

1. INTRODUCTION

The Moseley Associates, Inc. Model TGR-340 Audio Gain Rider was designed to automatically ride gain on a program line, providing maximum modulation on a long-term basis, with a minimum of audible or measurable byproducts. Simultaneously the program circuits are protected from overload. A switch-defeatable all-pass network is provided to increase signal symmetry, a feature especially useful in TV, FM and SCA program transmission. A recovery-enabling gate freezes the gain-riding activity during pauses in program, preventing background noise from being pumped up (or fading down). The recovery-enable threshold is adjustable from the front panel; a panel lamp is provided to facilitate adjustment. A continuously-variable front-panel control allows a time delay to be added to the AGC recovery for preservation of short-term dynamic range. Switch-defeatable low-distortion treble AGC is included to prevent overdrive in satellite, aural STL, tape or other systems using treble pre-emphasis. The operation of this circuit is monitored by a panel lamp. Other panel controls are the input and output level adjustments and the basic recovery rate. The front-panel meter is calibrated in terms of decibels of gain-reduction; an external output is available for remote metering purposes. A pair of TGR-340s may be interconnected for stereophonic transmission. The transformerless output stage is direct-coupled for preservation of the output waveform. The TGR-340 uses FET-input and low-noise operational amplifiers. The unit is temperature-compensated for operation over the full -20°C to $+50^{\circ}\text{C}$ range. Filtering allows operation in high-intensity RF fields. The unit is field-repairable, uses standard parts and is free of black boxes and photocells. The precisely-regulated and overload-protected power supply is enhanced by the use of computer-grade filter capacitors. Integrated circuits and transistors are socketed. Service loops allow inspection without extender cards. The TGR-340 accommodates line voltages of 120 and 240 VAC at 50 or 60 Hz, and requires one rack unit of space.

2. SPECIFICATIONS

Input Level	-26 dBm for limiting threshold with input level control at maximum; switchable 20 dB input attenuator
Input Impedance	600 ohms $\pm 10\%$, resistive, balanced, floating
Output Level	Adjustable up to +18 dBm into 600 ohms
Load Impedance	600 ohms, balanced, transformerless
Control (AGC) Range	Greater than 30 dB
Control Mechanism	Monolithic Semiconductor Array
Input/Output Compression Ratio	Greater than 60:1 in dB (30 dB input level variation yields less than 0.5 dB output variation)
Attack Time (AGC loop) (System)	2 milliseconds Instantaneous
Recovery Time	200 milliseconds (for transient material); 5 to 25 seconds on program material, adjustable and program-controlled
Recovery-enable Threshold	Continuously adjustable, 0 to 25 dB below AGC threshold
Recovery-enable Bandpass	200 to 4000 Hz; response falls off at 12 dB/octave outside this band
Recovery-enable Indicator	Panel lamp (LED)
Metering	Critically-damped movement calibrated (0 to 20 dB) panel meter; external output for remote metering

Treble AGC Attack Time	1 millisecond
Treble AGC Recovery Time	5 to 30 milliseconds, program-controlled
Treble AGC Indication	Panel lamp (LED)
Polarity Controller	Three-stage second-order allpass network optimized for male voice; switch-defeatable
Frequency Response	± 1 dB, 30 Hz to 15 kHz (below treble AGC threshold)
Harmonic Distortion	Less than 0.2% below thresholds of AGC; less than 0.7% at any frequency (50 Hz to 15 kHz) and any degree of AGC (0 to 20 dB), with any combination of front-panel control settings
Intermodulation Distortion	Less than 0.3% below thresholds of AGC; less than 1% at any degree of AGC (0 to 20 dB), using 60 Hz and 7 kHz mixed 4:1
Signal to Noise Ratio	Better than 70 dB, 20 Hz to 20 kHz, unweighted
Temperature Range	-20°C to +50°C
Power Requirements	120/240 VAC, 50/60 Hz, 10 W
Size	4.5 cm H x 48.4 cm W x 33 cm D (1.75" H x 19" W x 13" D)
Weight	3.6 kg (8#) net, 4.5 kg (10#) domestic shipping

3. UNPACKING

The TGR-340 should be carefully unpacked and inspected for evident shipping damage. Keep all packing material in case a claim is to be made against the carrier for damages. Should this inspection reveal any damage, immediately file a claim with the carrier.

