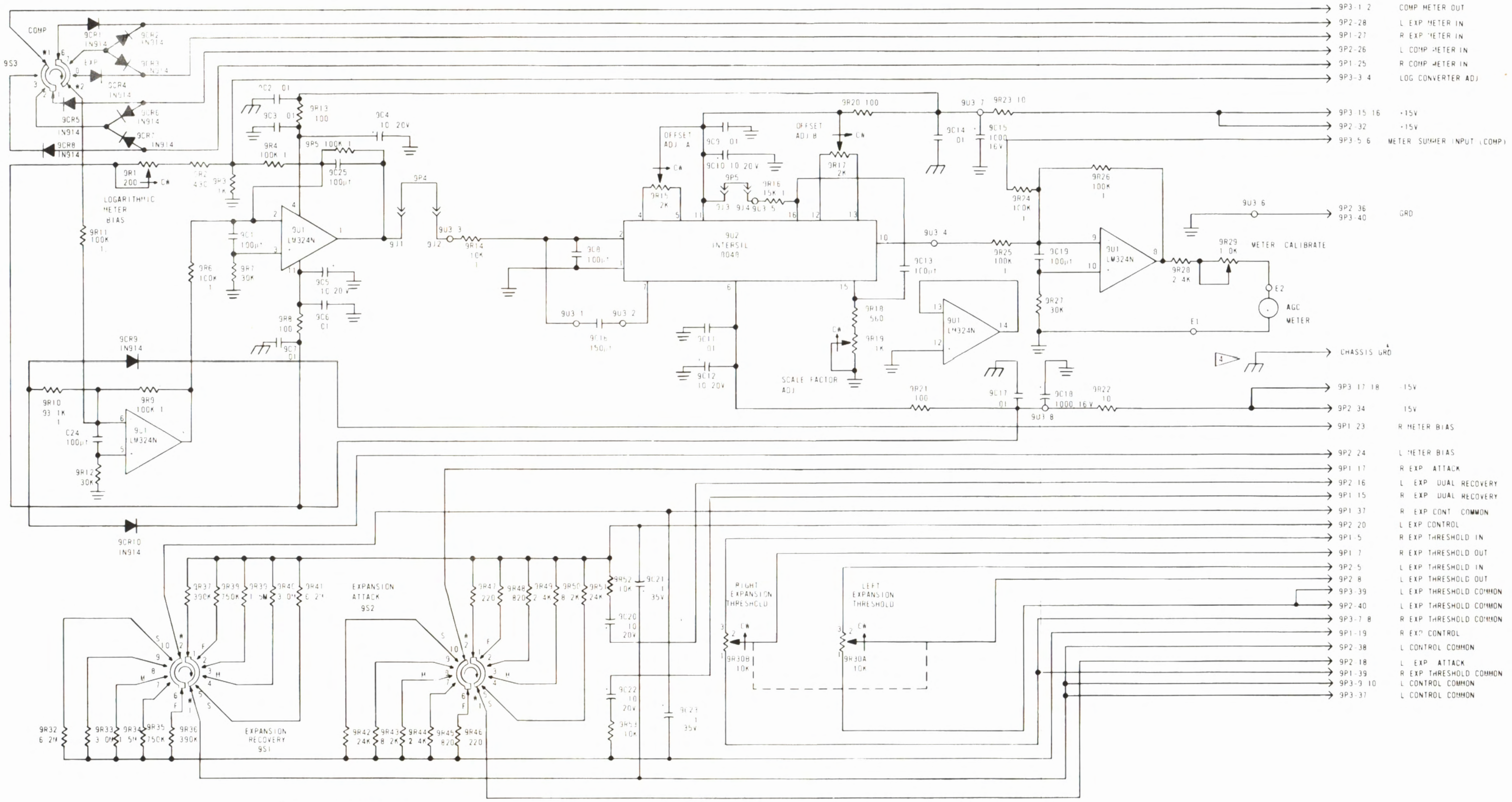
REV. B: 10/78



1753 700

FIGURE 5-2. (SHEET 2 OF 2) COMPRESSION BOARD
COMPONENT LOCATION - 843 2192 001

WARNING: Disconnect primary power prior to servicing.



4. TOP FOIL GROUND PLANE
3. ALL CAPACITANCE IN UF
2. ALL RESISTANCE IN OHMS
1. ALL 1% RESISTORS 1/4W
ALL OTHER RESISTORS 1/2W
UNLESS OTHERWISE NOTED

FIGURE 5-3.
(SHEET 1 OF 2)
AGC METER MODULE
(EXPANSION METERING)
SCHEMATIC
843 2080 001

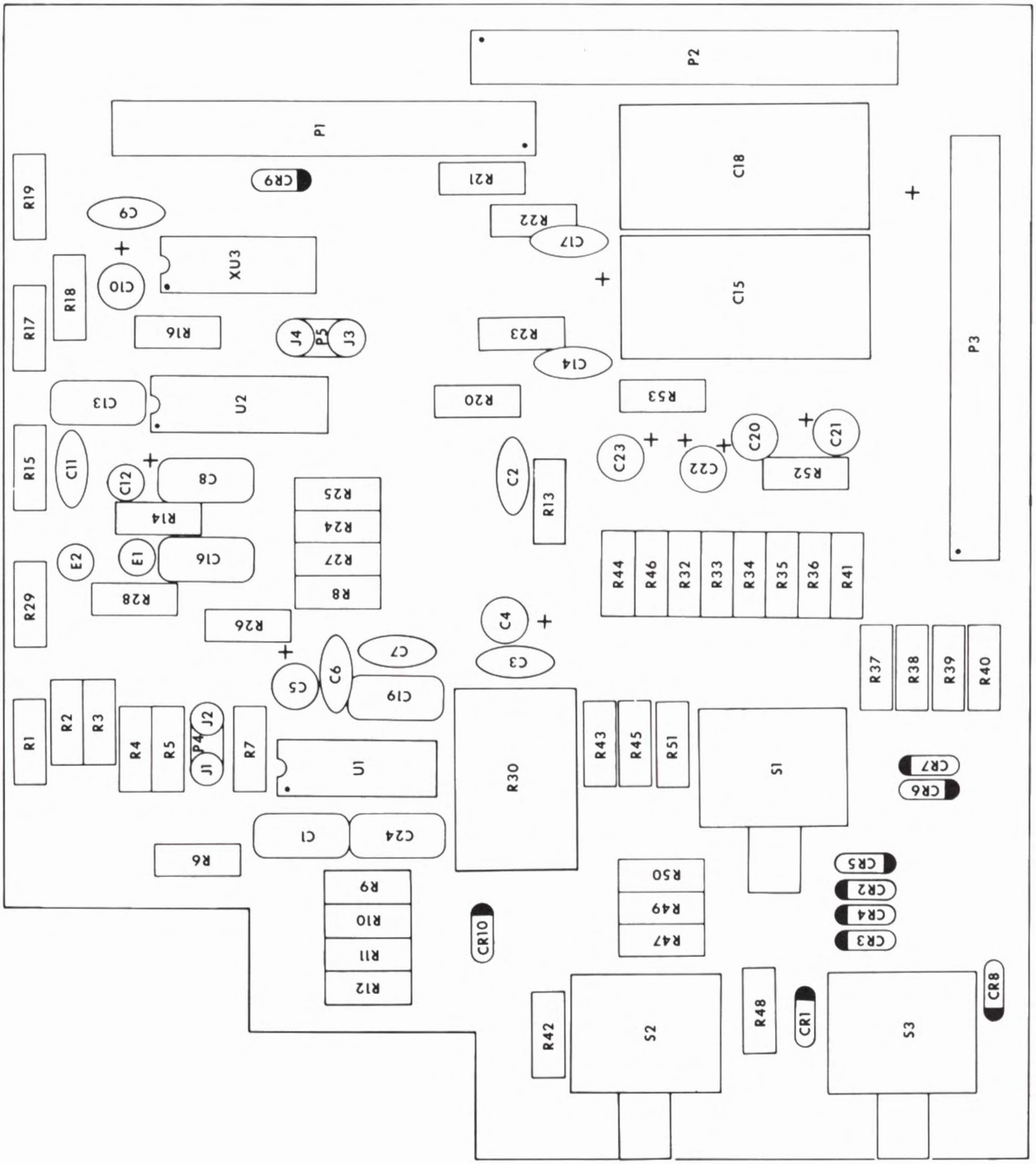


FIGURE 5-3. (SHEET 2 OF 2) EXPANSION CARD F.M.A.P.
COMPONENT LOCATION - 843 2200 001

WARNING: Disconnect primary power prior to servicing.

d. Remove the 10k resistor from pins 2 and 7 of 8U2.

5-8. 8R12 Offset Adjustment.

a. Remove 8P2 from its socket.

b. Apply +10.0 $\pm$0.005 vdc at 8U3-1.

c. Install 8P3 in its socket.

d. Adjust offset control, 8R12, for 0.0 $\pm$0.005 vdc at pin 10 of 8U2.

5-9. 8R15 Scale Factor Adjustment.

a. Remove 8P2 from its socket.

b. Install 8P3 in its socket.

c. Reduce the voltage input to 8U3-1 to +0.1 $\pm$0.005 vdc.

d. Adjust scale factor control, 8R15, for +3.0 $\pm$0.005 vdc at pin 10 of 8U2.

e. Replace 8P2 in its socket.

5-10. EXPANSION PC ASSEMBLY. Refer to figure 5-1 for parts locations. The EXPANSION THRESHOLD control, 9R30, is factory set and should not normally require adjustment. Should adjustment be required for any reason such as following parts replacement, refer to Technical Manual 888 1753 001, Volume I, paragraph 3-21 for proper adjustment procedure.

5-11. Socket 9U3 contains test points used for alignment and troubleshooting purposes. The pins are refered to as 9U3-1 (pin 1), etc. The pins are numbered counterclockwise beginning from the top left corner (marked 9U3-1 in figure 5-1).

NOTE

All the adjustments of paragraphs 5-12 through 5-16 must be completed when performing the following procedure.

5-12. 9U1 Bias Adjustment. Adjust 9R1 for -10.0 $\pm$0.05 vdc across 9R3.

5-13. 9R15 Offset Adjustment.

a. Remove 9P4 and 9P5 from their sockets.

b. Jumper a 10k resistor between pins 2 and 7 of 9U2.

c. Adjust offset control, 9R15, for 0.0 $\pm$0.005 vdc at pin 7 of 9U2.

d. Remove the 10k resistor from pins 2 and 7 of 9U2.

5-14. 9R17 Offset Adjustment.

a. Remove 9P4 from its socket.

b. Apply +10.0 $\pm$0.005 vdc at 9U3-3.

c. Install 9P5 into its socket.

d. Adjust offset control, 9R17, for 0.0 $\pm$0.005 vdc at pin 10 of 9U2.

5-15. 9R19 Scale Factor Adjustment.

a. Remove 9P4 from its socket.

b. Install 9P5 into its socket.

c. Reduce the voltage input at 9U3-3 to +0.1 $\pm$0.005 vdc.

d. Adjust scale factor control, 9R19, for +3.0 $\pm$0.005 vdc at pin 10 of 9U2.

e. Install 9P4 and 9P5 into their sockets.

5-16. Meter Current Adjustment.

a. Set the EXPANSION FUNCTION switches on both control modules to OFF.

b. Replace 9P4 and 9P5 in their sockets.

c. Adjust meter current control 9R29, until the module meter pointer rests in the center of the black portion of the meter scale between expansion and compression.

5-17. TROUBLESHOOTING. Troubleshooting the AGC meter module is divided into two procedures presented in the Compression Troubleshooting Chart (figure 5-4) and the Expansion Troubleshooting Chart (figure 5-5). The Log Amplifier Voltage Reference Chart (figure 5-3) is used for both procedures. In order to troubleshoot the module, both boards must be removed (see paragraph 5-4).

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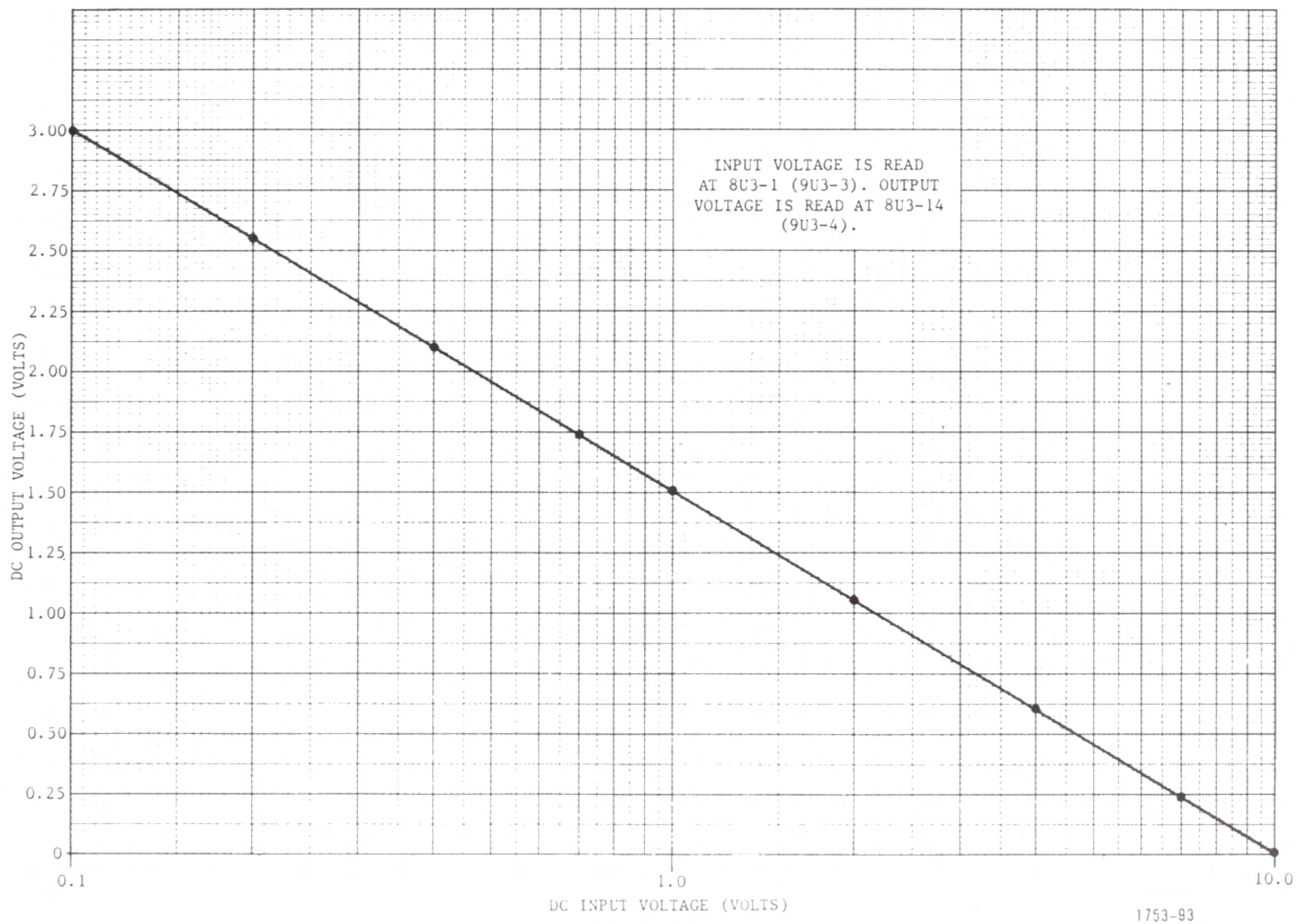

Figure 5-4. Log Amplifier Voltage Reference Chart

CONTROL SETTINGS:
CONTROL MODULE
COMPRESSION FUNCTION - ON (ALL BANDS)
EXPANSION FUNCTION - OFF (ALL BANDS)

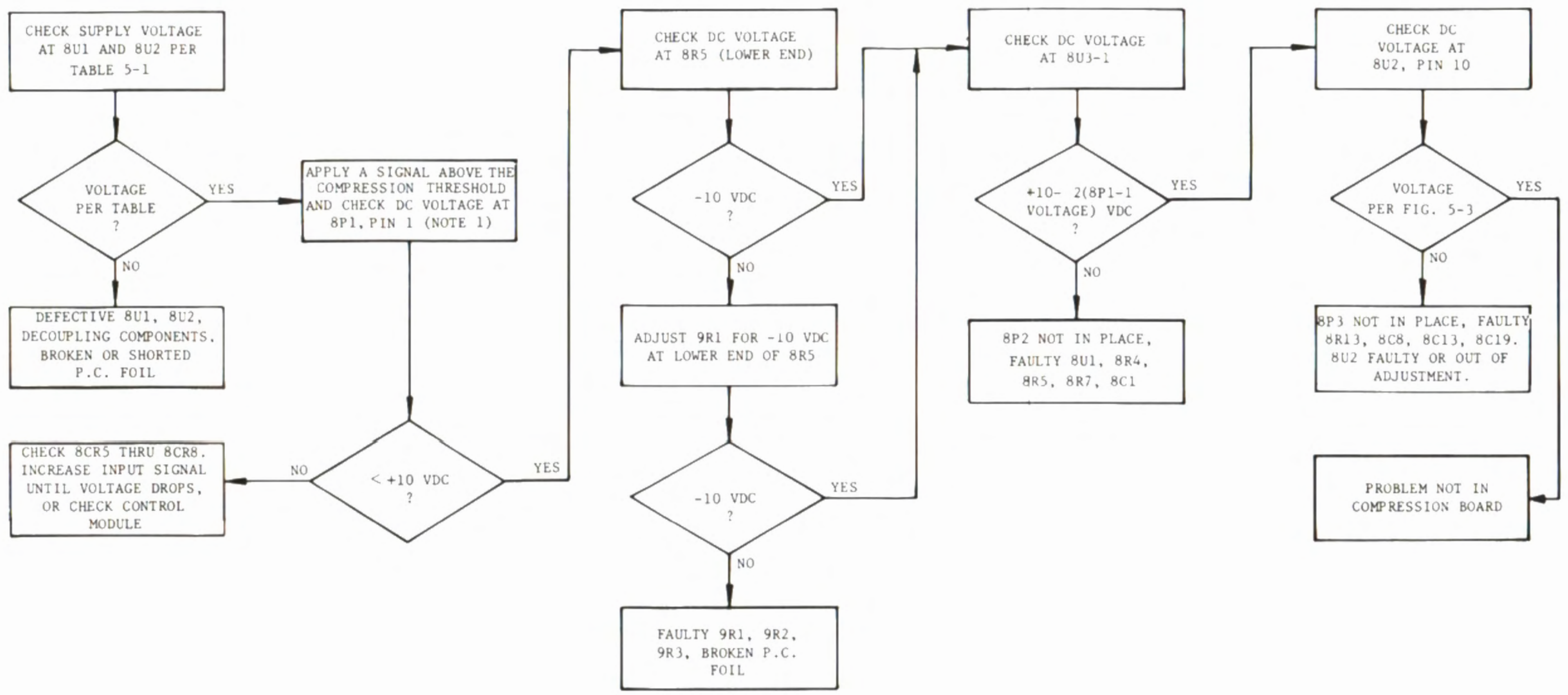

TABLE 5-1. POWER SUPPLY DECOUPLING NETWORKS

DEVICE	POSITIVE SUPPLY +15 ± 0.6 VDC		NEGATIVE SUPPLY -15 ± 0.6 VDC	
	PIN	COMPONENTS	PIN	COMPONENTS
8U1 8U2	7 11	8R8, 8C2, 8C3, 8C4 8R17, 8C9, 8C10, 8C14 8R18, 8C15	4 6	8R9, 8C5, 8C6, 8C7 8R16, 8C11, 8C12, 8C17 8R19, 8C18

NOTE 1. NORMALLY THE SIGNAL WILL BE ABOVE THE COMPRESSION THRESHOLD IF THE OTHER AGC METER MODULES ARE INDICATING COMPRESSION UNLESS THE COMPRESSION AND EXPANSION THRESHOLD CONTROLS ARE IMPROPERLY ADJUSTED. THIS CAN BE DETERMINED BY OBSERVING THE SIGNAL AT 8P1, PIN 25 OR 27. WHEN THERE IS LESS INCREASE IN SIGNAL AMPLITUDE THAN THE INCREASE IN INPUT SIGNAL, COMPRESSION IS TAKING PLACE.

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FIGURE 5-5.
COMPRESSION TROUBLESHOOTING CHART

CONTROL POSITIONS:
CONTROL MODULE
COMPRESSION FUNCTION - OFF (ALL BANDS)
EXPANSION FUNCTION - ON (ALL BANDS)

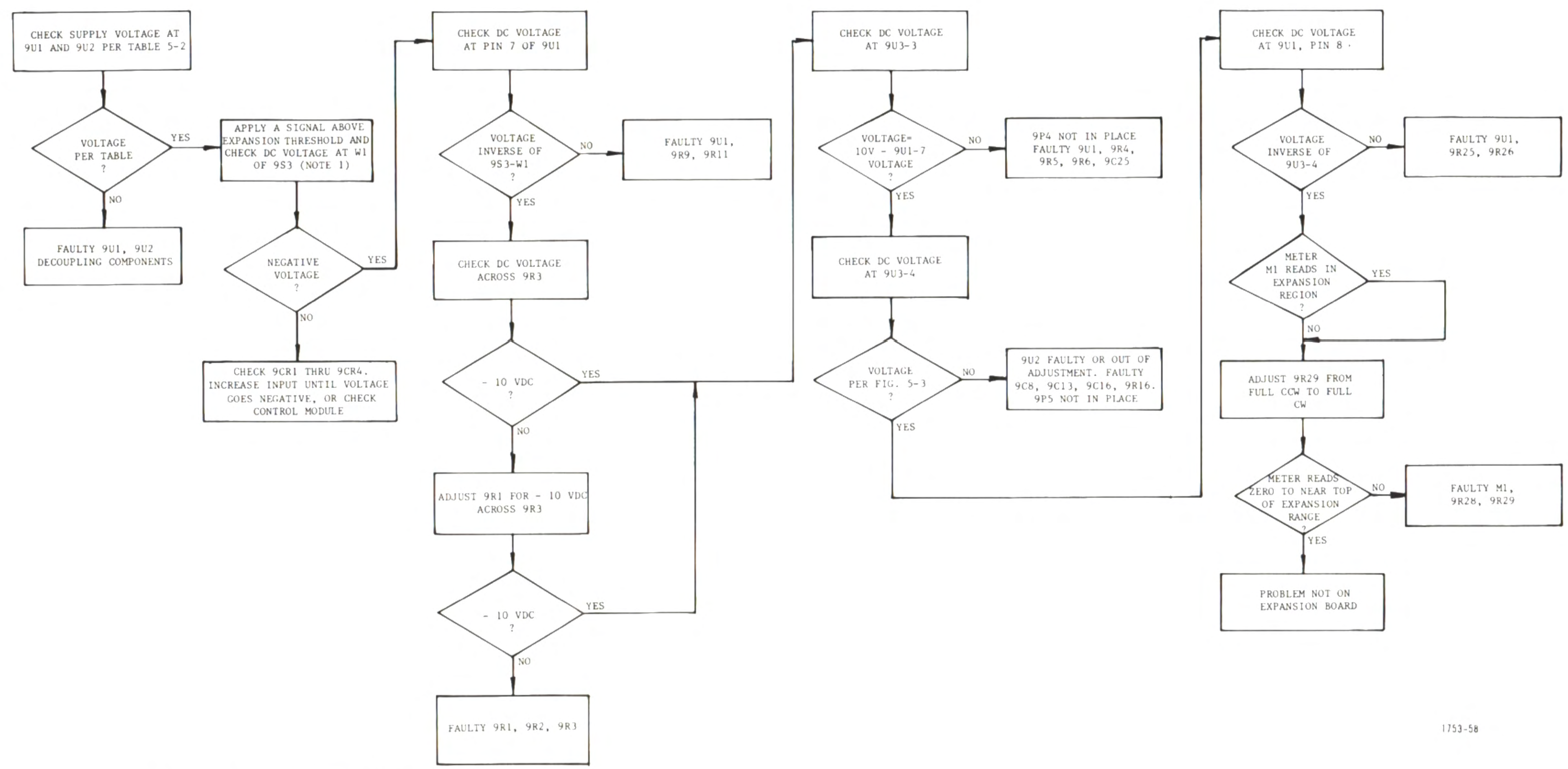

Table 5-2. POWER SUPPLY DECOUPLING NETWORKS

DEVICE	POSITIVE SUPPLY + 15 ± 0.6 VDC		NEGATIVE SUPPLY - 15 ± 0.6 VDC	
	PIN	COMPONENTS	PIN	COMPONENTS
9U1 9U2	4 11	9R13, 9C2, 9C3, 9C4 RR20, 9C9, 9C10, 9C14 9R23, 9C15	11 6	9R8, 9C5, 9C6, 9C7 9R21, 9C11, 9C12, 9C17 9R22, 9C18

NOTE 1. NORMALLY THE SIGNAL WILL BE ABOVE THE EXPANSION THRESHOLD IF THE OTHER AGC METER MODULES ARE INDICATING EXPANSION UNLESS THE COMPRESSION AND EXPANSION THRESHOLDS ARE IMPROPERLY ADJUSTED. THIS CAN BE DETERMINED BY OBSERVING THE SIGNAL AT 9P2, PIN 7 OR 8. WHEN THERE IS A LARGER INCREASE IN SIGNAL LEVEL AT THIS POINT THAN THE INPUT SIGNAL INCREASE, EXPANSION IS TAKING PLACE.

FIGURE 5-6.
EXPANSION TROUBLESHOOTING CHART

SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This section provides a description, reference designator, and order number for replaceable electrical parts, assemblies, and selected mechanical parts necessary for proper maintenance of the AGC meter module. Table 6-1 lists the replaceable parts for the AGC meter module assembly, table 6-2 lists the parts for the compression PC board assembly, and table 6-3 lists the parts for the expansion PC board assembly.

6-3. REPLACEABLE PARTS SERVICE.

6-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Service Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

6-5. TECHNICAL ASSISTANCE.

6-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Department during normal working hours. Emergency technical service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301. The Harris factory may also be contacted through a TXW facility (910-246-3312) or a TELEX service (40-4347).