Remove the top covers from the units. Confirm that the various plug-in components are securely seated in their sockets. Restore the covers.

4. INSTALLATION

The following installation suggestions are based on the assumption that the TGR-340 will be used in its most common application, that of 'riding gain' on a program line; the input level will be 'console' level and the output will be 'line' level.

4.1 LOCATION

The TGR-340 may be located in any standard grounded equipment rack, at a height which will allow occasional readjustment. The frontpanel meter should be visible to an observer. Connections required will be the primary power, the input line (from the console or other source) and the output line (to the following equipment). In addition, inter-unit connections may be used in the case of stereo operation. Connections to a remote meter (or remote-control system) are also optional.

4.2 INPUT CONNECTIONS

The program source should be connected to the TGR-340 input terminals on the rear panel. This should be a balanced (two conductors plus shield) line, with the shield going to the "G" (ground) terminal. The level at this point should be at least -26 dBm to reach the threshold of limiting, and should be less than +18 dBm. The impedance looking into the TGR-340 is 600 ohms. If this connection is directly from a wire-line loop, an external repeat coil should be supplied as part of the equalization circuitry provided by the telephone company. Significant common-mode (usually power-line related hum) components are eliminated by such a transformer. In addition, transient over-voltage protection is assumed to have been provided by the operating telephone company.

4.3 OUTPUT CONNECTIONS

The load should be connected to the TGR-340 output terminals on the rear panel. This should be a balanced line with the shield going to the "G" terminal. The level at these connections is adjustable up to +18 dBm in a vernier fashion by the front-panel OUTPUT control. An internal control allows a coarse setting of output level. The unit is designed to deliver +10 dBm; the recommended load impedance is 600 ohms (which is also the internal impedance looking back into the TGR-340). Transient over-voltage protection should be provided by the operating telephone company if the TGR-340 is used to feed a telephone loop.

4.4 POWER CONNECTIONS

As normally shipped, the TGR-340 is set for 120 VAC operation, at either 50 or 60 Hz. To change the device to 240 VAC operation, refer to section 8.1. When the power cords are attached and installed, the front-panel POWER lamp should glow. It is highly recommended that the neutral wire on the power cable be left intact; use the proper power receptacle.

4.5 STEREO INTERCONNECTIONS

When a pair of TGR-340 Audio Gain Riders is used in stereo, the gain-riding activity should be interconnected to avoid losing the stereo center image. In addition, the recovery-enabling gates require an interconnection. All of these interconnections can be made by using the rear-panel terminals. Use a two-conductor plus shield cable; one wire connects the AGC terminals on one unit to the AGC terminal on the other unit(s). The second wire connects between the REC terminal on one unit and the REC terminal on the other unit. The shield connects the two "G" (ground) terminals. When these connections are made the units will act in unison, preserving the stereo center image. To separate them, operate the MULTI/SINGLE switches to the SINGLE position. Under these conditions the units have no interconnection at all; they operate independently.

4.6 REMOTE METERING CONNECTIONS

An optional connection to the rear of the TGR-340 is a remote indication of gain-riding activity. The output provided for this purpose appears at the REM MTR connection (positive) and "G" (negative). This can be connected (shielded wire is recommended) to either a remote-control system (or logger) or to an extension meter. The remote-metering circuit is discussed in section 8.2. The remote metering circuit is shown in schematic 91A7219, at the text end.

5. ADJUSTMENTS

The TGR-340 has a series of adjustments for operational flexibility and to allow realistic manufacturing tolerances. Sections 5.1 through 5.9 describe the front-panel controls. The internal controls are described in sections 7.1 through 7.13.

5.1 ALLPASS / DEFEAT

This switch, when in the ALLPASS position, inserts a network into the program line which 'scrambles' the audio phase-wise, largely removing asymmetry. Unless a specific reason exists, this switch should be left in the ALLPASS position.