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Table 6-1. AGC Meter Module Assembly - 992 4955 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
M1	632 0964 000	Meter, AGC	1
	992 4944 001	Expansion Printed Circuit Board (Refer to table 6-3)	1
	992 4945 001	Compression Printed Circuit Board (Refer to table 6-4)	1
	358 1838 000	Insert, Small, Red	2
	358 1839 000	Insert, Small, Green	2
	358 1837 000	Insert, Small, Blue	1
	650 0254 000	Knob	6
	358 2081 000	Mounting Plate, Switch	6

Table 6-2. Compression Printed Circuit Board - 992 4945 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	500 0759 000	Capacitor, 100 pF	1
C2,C3	516 0375 000	Capacitor, 0.01 uF, 50V	1
C4,C5	526 0048 000	Capacitor, 10 uF, 20V	2
C6,C7	516 0375 000	Capacitor, 0.01 uF, 50V	2
C8	500 0759 000	Capacitor, 100 pF	1
C9	516 0375 000	Capacitor, 0.01 uF, 50V	1
C10	526 0048 000	Capacitor, 10 uF, 20V	1
C11	516 0375 000	Capacitor, 0.01 uF, 50V	1
C12	526 0048 000	Capacitor, 10 uF, 20V	1
C13	500 0759 000	Capacitor, 100 pF	1
C14	516 0375 000	Capacitor, 0.01 uF, 50V	1
C15	522 0391 000	Capacitor, 1000 uF, 16V	1
C17	516 0375 000	Capacitor, 0.01 uF, 50V	1
C18	522 0391 000	Capacitor, 1000 uF, 16V	1
C19	500 0761 000	Capacitor, 150 pF	1
C20	526 0048 000	Capacitor, 10 uF, 20V	1
C21	526 0050 000	Capacitor, 1 uF, 35V	1
C22	526 0048 000	Capacitor, 10 uF, 20V	1
C23	526 0050 C00	Capacitor, 1 uF, 35V	1
J1,J2,J3,J4	612 0775 000	Jack	4
P1	610 0748 000	Plug, 40 Pin P.C. Type	1
P2,P3	610 0679 000	Plug	2
R4	548 1407 000	Resistor, 51.1k ohm, 1/4W, 1%	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-2. Compression Printed Circuit Board - 992 4945 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R5	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R6	540 1109 000	Resistor, 33k ohm, 1/2W, 5%	1
R7	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R8,R9	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R10	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R11	550 0899 000	Potentiometer, 2k ohm, 10%	1
R12	550 0956 000	Potentiometer, 2k ohm, 1/2W, 10%	1
R13	548 0340 000	Resistor, 15k ohm, 1/4W, 1%	1
R14	540 1191 000	Resistor, 560 ohm, 1/2W, 5%	1
R15	550 0947 000	Potentiometer, 1k ohm, 1/2W, 10%	1
R16,R17	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R18,R19	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	2
R20	550 0917 000	Potentiometer, 10k/10k Dual Section, 10%	1
R25	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R26	548 0282 000	Resistor, 11.0k ohm, 1/4W, 1%	1
R27	548 1436 000	Resistor, 2370 ohm, 1/4W, 1%	1
R28	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R30	540 1340 000	Resistor, 6.2 Megohm, 1/2W, 5%	1
R31	540 1339 000	Resistor, 3.0 Megohm, 1/2W, 5%	1
R32	540 1234 000	Resistor, 1.5 Megohm, 1/2W, 5%	1
R33	540 1338 000	Resistor, 750k ohm, 1/2W, 5%	1
R34,R35	540 1318 000	Resistor, 390k ohm, 1/2W, 5%	2
R36	540 1338 000	Resistor, 750k ohm, 1/2W, 5%	1

1753 700

WARNING: Disconnect primary power prior to servicing.

Table 6-2. Compression Printed Circuit Board - 992 4945 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R37	540 1318 000	Resistor, 1.5 Megohm, 1/2W, 5%	1
R38	540 1339 000	Resistor, 3.0 Megohm, 1/2W, 5%	1
R39	540 1340 000	Resistor, 6.2 Megohm, 1/2W, 5%	1
R40	540 1143 000	Resistor, 24k ohm, 1/2W, 5%	1
R41	540 1153 000	Resistor, 8.2k ohm, 1/2W, 5%	1
R42	540 1193 000	Resistor, 1k ohm, 1/2W, 5%	1
R43	540 1127 000	Resistor, 820 ohm, 1/2W, 5%	1
R44,R45	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	2
R46	540 1127 000	Resistor, 820 ohm, 1/2W, 5%	1
R47	540 1193 000	Resistor, 1k ohm, 1/2W, 5%	1
R48	540 1153 000	Resistor, 8.2k ohm, 1/2W, 5%	1
R49	540 1143 000	Resistor, 24k ohm, 1/2W, 5%	1
R50,R51	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	2
R52	540 1162 000	Resistor, 1 Megohm, 1/2W, 5%	1
R53	548 0282 000	Resistor, 11.0k ohm, 1/4W, 1%	1
R54	548 1436 000	Resistor, 2370 ohm, 1/4W, 1%	1
R55	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	1
R56,R57	540 1165 000	Resistor, 3.3k ohm, 1/2W, 5%	2
S1,S2	600 0580 000	Switch, 2P-5POS, Rotary	2
S3	600 0583 000	Switch, Rotary	1
U1	382 0187 000	Integrated Circuit, LM741CN	1
U2	382 0509 000	Integrated Circuit, 1CL8048CCPE	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-2. Compression Printed Circuit Board - 992 4945 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
XU1	404 0504 000	Socket, 8 Pin, Dip	1
XU2	404 0506 000	Socket, 16 Pin, Dip	1
XU3	404 0505 000	Socket, 14 Pin, Dip	1
	843 1908 000	Printed Circuit Board	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-3. Expansion Printed Circuit Board - 992 4944 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	500 0759 000	Capacitor, 100 pF	1
C2,C3	516 0375 000	Capacitor, 0.01 uF, 50V	2
C4,C5	526 0048 000	Capacitor, 10 uF, 20V	2
C6,C7	516 0375 000	Capacitor, 0.01 uF, 50V	2
C8	500 0759 000	Capacitor, 100 pF	1
C9	516 0375 000	Capacitor, 0.01 uF, 50V	1
C10	526 0048 000	Capacitor, 10 uF, 20V	1
C11	516 0375 000	Capacitor, 0.01 uF, 50V	1
C12	526 0048 000	Capacitor, 10 uF, 20V	1
C13	500 0759 000	Capacitor, 100 pF	1
C14	516 0375 000	Capacitor, 0.01 uF, 50V	1
C15	522 0391 000	Capacitor, 1000 uF, 16V	1
C16	500 0761 000	Capacitor, 150 pF	1
C17	516 0375 000	Capacitor, 0.01 uF, 50V	1
C18	522 0391 000	Capacitor, 1000 uF, 16V	1
C19	500 0759 000	Capacitor, 100 pF	1
C20	526 0048 000	Capacitor, 10 uF, 20V	1
C21	526 0050 000	Capacitor, 1 uF, 35V	1
C22	526 0048 000	Capacitor, 10 uF, 20V	1
C23	526 0050 000	Capacitor, 1 uF, 35V	1
C24,C25	500 0759 000	Capacitor, 100 pF	2
CR1 thru CR10	384 0205 000	Diode, 1N914	10
J1,J2,J3,J4	612 0775 000	Jack	4
P1,P2,P3	610 0748 000	Plug, 40 Pin PC Type	3

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WARNING: Disconnect primary power prior to servicing.

Table 6-3. Expansion Printed Circuit Board - 992 4944 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
P4,P5	610 0679 000	Plug	2
R1	550 0842 000	Potentiometer, 200 ohm, 10%	1
R2	540 1170 000	Resistor, 430 ohm, 1/2W, 5%	1
R3	540 1116 000	Resistor, 1k ohm, 1/2W, 5%	1
R4,R5,R6	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	3
R7	540 1131 000	Resistor, 30k ohm, 1/2W, 5%	1
R8	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R9	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R10	548 1446 000	Resistor, 93.1k ohm, 1/4W, 1%	1
R11	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	1
R12	540 1131 000	Resistor, 30k ohm, 1/2W, 5%	1
R13	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R14	548 1361 000	Resistor, 10k ohm, 1/4W, 1%	1
R15	550 0899 000	Potentiometer, 2k ohm, 10%	1
R16	548 0340 000	Resistor, 15k ohm, 1/4W, 1%	1
R17	550 0956 000	Potentiometer, 2k ohm, 1/2W, 10%	1
R18	540 1191 000	Resistor, 560 ohm, 1/2W, 5%	1
R19	550 0947 000	Potentiometer, 1k ohm, 1/2W, 10%	1
R20,R21	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R22,R23	540 1151 000	Resistor, 10 ohm, 1/2W, 5%	2
R24,R25,R26	548 0932 000	Resistor, 100k ohm, 1/4W, 1%	3
R27	540 1131 000	Resistor, 30k ohm, 1/2W, 5%	1
R28	540 1193 000	Resistor, 2.4k ohm, 1/2W, 5%	1
R29	550 0865 000	Potentiometer, 1k ohm, 10%	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-3. Expansion Printed Circuit Board - 992 4944 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R30	550 0917 000	Potentiometer, 10k/10k Dual Section, 10%	1
R32	540 1335 000	Resistor, 6.2 Megohm, 1/2W, 5%	1
R33	540 1336 000	Resistor, 3.0 Megohm, 1/2W, 5%	1
R34	540 1234 000	Resistor, 1.5 Megohm, 1/2W, 5%	1
R35	540 1338 000	Resistor, 750k ohm, 1/2W, 5%	1
R36,R37	540 1318 000	Resistor, 390k ohm, 1/2W, 5%	2
R38	540 1338 000	Resistor, 750k ohm, 1/2W, 5%	1
R39	540 1234 000	Resistor, 1.5 Megohm, 1/2W, 5%	1
R40	540 1336 000	Resistor, 3.0 Megohm, 1/2W, 5%	1
R41	540 1335 000	Resistor, 6.2 Megohm, 1/2W, 5%	1
R42	540 1143 000	Resistor, 24k ohm, 1/2W, 5%	1
R43	540 1153 000	Resistor, 8.2k ohm, 1/2W, 5%	1
R44	540 1193 000	Resistor, 2.4k ohm, 1/2W, 5%	1
R45	540 1127 000	Resistor, 820 ohm, 1/2W, 5%	1
R46,R47	540 1118 000	Resistor, 220 ohm, 1/2W, 5%	2
R48	540 1127 000	Resistor, 820 ohm, 1/2W, 5%	1
R49	540 1193 000	Resistor, 2.4k ohm, 1/2W, 5%	1
R50	540 1153 000	Resistor, 8.2k ohm, 1/2W, 5%	1
R51	540 1143 000	Resistor, 24k ohm, 1/2W, 5%	1
R52,R53	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	2
S1,S2	600 0580 000	Switch, 2P-5 POS, Rotary	2
S3	600 0583 000	Switch, Rotary	1

WARNING: Disconnect primary power prior to servicing.

Table 6-3. Expansion Printed Circuit Board - 992 4944 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
U1	382 0415 000	Integrated Circuit, LM324N	1
U2	382 0509 000	Integrated Circuit, 1CL8048CCPE	1
XU1	404 0505 000	Socket, 14 Pin, Dip	1
XU2	404 0506 000	Socket, 16 Pin, Dip	1
XU3	404 0505 000	Socket, 14 Pin, Dip	1
	943 1909 000	Printed Circuit Board	1

1753 700

WARNING: Disconnect primary power prior to servicing.

LIMITER METER MODULE
888 1753 800

TECHNICAL MANUAL

LIMITER METER MODULE

992 4956 001

HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1753 800

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SAFETY NOTICE

WARNING: THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND UNDER CERTAIN CONDITIONS, COULD BE FATAL.

This manual is intended as general guidance for trained and qualified installation, operating, maintenance and service personnel who are familiar with and aware of the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

THE INSTALLATION, OPERATION, MAINTENANCE AND SERVICING OF THIS EQUIPMENT INVOLVES RISKS TO BOTH PERSONNEL AND EQUIPMENT, AND MUST BE PERFORMED ONLY BY PROPERLY TRAINED AND EXPERIENCED PERSONNEL EXERCISING DUE CARE. PERSONNEL MUST FAMILIARIZE THEMSELVES WITH SAFETY REQUIREMENTS, SAFE HANDLING AND OPERATING PRACTICE, AND RELATED FIRST-AID PROCEDURES (E.G., FOR ELECTRICAL BURNS AND ELECTRICAL SHOCK).

HARRIS CORPORATION Broadcast Equipment Division shall not be responsible for injury or damage resulting from improper installation, operation, maintenance or servicing, or from the use of improperly trained or inexperienced personnel in the performance of such tasks, or from the failure of persons engaged in such tasks to exercise due care.

As with all electronic equipment, care should be taken to avoid electrical shock in all circuits where substantial currents or voltages may be present, either through design or short circuit. Caution should also be observed in lifting and hoisting equipment, especially regarding large structures, during installation.

LIABILITY LIMITATION

The procedures outlined in this Manual are based on the information available at the time of publication and should permit the specified use with minimum risk. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

The manufacturer is specifically not liable for any damage or injury arising out of failure to follow the instructions in this Manual or failure to exercise due care and caution during installation, operation, maintenance and service of this equipment.

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CAUTIONARY NOTICE

Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

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WARNING: Disconnect primary power prior to servicing.

SECTION I

GENERAL DESCRIPTION

1-1. EQUIPMENT PURPOSE.

1-2. The limiter meter module is the primary monitoring device for the left and right limiter modules. It also contains the limiting level control and the manual attack and recovery time resistor circuits.

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SECTION II

INSTALLATION

2-1. GENERAL.

2-2. Installation of the limiter meter module is covered in Technical Manual 888 1753 001, MSP 100 Audio Processor, Volume I, Section II, Installation.

WARNING: Disconnect primary power prior to servicing.

SECTION III

CONTROLS AND INDICATORS

3-1. GENERAL.

3-2. Figure 3-1 shows all of the user controls and indicators provided on the limiter meter module, and table 3-1 describes the function of each and its affect on module operation.

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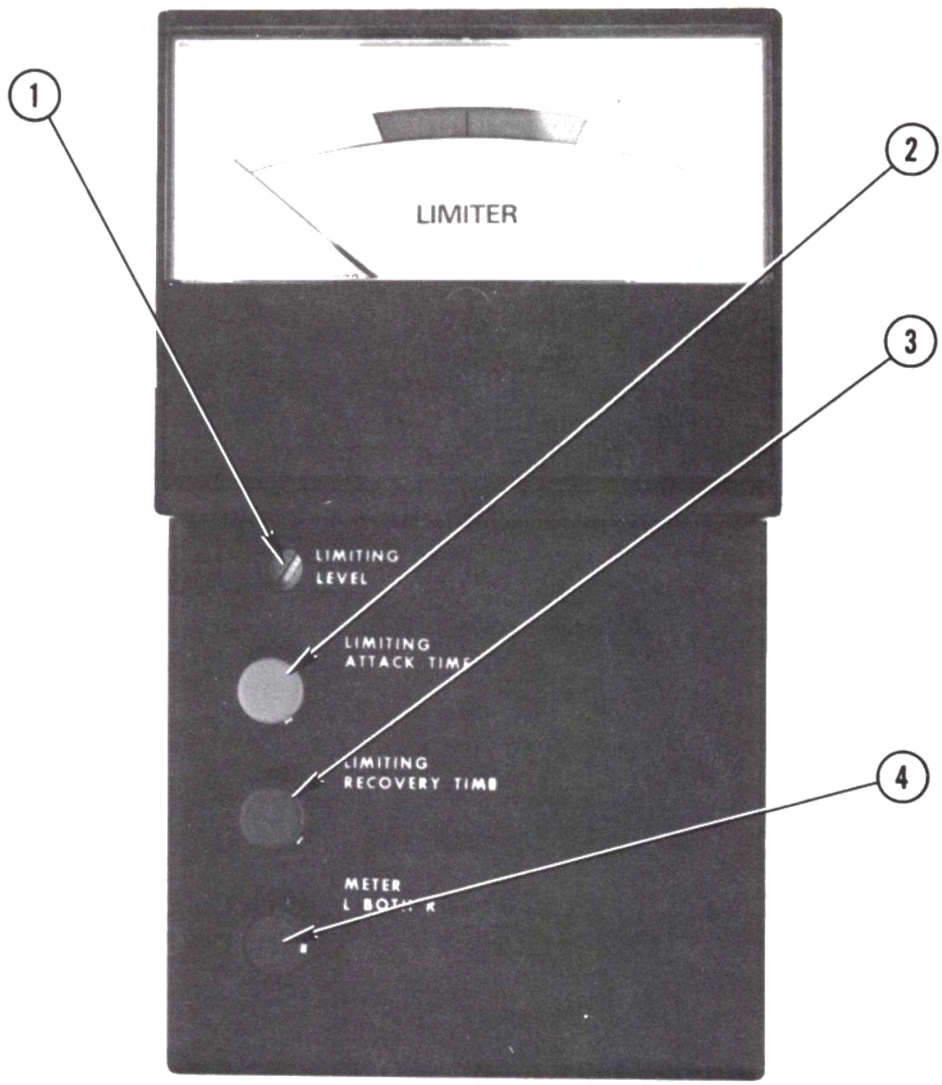

1753-36

Figure 3-1. Limiter Meter Module Controls and Indicators
(Sheet 1 of 2)

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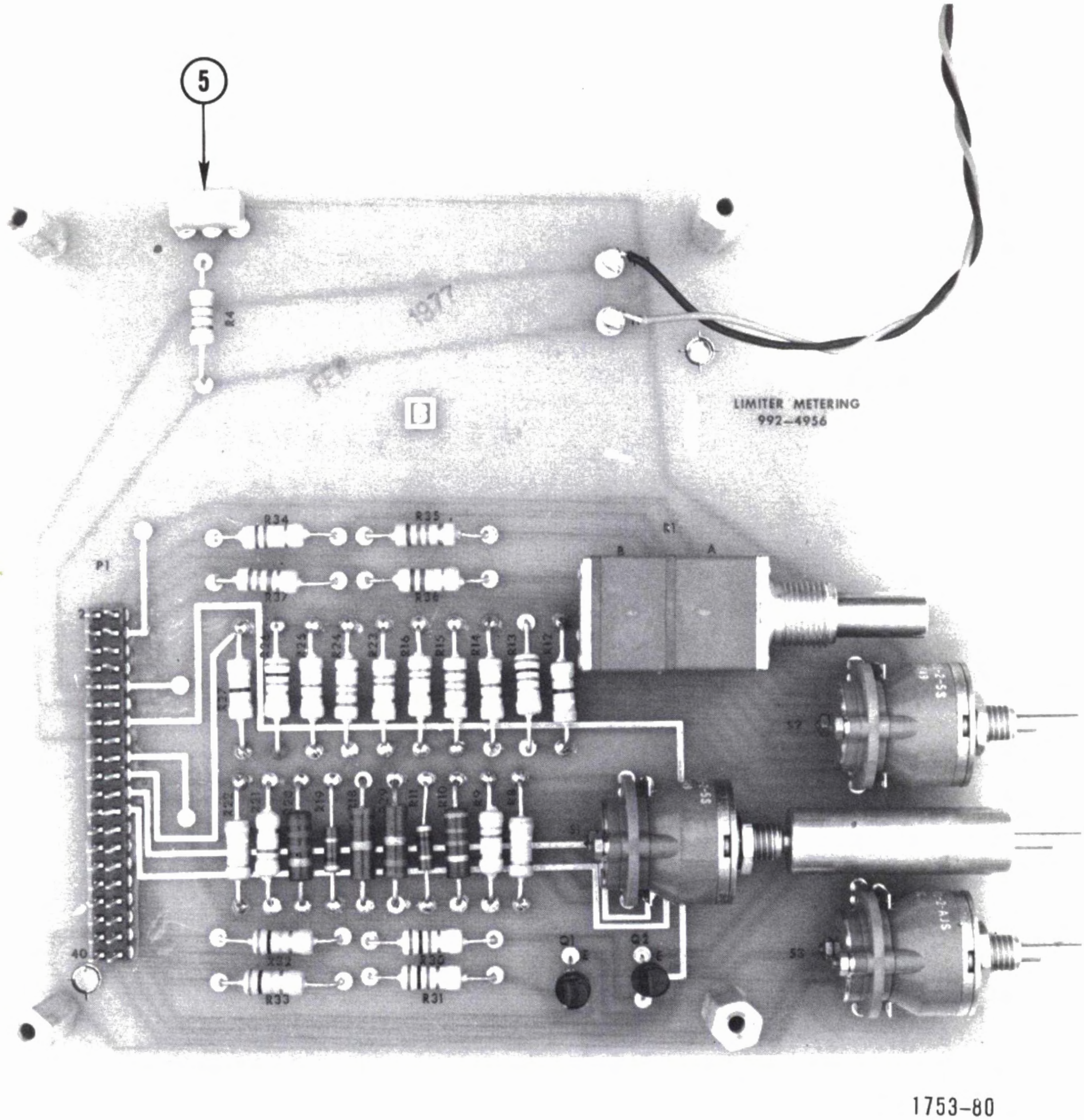

Figure 3-1. Limiter Meter Module Controls and Indicators
(Sheet 2 of 2)

Table 3-1. Limiter Meter Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	LIMITING LEVEL, 10R1	Adjusts the signal input level to the limiter module.
2	LIMITING ATTACK TIME, 10S2	Selects one of five attack time resistors for the limiter manual attack time function.
3	LIMITING RECOVERY TIME, 10S1	Selects one of five recovery time resistors for the limiter manual recovery time function.
4	METER/L BOTH R, 10S3	L Position: Selects the left limiter for monitoring. BOTH Position: Selects both left and right limiters for monitoring. (When the left and right limiters are strapped, the indication is the greater of the two control signals.) R Position: Selects the right limiter for monitoring.
5	METER CALIBRATE, 10R3	Adjusts meter current for calibration.

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SECTION IV

PRINCIPLES OF OPERATION

4-1. CIRCUIT DESCRIPTION.

4-2. The primary function performed by the limiter meter module is metering the control voltage of the left and right limiter modules. The manual attack time and recovery time resistors and the limiting level controls are also located in the module, although they are a part of the limiter module circuitry. Figure 4-1 shows how the limiter meter module is connected into the limiter module circuits. The limiter modules plug into edge connectors J5 and J6 on the motherboard. The limiter meter module plugs into J17 on the motherboard through a ribbon cable.

4-3. METERING CIRCUIT.

4-4. Switch 10S3 on the limiter meter module front panel selects either the left, right, or both limiter modules for monitoring. In the L (left) position, control voltage (before it is summed with the bias voltage) is fed through J5 pin 56 and CR2 on the motherboard to J17 pin 39 to switch 10S3 on the meter module, then through calibration potentiometer 10R3 and current limiter 10R4 to the meter. In the BOTH position, the greater of the two control voltages from the left or right limiter will be indicated on the meter. For example, if the left limiter control voltage is the greater than that of the right limiter, CR3 on the motherboard will be reverse biased and the left control voltage will predominate. Conversely, if the right limiter control voltage is the greater, CR4 will be reverse biased and the right control voltage will predominate. In the R position, 10S3 routes the right limiter control voltage to the meter circuit through CR1.

4-5. ATTACK TIME, RECOVERY TIME, AND LIMITING LEVEL CIRCUITS.

4-6. Figure 4-1 shows the routing of the manual attack time, manual recovery time, and limiting level circuits to the limiter modules. Refer to Technical Manual 888 1753 400, Section IV for a description of these circuits.

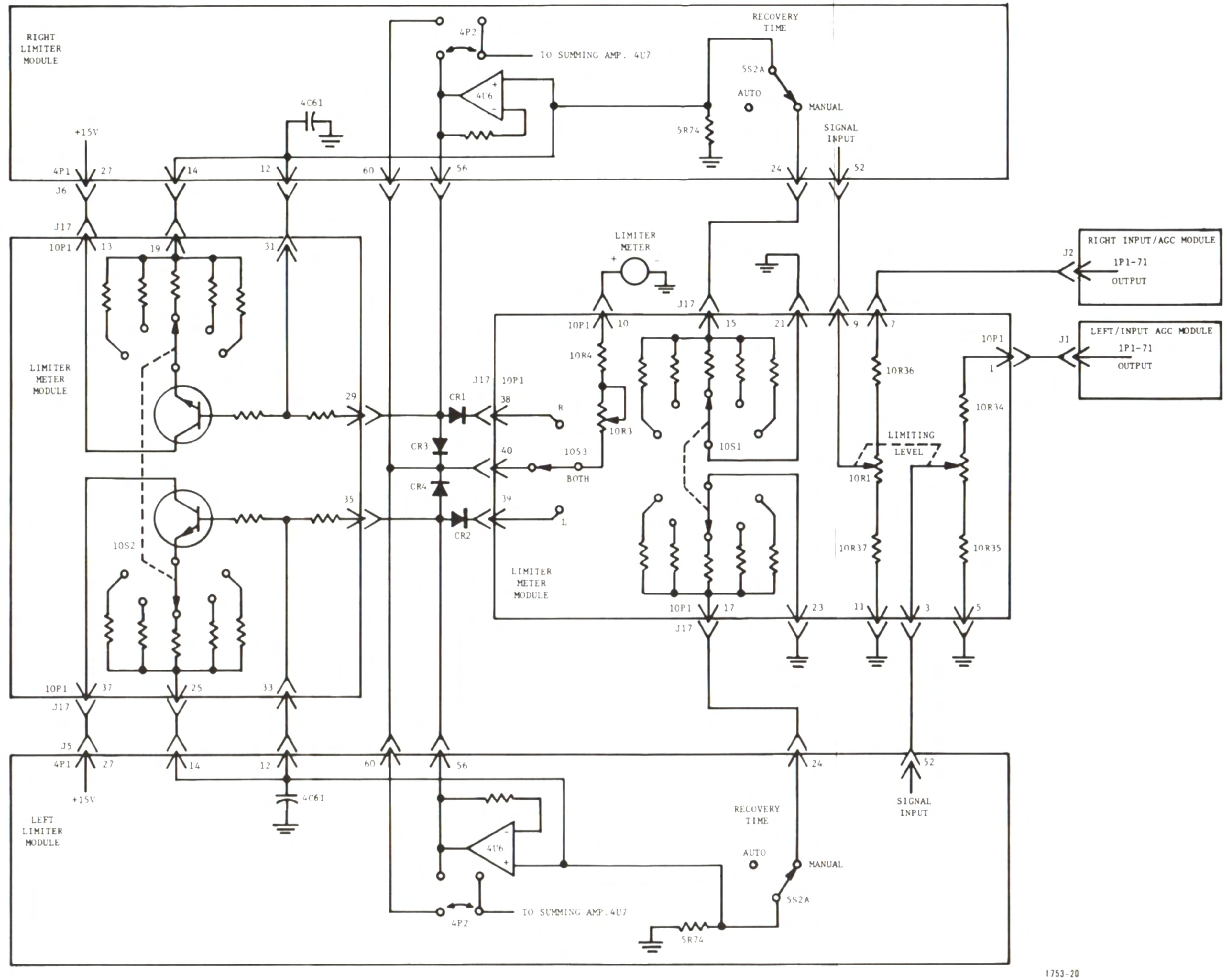

FIGURE 4-1.
LIMITER METER MODULE
BLOCK DIAGRAM

SECTION V

MAINTENANCE AND TROUBLESHOOTING

5-1. GENERAL.

5-2. This section describes the maintenance and troubleshooting procedures for the limiter meter module. As shown in figure 5-1, reference designators are printed on the printed circuit board. In addition, certain parts, significant to the procedures which follow are flagged. In the text and on the schematic (figure 5-2), the reference designators shown on the printed circuit board are prefixed with the number "10". For general repair and cleaning techniques, refer to Technical Manual 888 1753 001, Volume I, Section V.