5.2 HF AGC / DEFEAT

This switch enables the HF (treble) AGC system to be operative. This switch should be in the DEFEAT position if the following load is a telephone loop or other system WITHOUT pre-emphasis. This switch should be in the HF AGC position if the following load is a satellite feed, an aural STL, aural subcarrier on a video link or a tape recorder deck WITH pre-emphasis.

5.3 MULTI UNIT / SINGLE

This switch interconnects the AGC lines and the recovery-enable of two or more TGR-340s. For initial setup this switch should be in the SINGLE position. Subsequently this switch will probably be returned to the MULTI position. This switch has no effect in a monaural application.

5.4 AGC / DEFEAT

This switch, when in the DEFEAT position, prohibits the AGC system from functioning. This is useful when running a proof of performance or making other measurements where the system gain must remain absolutely stable for a period of time.

This switch does not control the HF AGC, whose activity is monitored by the front-panel lamp and which can be switched off by its own switch (HF AGC / DEFEAT).

5.5 INPUT LEVEL

The input level control should be adjusted for an indication of about 10 dB of limiting on the front-panel meter with typical program material. This 10 dB of limiting on typical program material is a generally satisfactory figure. Classical music operations may elect to use less limiting; a figure of 5 dB on loud passages should prove satisfactory. Popular music or speech-oriented operations will commonly use 10 to 15 dB of limiting. Low-level passages of music may show less limiting, perhaps none at all. Loud passages may indicate as much as 20 dB of limiting. The TGR-340 will handle levels greater than this without unreasonable side effects, but is rated as regards distortion to only 20 dB of limiting.

The INPUT LEVEL control has a restricted range; it cannot be 'shut off' by a full counter-clockwise rotation. Should the input level be very high, then the INPUT LEVEL switch (accessible through the top cover, right-front corner) should be set to the HIGH position. Low input levels will most likely require that this switch be set to the LOW position. This will allow the INPUT LEVEL control to be adjusted most easily.

Should the input level be extremely high, such that the input level controls cannot adequately control the degree of limiting, then an external attenuator may be added to the input signal line. See section 8.4.

5.6 RECOVERY ENABLE

The recovery-enable control should be set so that with any reasonable program material the front-panel SIGNAL lamp is on. Very low passages, for example the quiet crowd noise at a ball game, should allow the lamp to go out. The recovery-enable circuit operates at a syllabic rate, and so marginal levels may cause the lamp to flicker. This is normal, particularly for speech with little or no background noise or bed. The recovery-enable circuit responds largely to midband audio.

5.7 RECOVERY TIME

This control is best adjusted by observing the front-panel meter on the TGR-340 while listening to the program material through the unit. It will be noted that faster recovery times will cause some degree of loudness enhancement compared with a longer recovery time. The program will usually sound more natural with a longer recovery time, at a small sacrifice in loudness. The internal recovery control computer enables a significant increase in loudness to be achieved on 'raw'

(not previously processed) program material as compared with ordinary audio AGC systems. It will be observed that program material of a transient or 'bouncy' nature causes automatic gain control activity with a fast recovery time; sustained heavy compression will cause the recovery time to lengthen. Previously compressed program material will cause the recovery time to become infinite: the system seeks the proper gain setting and then 'locks up,' not 're-compressing' the program.

5.8 RECOVERY DELAY

This control allows the AGC recovery to be delayed (as opposed to simply making the time slower). This feature, which is of great benefit to a classical music operation, preserves the short-term dynamic range. Ordinary AGC systems have gains which are always either rising or falling; with the recovery delay operative in the TGR-340, this can be avoided, with a greater naturalness in music transmission.

The recovery delay is particularly effective in a system involving repeated processing. For example, tape recordings which are dubbed over and over can be processed through the TGR-340 at each dubbing with minimal side effects, as compared with older AGC designs, or to the TGR-340 without the recovery delay.

The adjustment of this control is best accomplished by passing typical program material through the TGR-340 and observing the result, both by audible monitoring of the sound and watching the front-panel meter. Short recovery timing with considerable recovery delay may result in gain pumping. In general, use the least amount of delay which will make the meter on the front panel tend to 'hang onto' the correct gain setting. Values of recovery delay shorter than this will increase the average level, at a slight expense of naturalness.