5-3. ADJUSTMENT PROCEDURES.

5-4. There are two adjustments on the limiter meter module; LIMITING LEVEL, 10R1, which is covered in Section III of Technical Manual 888 1753 001, Volume I, and meter calibrate control, 10R3.

5-5. The meter is calibrated by removing both limiter modules from the main frame and applying +5.0 vdc to pin 40 of P1. Meter calibrate control, 10R3, is then adjusted for mid scale deflection of the meter.

5-6. TROUBLESHOOTING.

5-7. Troubleshooting the limiter meter module consists primarily of continuity checking with an ohmmeter. If transistors 10Q1 and 10Q2 are suspected sources of trouble, they can be checked for conduction by measuring the base emitter voltage which should be approximately 0.7 volt when in the conducting state. A higher voltage would indicate on open junction, and a lower voltage would indicate nonconduction.

5-8. The module can be removed for troubleshooting or repair by loosening three cross-recessed screws in the bottom of the module, sliding the module rearward, and lifting it out of the main frame. The printed circuit board may be removed by first removing the knobs from the three front panel controls, then removing four cross-recessed screws from the side of the module. The circuit board can then be lifted out of the module.

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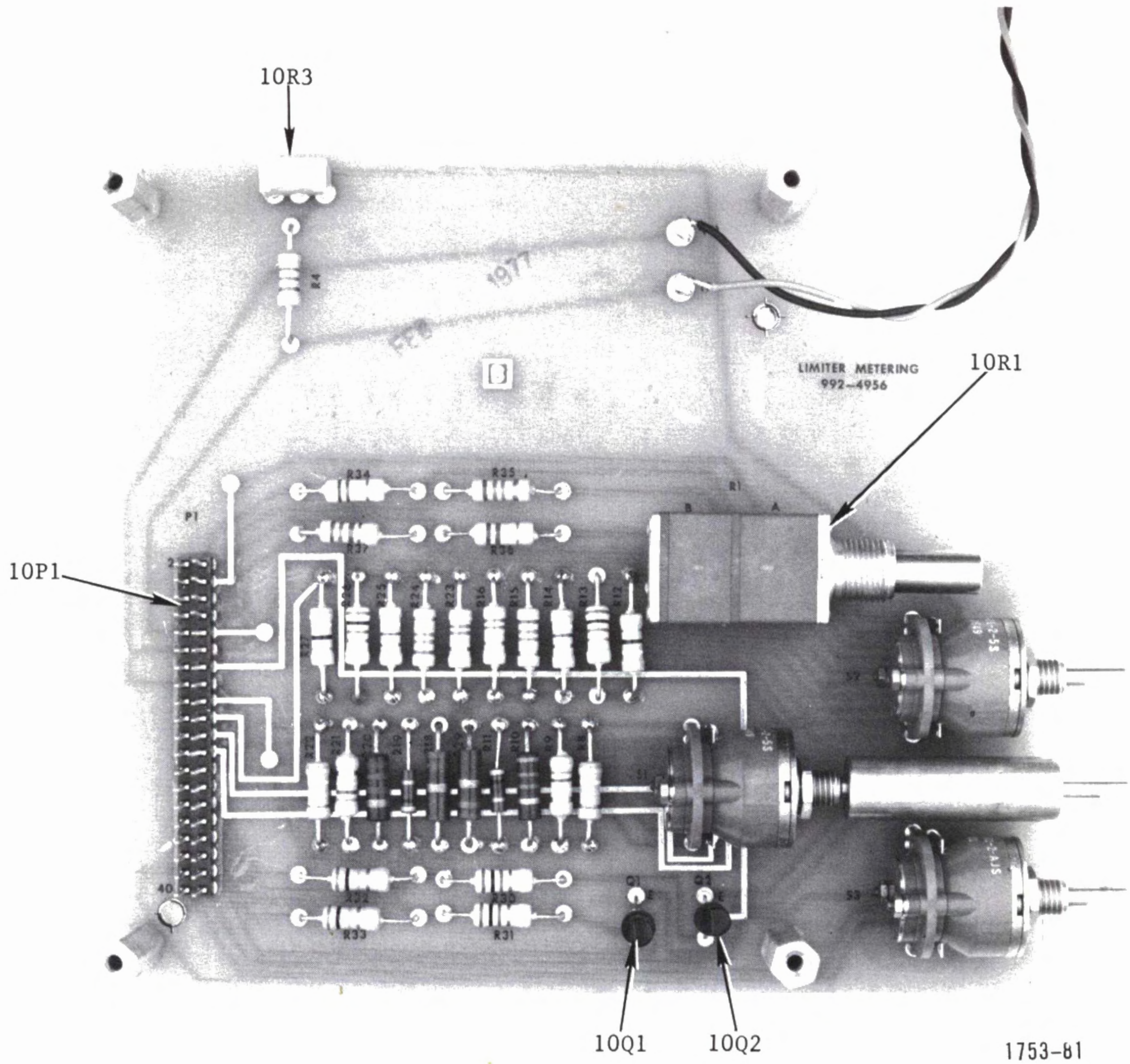

Figure 5-1. Limiter Meter Module Parts Layout

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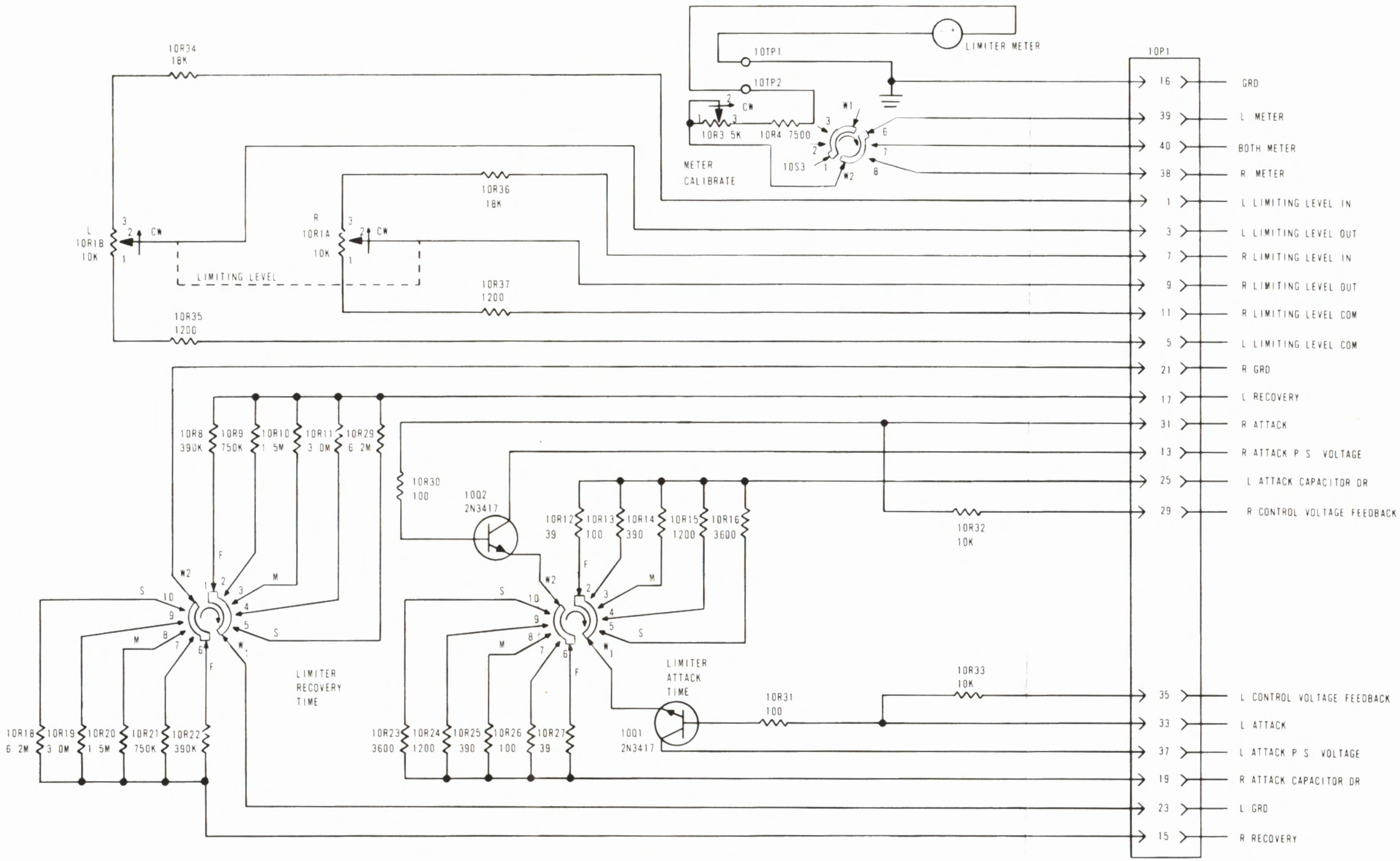

4 10TP1 AND 10TP2 ARE TURRET TERMINALS
3 ALL CAPACITANCE IN UF
2 ALL RESISTANCE IN OHMS
1 ALL RESISTORS 1 2W.5
UNLESS OTHERWISE NOTED
NOTES

FIGURE 5-2.
(SHEET 1 OF 2)
LIMITER METER MODULE
SCHEMATIC
839 3202 001

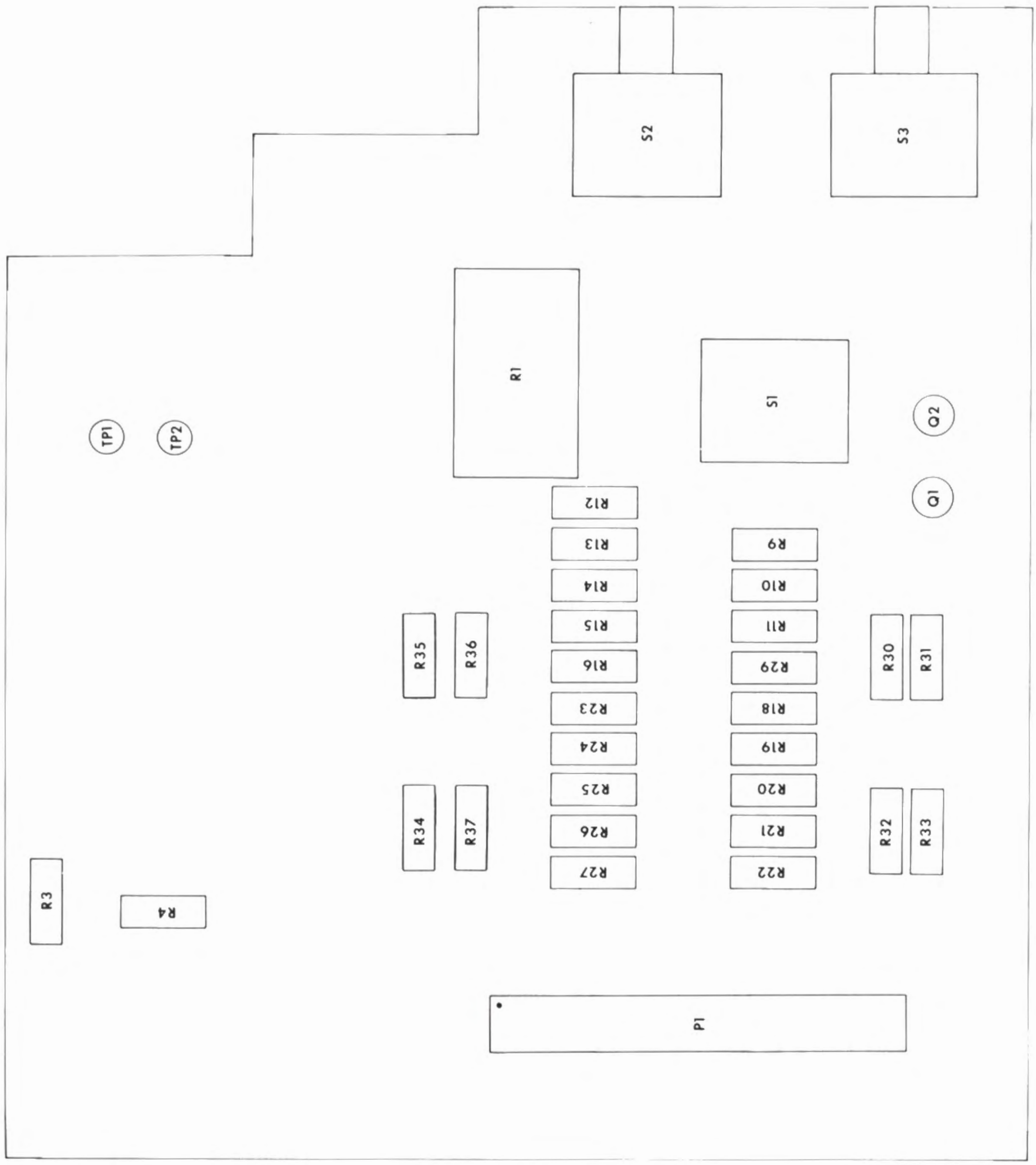

FIGURE 5-2. (SHEET 2 OF 2) LIMITER
COMPONENT LOCATION - 843 2198 001

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SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This section provides a description, reference designator, and order number for replaceable electrical parts, assemblies, and selected mechanical parts necessary for proper maintenance of the limiter meter module. Table 6-1 lists the parts for the limiter meter module assembly, and table 6-2 lists the parts for the limiter meter module printed circuit board assembly.

6-3. REPLACEABLE PARTS SERVICE.

6-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Service Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

6-5. TECHNICAL ASSISTANCE.

6-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Department during normal working hours. Emergency technical service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301. The Harris factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

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Table 6-1. Limiter Meter Module Assembly - 992 4956 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
M1	632 0963 000	Meter, Limiter	1
	358 1838 000	Insert, Small Red	1
	358 1837 000	Insert, Small Blue	1
	358 1839 000	Insert, Small Green	1
	992 4946 001	Limiter Meter Module Printed Circuit Board (Refer to table 6-2)	1
	358 2081 000	Mounting Plate, Switch	3

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Table 6-2. Limiter Meter Module Printed Circuit Board - 992 4946 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
P1	610 0748 000	Plug, 40 Pin, PC Type	1
Q1,Q2	380 0111 000	Transistor, 2N3417	2
R1	550 0917 000	Potentiometer, 10k/10k 10% Dual Section	1
R3	550 0870 000	Potentiometer, 5k ohm, 10%	1
R4	540 1154 000	Resistor, 7.5k ohm, 1/2W, 5%	1
R5	540 1112 000	Resistor, 510 ohm, 1/2W, 5%	1
R6	540 1178 000	Resistor, 750 ohm, 1/2W, 5%	1
R7	550 0901 000	Potentiometer, 500 ohm, 10%	1
R8	540 1318 000	Resistor, 390k ohm, 1/2W, 5%	1
R9	540 1338 000	Resistor, 750k ohm, 1/2W, 5%	1
R10	540 1234 000	Resistor, 1.5 Megohm, 1/2W, 5%	1
R11	540 1336 000	Resistor, 3.0 Megohm, 1/2W, 5%	1
R12	540 1224 000	Resistor, 39 ohm, 1/2W, 5%	1
R13	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R14	540 1164 000	Resistor, 390 ohm, 1/2W, 5%	1
R15	540 1205 000	Resistor, 1.2k ohm, 1/2W, 5%	1
R16	540 1179 000	Resistor, 3600 ohm, 1/2W, 5%	1
R18	540 1335 000	Resistor, 6.2 Megohm, 1/2W, 5%	1
R19	540 1336 000	Resistor, 3.0 Megohm, 1/2W, 5%	1
R20	540 1234 000	Resistor, 1.5 Megohm, 1/2W, 5%	1
R21	540 1338 000	Resistor, 750k ohm, 1/2W, 5%	1
R22	540 1318 000	Resistor, 390k ohm, 1/2W, 5%	1

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WARNING: Disconnect primary power prior to servicing.

Table 6-2. Limiter Meter Module Printed Circuit Board - 992 4946 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R23	540 1102 000	Resistor, 3600 ohm, 1/2W, 5%	1
R24	540 1205 000	Resistor, 1.2k ohm, 1/2W, 5%	1
R25	540 1164 000	Resistor, 390 ohm, 1/2W, 5%	1
R26	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	1
R27	540 1224 000	Resistor, 39 ohm, 1/2W, 5%	1
R29	540 1335 000	Resistor, 6.2 Megohm, 1/2W, 5%	1
R30,R31	540 1102 000	Resistor, 100 ohm, 1/2W, 5%	2
R32,R33	540 1111 000	Resistor, 10k ohm, 1/2W, 5%	2
R34	540 1113 000	Resistor, 18k ohm, 1/2W, 5%	1
R35	540 1205 000	Resistor, 1.2k ohm, 1/2W, 5%	1
R36	540 1113 000	Resistor, 18k ohm, 1/2W, 5%	1
R37	540 1205 000	Resistor, 1.2k ohm, 1/2W, 5%	1
S1,S2	600 0580 000	Switch, Rotary, 2P-5P	2
S3	600 0583 000	Switch, Rotary, 2P-3P	1
	943 1913 001	Printed Circuit Board	1

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TECHNICAL MANUAL

PROGRAM METER MODULE

992 4957 001

HARRIS CORPORATION

Broadcast Products Division

T.M. No. 888 1753 900

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4-4	Blank		
5-1 through 5-6	Rev. A: 3/78		
6-1 through 6-4	Rev. B: 10/78		

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WARNING: Disconnect primary power prior to servicing.

SAFETY NOTICE

WARNING: THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS AND UNDER CERTAIN CONDITIONS, COULD BE FATAL.

This manual is intended as general guidance for trained and qualified installation, operating, maintenance and service personnel who are familiar with and aware of the dangers inherent to handling potentially hazardous electrical and/or electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

THE INSTALLATION, OPERATION, MAINTENANCE AND SERVICING OF THIS EQUIPMENT INVOLVES RISKS TO BOTH PERSONNEL AND EQUIPMENT, AND MUST BE PERFORMED ONLY BY PROPERLY TRAINED AND EXPERIENCED PERSONNEL EXERCISING DUE CARE. PERSONNEL MUST FAMILIARIZE THEMSELVES WITH SAFETY REQUIREMENTS, SAFE HANDLING AND OPERATING PRACTICE, AND RELATED FIRST-AID PROCEDURES (E.G., FOR ELECTRICAL BURNS AND ELECTRICAL SHOCK).

HARRIS CORPORATION Broadcast Equipment Division shall not be responsible for injury or damage resulting from improper installation, operation, maintenance or servicing, or from the use of improperly trained or inexperienced personnel in the performance of such tasks, or from the failure of persons engaged in such tasks to exercise due care.

As with all electronic equipment, care should be taken to avoid electrical shock in all circuits where substantial currents or voltages may be present, either through design or short circuit. Caution should also be observed in lifting and hoisting equipment, especially regarding large structures, during installation.

LIABILITY LIMITATION

The procedures outlined in this Manual are based on the information available at the time of publication and should permit the specified use with minimum risk. However, the manufacturer cannot assume liability with respect to technical application of the contents and shall, under no circumstances, be responsible for damage or injury (whether to person or property) resulting from its use.

The manufacturer is specifically not liable for any damage or injury arising out of failure to follow the instructions in this Manual or failure to exercise due care and caution during installation, operation, maintenance and service of this equipment.

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CAUTIONARY NOTICE

Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

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LIST OF ILLUSTRATIONS

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WARNING: Disconnect primary power prior to servicing.

SECTION I

GENERAL DESCRIPTION

1-1. EQUIPMENT PURPOSE.

1-2. The program meter module monitors the program output signal, either from the output module or from the protection module, and monitor the primary power supply output voltage. Selection of the signal to be monitored is made with a jumper plug on the output module PC board. A selector switch on the meter module also selects left (L), right (R), or both (BOTH) channels for monitoring.

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SECTION II

INSTALLATION

2-1. GENERAL.

2-2. Installation of the module is covered in Technical Manual 888 1753 001, MSP 100 Audio Processor System, Volume I, Section II.

SECTION III

CONTROLS AND INDICATORS

3-1. GENERAL.

3-2. Figure 3-1 shows all of the user controls and indicators provided on the module, and table 3-1 describes the function of each.

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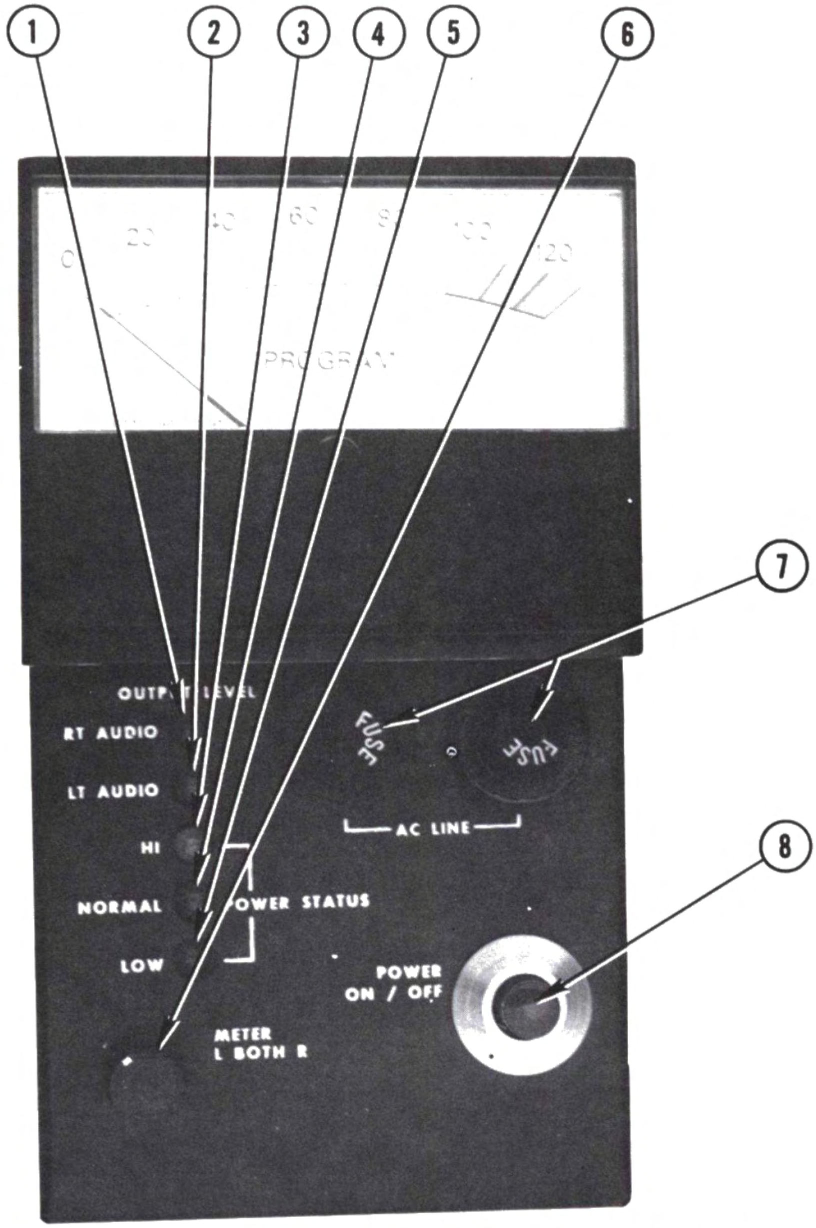

Figure 3-1. Program Meter Module Controls and Indicators

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Table 3-1. Output Meter Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	RT AUDIO, 11DS2	LED indicator (green): indicates relative level of signal in right audio channel (brilliance proportional to level).
2	LT AUDIO, 11DS1	LED indicator (green): indicates relative level of signal in left audio channel (brilliance proportional to level).
3	POWER STATUS HI, 11DS3	LED indicator (yellow): glows when primary power supply voltage is high.
4	NORMAL, 11DS4	LED indicator (green): glows when primary power supply voltage is normal.
5	LOW, 11DS5	LED indicator (red): glows when primary power supply voltage is low.
6	METER L/BOTH/R, 11S1	L Position: selects left audio channel output for metering. BOTH Position: selects both left and right audio channels outputs for metering (meter indication is greater of the two). R Position: selects right audio channel output for metering.
7	AC LINE, 11F1/11F2	AC power line fuses (located in input to primary of power transformer).
8	POWER ON/OFF, 11S2	Closes ac power line circuit energizing primary power supply.

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SECTION IV

PRINCIPLES OF OPERATION

4-1. CIRCUIT DESCRIPTION.

4-2. The program meter module has two functional circuits, a program output level indicating meter circuit, and a power supply monitoring circuit. In addition, the module contains the primary power supply fuses and ON/OFF switch.

4-3. METERING CIRCUIT.

4-4. The left and right audio output modules each contain a precision rectifier which detects the audio signal and outputs a dc voltage which is a replica of the audio envelope. As shown in figure 4-1 this voltage enters the program meter module through diodes 11CR1 through 11CR4 and switch 11S1. Assuming the switch is in the BOTH position, the left detected audio would be applied to the anode of 11CR2, and the right detected audio would be applied to the anode of 11CR3. The diode which has the highest anode voltage will conduct and reverse bias the other; therefore, the channel with the largest signal will be the one causing the meter deflection. The conducting diode supplies base current to 11Q2, also causing conduction and forward biasing the base of 11Q5. Diode 11CR6 sets a fixed bias of 0.7 vdc on the base of 11Q4, limited by 11R5, and causing 11Q4 to supply a constant current (established by the setting of 11R13) to the base of 11Q4. This bias is used for meter calibration. The drop across 11R14, which follows the audio envelope is the source of current for meter deflection. Meter current is limited by 11R15, 11R16, and 11R17. Thermistor 11RT1 in parallel with 11R16 compensates for temperature changes.

4-5. CHANNEL INDICATORS.

4-6. Relative activity of the left and right audio channels is indicated by LEDs, 11DS1 (left) and 11DS2 (right). The detected audio signal from the left output module establishes the base bias for 11Q1 through 11R1 and 11R2. This bias, which varies with the audio envelope, causes 11Q1 to conduct varying amounts of current, which in turn causes the brilliance of 11DS1 to vary. Current through 11DS1 is limited by 11R4. Right channel activity is similarly indicated by 11DS2 and associated components.

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4-7. POWER SUPPLY STATUS CIRCUIT.