5.9 OUTPUT LEVEL

The output level should be set to satisfactorily drive the following equipment. The TGR-340 has been designed to deliver +10 dBm into a 600 ohm load, such as an aural STL. If the front-panel control cannot be adjusted to the correct level, then the internal COARSE OUTPUT ADJ. control may have to be called upon. Do not attempt to exceed +18 dBm output unless an increase in distortion is allowed. The output level can be most conveniently monitored on the Program or Modulation metering position of the following equipment. Bear in mind that on program material the DB meter on most metering systems will read low compared to sinusoidal test signals. Moseley Associates aural STLs use peak-reading modulation metering to circumvent this problem. If such a Moseley product is used, merely adjust the OUTPUT LEVEL control for a "0" reading on the STL.

6. CIRCUIT DESCRIPTION

The following discussion of the circuitry in the TGR-340 is with reference to the main-frame drawing 91C7165 and schematic drawing 91D7166.

6.1 INPUT AMPLIFIER

Program audio is applied to the audio input barrier-strip terminals on the rear of the TGR-340. After passing through RF filtering, this signal appears at terminals 27 and 28 of the main printedcircuit board. Resistors R1 through R4 provide input termination for the program line. This balanced and floating signal is converted to a single-ended form by transformer T1. The input level control is across the transformer secondary. The range of this control has been restricted to about 25 dB by the addition of R10. Should high level signals be applied to the input, then switch S1 may be called into play to provide 20 dB of attenuation to the signal. This is accomplished by carefully loading the transformer secondary.

That portion of the signal which has been selected by the input level control is applied to the input amplifier using U1 and associated components. This stage provides gain and frequency-response correction for the system. R8 and C2 provide RF filtering on-board. R214 and C102 provide the response correction. The input to this stage is observable at TP1, the orange test point, and the output appears at TP2, the yellow test point.

The output of this amplifier is routed to both an allpass network (phase scrambler) and to an adjustable attenuator. The attenuator provides the same attenuation (a few decibels) as does the allpass network. In this manner when the allpass is switched in or out there is no level change.

6.2 ALLPASS NETWORK

The purpose of this network is to alter the program waveforms so that asymmetric signals, such as those from a live announcement, are made more symmetrical. This is accomplished by altering the phase relationships between the program audio fundamental frequencies and their harmonics. When listening to the program alone, this is absolutely inaudible save for a potential increase in loudness. This feature can increase the loudness of the program by as much as 6 dB, and is especially useful in TV and FM transmission, where asymmetric audio cannot be 'polarized' as it can in AM transmission.

There is a slight loss in the audio level going through the allpass network. When it is bypassed (switched out), a similar loss must be introduced into the system so that there is no level change with or without the allpass network. This loss-matching is accomplished by R15, R16 and R17. Controls R20, R27 and R33 are used to adjust each stage of the allpass network for a flat frequency response.

6.3 WIDEBAND AGC

A wideband (essentially flat response throughout the audio spectrum) AGC system is formed by the circuitry around U8 through U12, and U13, U14, U15 and U17.

Audio from the allpass in-out switch S2 is applied to the AGC system at pin 24. The signal can be viewed at this point by observing TP3. Capacitors C17 and C18 prohibit DC offsets from affecting the variollosser. Resistor R39 and capacitor C19 bypass residual RF. Resistor R40 forms a series leg of a voltage divider, the shunt leg of which is formed by diode array U8. This array is operated at low level (about 0.2 volts peak-to-peak) and so is essentially distortionless. Observe that this variollosser is operated with the audio signal single-ended while the AGC voltage is in push-pull.

The output of the variollosser is applied to linear amplifier U9. This amplifier is operated at a stable fixed gain such that its output level is about 5 volts peak-to-peak, observable at TP7. The output of this stage is routed to two locations: a full-wave rectifier circuit using CR1, CR2 and U10, as well as to a transient clipper using CR12 and CR13 and associated circuitry.