4-8. Outputs of the 20-volt regulators in the primary power supply are routed to the program meter module where the power supply status is displayed (see figure 4-2). Should the power supply voltage go high as might occur if a regulator developed an internal short, LED, 11DS3, will glow, since the zener voltage of 11CR12 and 11CR13 would be exceeded and they would conduct. In this case, 11Q7 would be turned on by current through 11R24, shunting current around 11DS4, and 11Q6 would be turned on, shunting current around 11DS5. As long as the voltage between the positive and

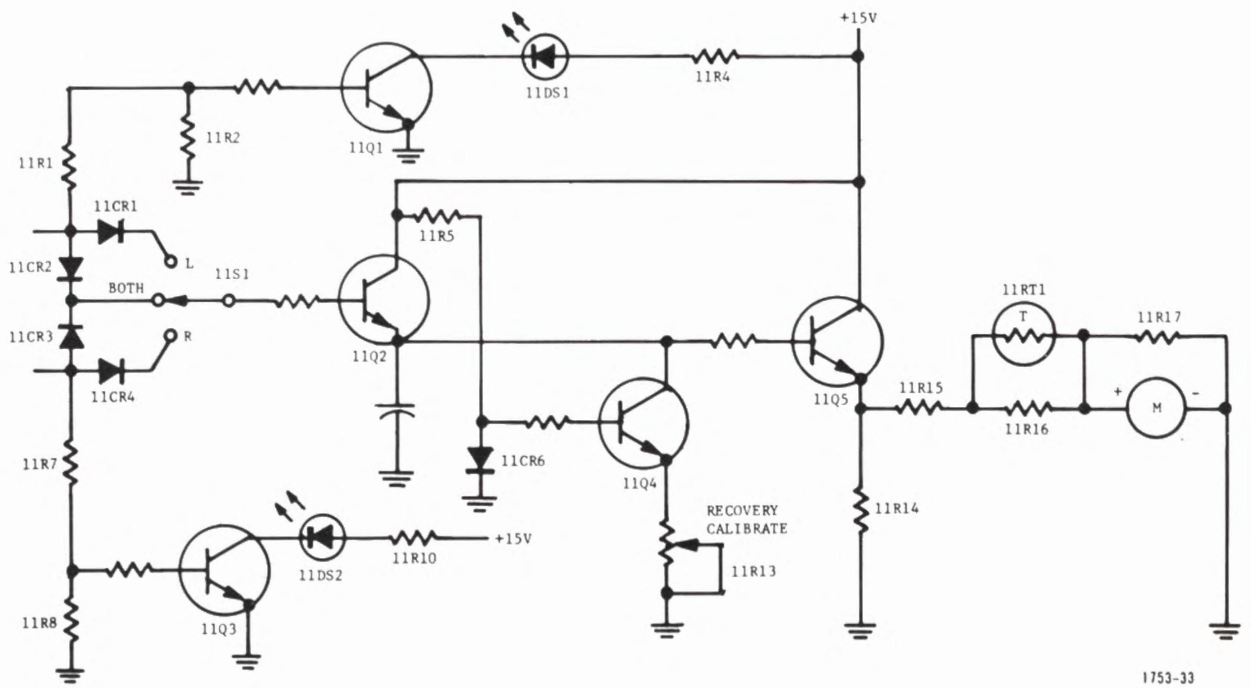

Figure 4-1. Metering Circuit

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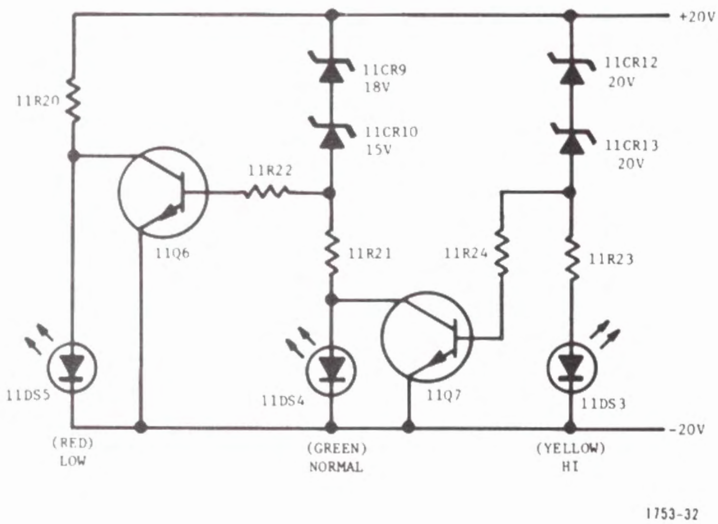

Figure 4-2. Power Status Indicating Circuit

negative supplies is above 35 volts and below 42 volts, 11DS4 will glow, indicating normal power supply status, becuase the zener voltage of 11CR9 and 11CR10 is exceeded and 11Q7 is turned off. In this case 11Q6 is turned on due to base current through 11R22, and current is shunted around 11DS5. If the power supply voltage falls below 35 volts, 11CR9 and 11CR10 cease to conduct, turning 11Q6 off and depriving 11DS4 of current. 11DS5 then will glow indicating low power supply voltage.

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SECTION V

MAINTENANCE AND TROUBLESHOOTING

5-1. GENERAL.

5-2. This section describes the maintenance and troubleshooting procedures for the program meter module. As shown in figure 5-1, reference designators are printed on the printed circuit board. In addition, certain parts significant to the discussions which follow are flagged. In the text and on the schematic (figure 5-2), the reference designators shown on the printed circuit board are prefixed with the number "11". If the module does not perform properly, figures 5-3 and 5-4 may be used as a guide for troubleshooting. For general cleaning and repair techniques, and for a list of recommended test equipment, refer to Technical Manual 888 1753 001, MPS 100 Audio Processor System, Volume I, Section V.

5-3. MODULE ADJUSTMENTS.

5-4. The only adjustment on the program meter module is the RECOVERY CALIBRATE potentiometer, 11R13, which controls meter pointer ballistics. This control is set at the factory and should not be adjusted.

5-5. TROUBLESHOOTING.

5-6. If the system does not perform properly and the fault is traced to the program meter module, the troubleshooting charts (figures 5-3 and 5-4) which follow may be used.

WARNING: Disconnect primary power prior to servicing.

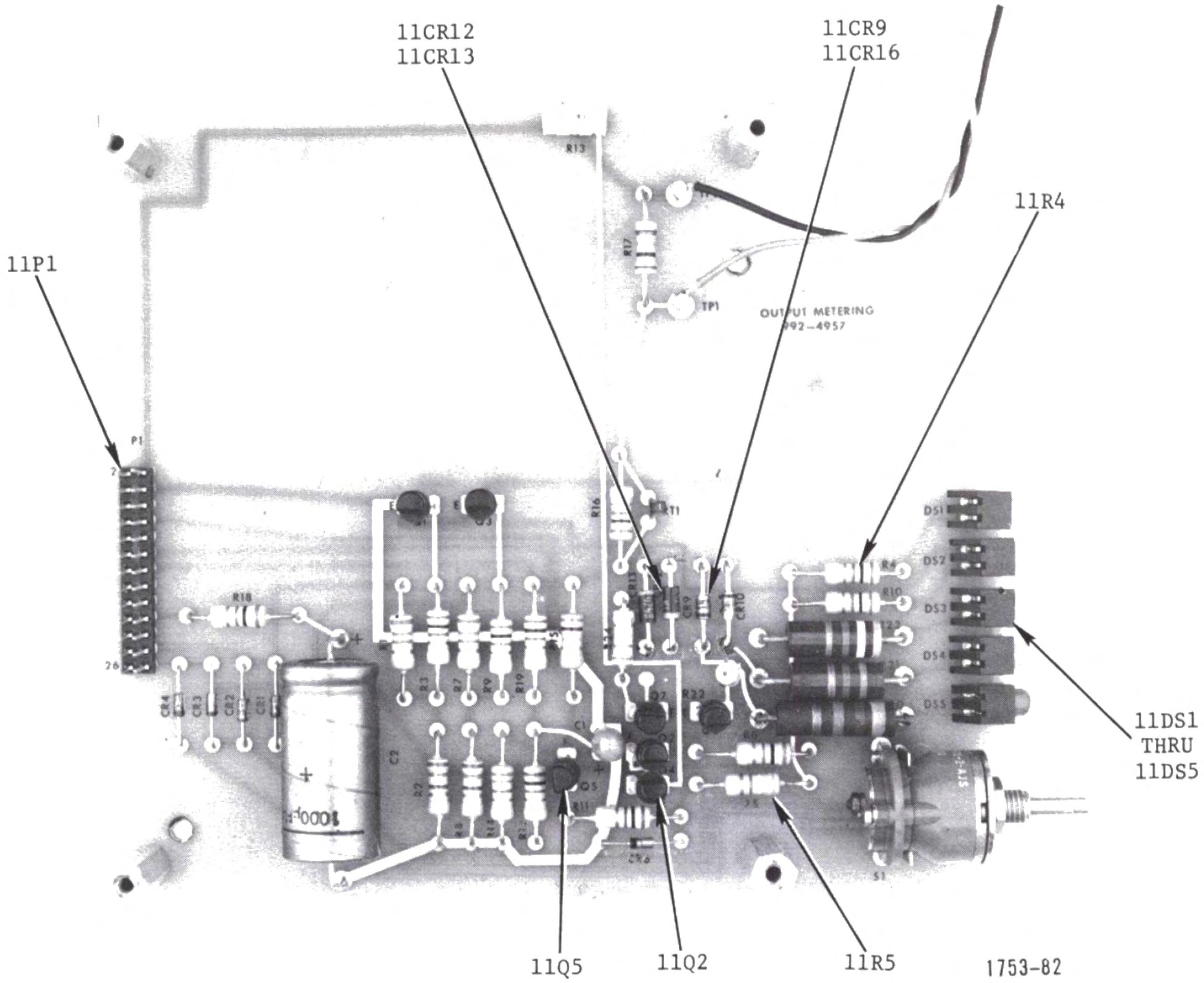

Figure 5-1. Program Meter Module Parts Layout

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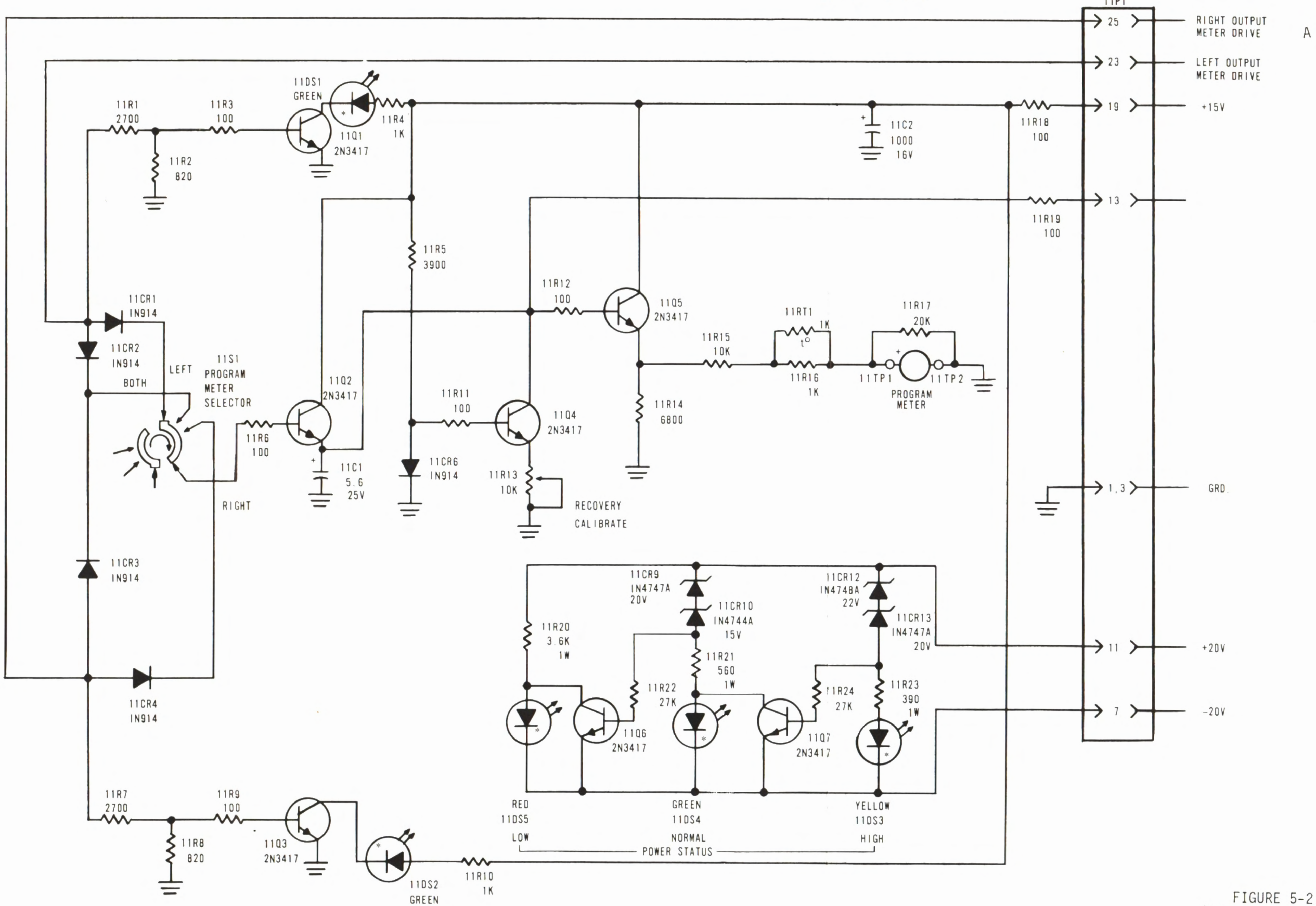

FIGURE 5-2.
(SHEET 1 OF 2)
PROGRAM METER MODULE
SCHEMATIC
839 3201 001

4. * FRONT PANEL.
3. ALL CAPACITANCE IN UF.
2. ALL RESISTANCE IN OHMS.
1. ALL RESISTORS 1/2W, 5%.
UNLESS OTHERWISE NOTED
NOTES:

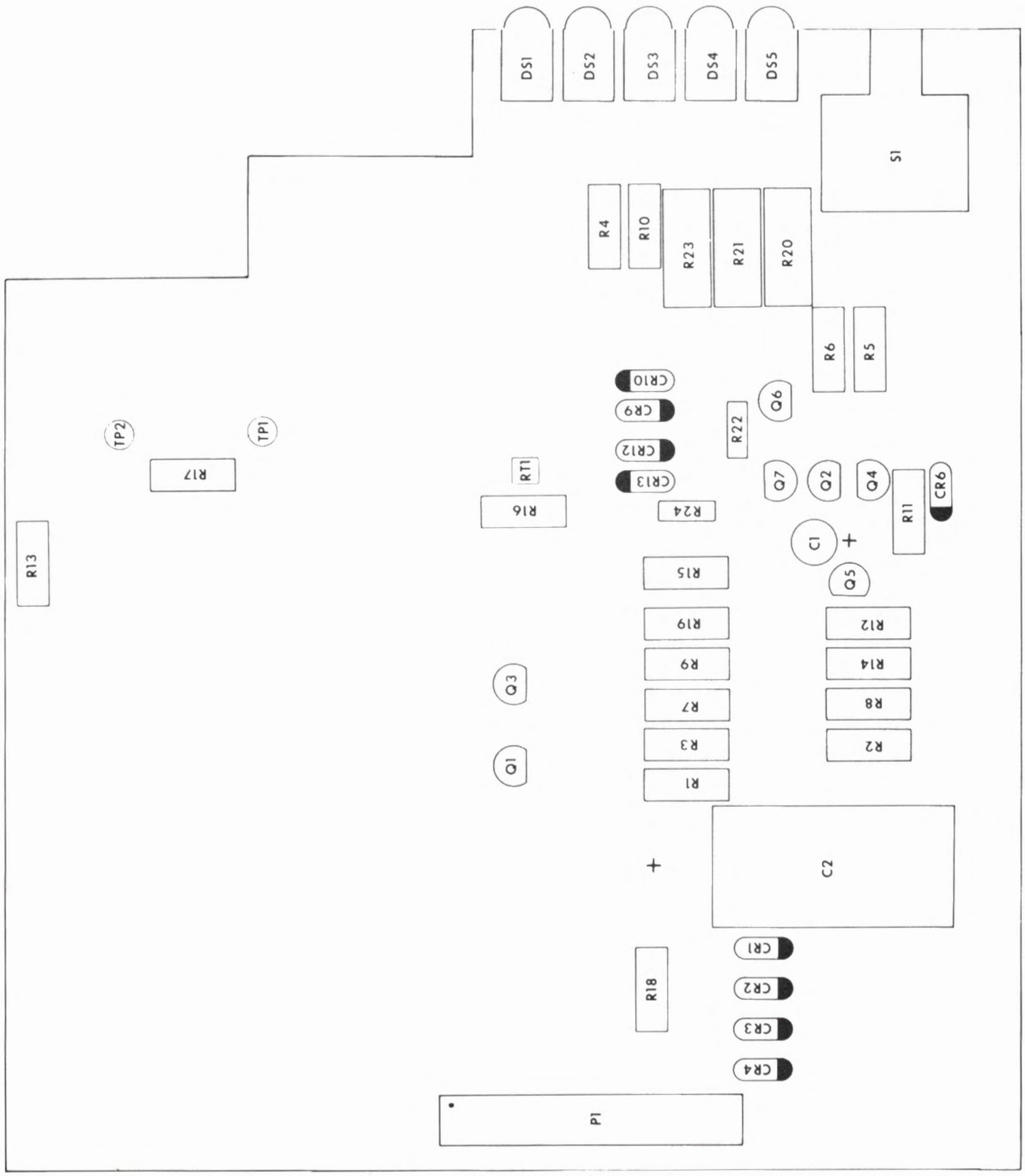

FIGURE 5-2. (SHEET 2 OF 2) PPM METER PANEL OUTPUT
COMPONENT LOCATION - 843 2195 001

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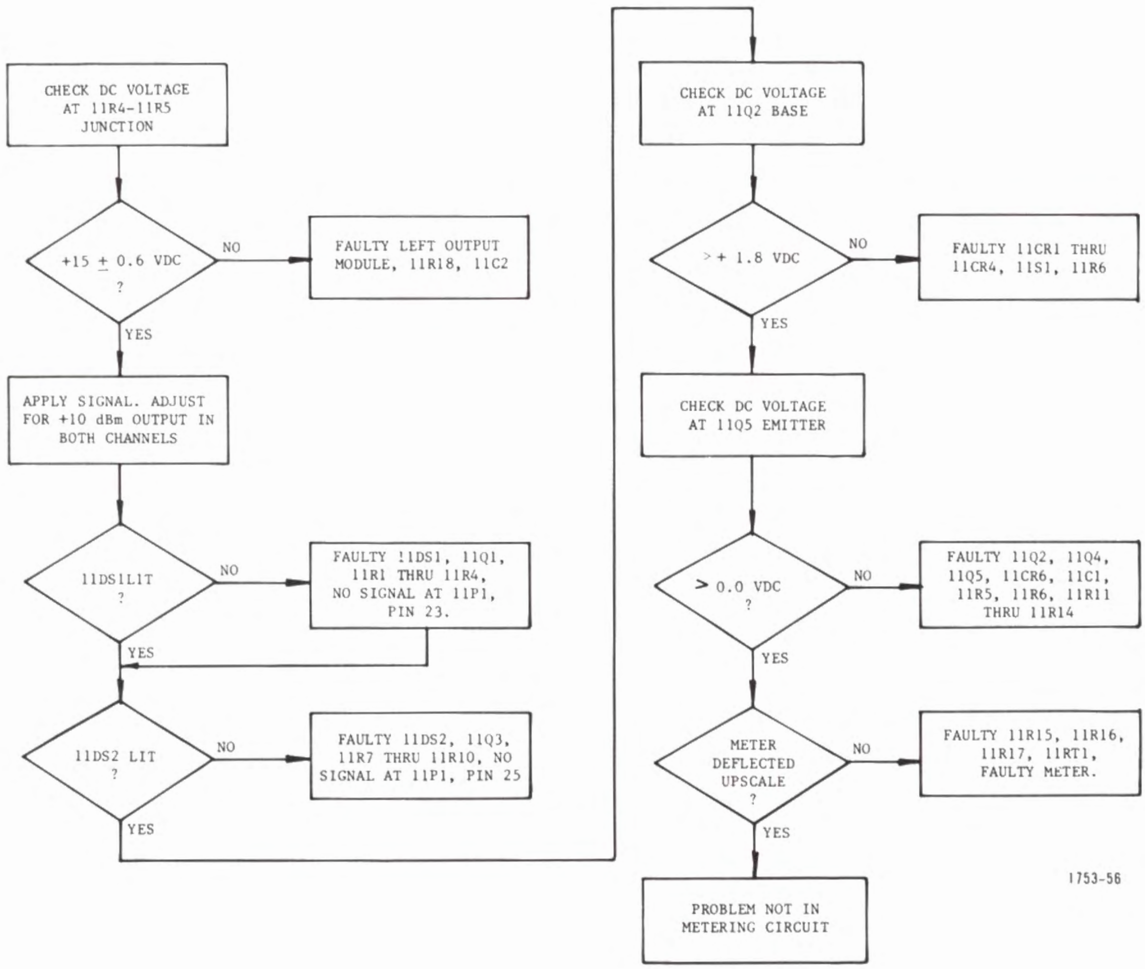

Figure 5-3. Metering Circuit Troubleshooting Chart

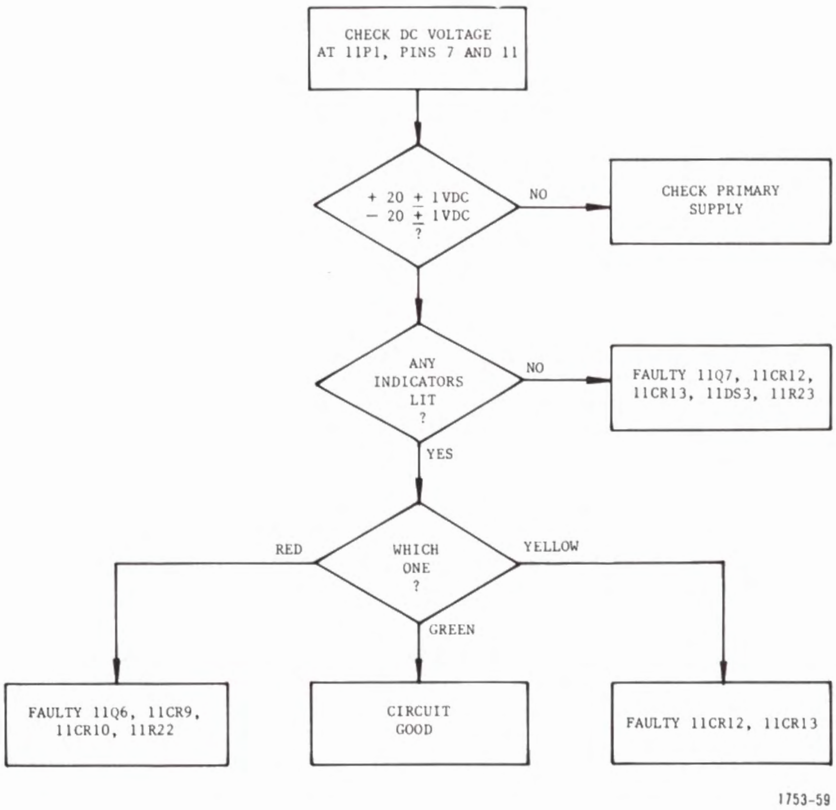

Figure 5-4. Power Status Indicating Circuit Troubleshooting Chart

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SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This section provides a description, reference designator, and order number for replaceable electrical parts, assemblies, and selected mechanical parts necessary for proper maintenance of the program meter module. Table 6-1 lists the parts for the program meter module assembly, and table 6-2 lists the parts for the printed circuit board assembly.

6-3. REPLACEABLE PARTS SERVICE.

6-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Service Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

6-5. TECHNICAL ASSISTANCE.

6-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Department during normal working hours. Emergency technical service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301. The Harris factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

Table 6-1. Program Meter Module - 992 4957 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
16FX1,16XF2	402 0022 000	Fuseholder	2
F1,F2	398 0052 000	Fuse, 3/4 Ampere, Slow Blow	2
M1	632 0965 000	Meter, Program	1
16S1	604 0755 000	Switch, DPDT	1
	358 1837 000	Insert, Small, Blue	1
	650 0254 000	Knob, Small 1/8" shaft	1
	992 4947 001	Program Meter Module Printed Circuit Board (Refer to table 6-2)	1
	358 2081 000	Mounting Plate, Switch	1

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Table 6-2. Program Meter Module Printed Circuit Board - 992 4947 001

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
C1	526 0348 000	Capacitor, 5.6 uF, 25V	1
C2	522 0391 000	Capacitor, 1000 uF, 16V	1
CR1 thru CR4	384 0205 000	Diode, 1N914	4
CR6	384 0205 000	Diode, 1N914	1
CR9	386 0137 000	Diode, Zener, 1N4746A	1
CR10	386 0082 000	Diode, Zener, 1N4744A	1
CR12,CR13	386 0100 000	Diode, Zener, 1N4747A	2
DS1,DS2	384 0661 000	LED, Green	2
DS3	384 0664 000	LED, Yellow	1
DS4	384 0661 000	LED, Green	1
DS5	384 0662 000	LED, Red	1
P1	610 0747 000	Plug, 26 Pin, PC Type	1
Q1 thru Q7	380 0111 000	Transistor, 2N3417	7
R1	540 1156 000	Resistor, 2700 ohm, 1/2W	1
R2	540 1127 000	Resistor, 820 ohm, 1/2W	1
R3	540 1102 000	Resistor, 100 ohm, 1/2W	1
R4	540 1116 000	Resistor, 1000 ohm, 1/2W	1
R5	540 1137 000	Resistor, 3900 ohm, 1/2W	1
R6	540 1102 000	Resistor, 100 ohm, 1/2W	1
R7	540 1156 000	Resistor, 2700 ohm, 1/2W	1
R8	540 1127 000	Resistor, 820 ohm, 1/2W	1
R9	540 1102 000	Resistor, 100 ohm, 1/2W	1

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Table 6-2. Program Meter Module Printed Circuit Board - 992 4947 001 (Continued)

REF. SYMBOL	HARRIS PART NO.	DESCRIPTION	QTY.
R10	540 1116 000	Resistor, 1000 ohm, 1/2W	1
R11,R12	540 1102 000	Resistor, 100 ohm, 1/2W	2
R13	550 0628 000	Potentiometer, 10k ohm	1
R14	540 1145 000	Resistor, 6800 ohm, 1/2W	1
R15	540 1111 000	Resistor, 10k ohm, 1/2W	1
R16	540 1116 000	Resistor, 1000 ohm, 1/2W	1
R17	540 1107 000	Resistor, 20k ohm, 1/2W, 5%	1
R18,R19	540 1102 000	Resistor, 100 ohm, 1/2W	2
R20	540 0345 000	Resistor, 3.6k ohm, 1W	1
R21	540 0326 000	Resistor, 560 ohm, 1W	1
R22	540 1147 000	Resistor, 27k ohm, 1/2W	1
R23	540 0322 000	Resistor, 390 ohm, 1W	1
R24	540 1147 000	Resistor, 27k ohm, 1/2W	1
RT1	559 0003 000	Thermistor, 1k ohm	1
S1	600 0853 000	Switch, 2P-3P Rotary	1
	943 1926 001	Printed Circuit Board	1

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HARRIS COMMUNICATIONS AND INFORMATION HANDLING

HARRIS CORPORATION Broadcast Products Division

P.O. Box 4290 Quincy, Illinois 62301