The full-wave rectifier, whose output is observable at TP8, selects whichever program peak (positive or negative) is greatest and applies that signal to a comparator. When the audio level is excessive the comparator (U11) delivers a positive output to rectifier CR3. This signal is shaped by resistor R63 and capacitor C36, which together determine the AGC reaction (attack) time. The signal appearing across C36 is brought out to pin 22 for application to a mating TGR-340. It is also applied to buffer U12. The output from U12 is observable at TP10; it is applied to the recovery-timing circuitry utilizing U14 and U13.

The output signal from U12 is a series of pulses which are used to charge capacitor C55 via diode CR9. C55 can discharge only through diode CR11 (in series with resistor R98). The output from U12 is also routed through diode CR8, resistor R93 and resistor R218 to capacitor C106.

The output from U12 is routed via diode CR8 to a timing network using R93, C54, R218 and C106. The output of this network is applied to adjustable-gain amplifier U14. This amplifier operates to forward- or back-bias diode CR11, allowing or preventing recovery. On transients the timing network does not charge, the output of U14 remains low and a fast recovery results. On sustained limiting, the timing network charges, the output of U14 goes positive and back-biases CR11, preventing recovery.

The timing network can discharge only through R92 (in series with the RECOVERY control R91), which is in series with the switch using FET Q2. When Q2 is allowed to conduct (when it is at zero bias), the timing network can discharge, allowing recovery. When Q2 is non conducting (when it is pinched off with a negative voltage on its gate), the AGC recovery is 'frozen.'

The voltage across capacitor C55 is applied to high-input-impedance buffer U13. The output of this buffer is observed at TP11. This output signal is applied to the meter-driving amplifier U16 and to buffer amplifier U15. The output of U15 is also applied to inverting amplifier U17, which delivers an equal but opposite AGC voltage to pin 2 of U8. The two AGC voltages applied to U8 are equal but of opposite polarity. Control R116 adjusts this equality.

Meter-driving amplifier U16 provides two outputs: One is provided with a meter-calibration control R111. The second is routed via decoupling resistor R113 to terminal 18. This output is intended to drive a remote-control system. This signal idles at ground potential without AGC activity and goes to about 8 volts with 20 dB of limiting. The idling voltage from U16 is trimmed to zero by control R107, the meter zero adjustment.

Summed with the output of U13 is a temperature-compensating signal from thermistor R103. This summing system also allows a pre-bias to be added to the AGC voltage applied to the variolossor. This prebias is normally adjusted for a quiescent (idling, below threshold of AGC) gain-reduction of 3 dB. As a result of this temperature compensation, the gain of the TGR-340 (below threshold of limiting) is held within about 2 dB over the -20°C to +50°C range.

6.4 RECOVERY CONTROL

A sample of the same audio signal used to actuate the AGC system is also applied to a recovery-enable system. The purpose of this circuitry is to prevent recovery (gain-increase) of the AGC system when the program level has dropped far below normal. An example of such a situation is a sporting event where the crowd noise is low (but present). When the normal announce signal drops, the crowd noise would be increased in an older-design AGC system. With the recovery-enable circuitry, the crowd noise is maintained at a constant level.

A second example of the usefulness of the recovery-control circuitry is in television, when a film with a noisy sound track is being broadcast. During pauses in the dialog, the background noise is maintained when the recovery-control is operative. Without this feature the noise would be magnified.

A sample of the allpass network output is applied to a bandpass amplifier using U5 and associated circuitry. Resistor R68 and capacitor C40, as well as R73 and capacitor C46, roll off the high-end response. C45 and R71, as well as C47 and R75, roll off the low-end response. This stage has a bandwidth at the 6 dB points of 200 to 4000 Hz. The response rolls off at 12 dB per octave outside this band. The net result of this shaping is that U5 delivers significant output at midband but does not deliver much signal at the hum and rumble frequencies below 100 Hz, nor does it respond significantly to high-frequency hiss and noise components.

The output of U5 is applied to a precision rectifier circuit using U6 and associated components. This circuit develops a positive signal when mid-band (i.e., legitimate) program audio is present. The signal has a rise time set by R79 operating in conjunction with C52; the fall time is largely determined by C52 and R80.

The output of the bandpass amplifier is observed at TP4. The output of the precision rectifier is observed at TP5.

The precision rectifier output is applied via resistor R82 to comparator U7. This stage compares the rectifier output with a reference voltage (obtained from the power supply, divided by R84 and R85). When the rectifier output is more positive than the reference voltage, the output of U7 goes positive. This drives the recovery gate transistor Q2 to zero bias. When the rectifier output is less positive than the reference, the output of U7 goes negative and inches off the recovery gate transistor. In this manner AGC recovery is prohibited, stabilizing the unit's gain during pauses in the program.

The output of U7 is also applied to the lamp-driving circuit using Q1. This lamp, which is powered during program presence, is the front-panel SIGNAL lamp.

The output of the comparator is observable at TP6.

The precision rectifier output is brought out to terminal 30, for interconnection to a mating TGR-340. When operating in the stereophonic mode, the AGC voltages of a pair of TGR-340s should be tied together in order to preserve the stereophonic center image. Likewise the recovery-enable lines should be tied together. In this manner, the loudest channel will control the gains of both channels, the stereo center image is preserved, and audio presence in either channel will allow recovery (and so gain-riding) in both channels. Both the AGC interconnections and the recovery-enable interconnections are controlled by the rear-panel SINGLE/MULTI switch.

6.5 TREBLE (HF) AGC

The output of the wideband AGC system (the output of U9) is applied to a treble AGC system using U18 through U26, and associated components.

The signal from U9 is applied via blocking capacitors C56 and C57 to the transient clipper circuit using CR12 and CR13 and associated parts. Control R119 adjusts the drive into the clipper circuit. This control is set so that normal program is not clipped; only transients (overshoots) are clipped.

The output of the clipper is applied to a passive pre-emphasis network using R126, R127 and R128 as well as capacitors C59 and C58 (a vernier adjustment).

The output of the pre-emphasis circuit is applied to an AGC system which is similar to the wideband circuit with some modifications to optimize it for handling treble audio. The pre-emphasized signal, appearing at the junction of R126 and R127, is applied to the variollosser itself, consisting of series leg R129 and shunt leg U18. This electronically-controlled attenuator operates in a manner similar to that of the wideband AGC with the singular exception that the addition of capacitor C60 allows this AGC system to operate only upon treble audio.

The output of the variollosser itself is applied to linear amplifier U19, whose output is observable at TP14. The output of U19 is also routed to the following transient clipping circuitry (CR22 and CR23 and associated parts), as well as to the full-wave rectifier and comparator circuitry using U20 and U21. These circuits operate in a manner similar to that of the wideband AGC. The recovery-control circuitry is relatively simplified since its requirements are different from that of the wideband AGC.

The (treble) AGC voltage developed across timing capacitor C77 is applied to capacitor C80 via diode CR18. C80 can discharge only through CR19 and resistor R159. Recovery-controlling amplifier U23 operates the switch (CR19) in a manner similar to the wideband AGC controller U14.

The voltage across C80 is applied to buffer U22, whose output (observed at TP17) is applied to a voltage divider (R161 and R162) and then to a buffer (U24). The output of U24 is applied to the variollosser U18 pin 8 as well as to inverting amplifier U26, whose output is applied to U18 pin 2.

The input to U24 is also applied to amplifier U25, which delivers a positive signal with generation of treble AGC voltage. This positive signal is applied to lamp driver Q3, which activates the front-panel HF AGC lamp.

This HF AGC system is normally shipped with a 75 microsecond time-constant. Should other time-constants be more appropriate, see section 8.3 for the required changes.

6.6 OUTPUT CLIPPER AND AMPLIFIER

The output of the treble AGC system is taken from U19. It is applied via blocking capacitors C78 and C79 to the output clipper using CR22 and CR23 and associated components. Resistor R180 forms the series leg of a voltage divider while CR22 and CR23 form shunt legs. If the signal level appearing at the load end of R180 (as seen at TP20) exceeds the voltage at U27 pin 6, plus the diode voltage drop, then it will clip. The voltage at U27 pin 6 is determined by the setting of the clipping control, R177.

The circuitry as described is operative for one audio polarity. For the other polarity the circuit operation is similar excepting that the bias voltage (U27 pin 6) is inverted by U28 and used to bias CR23.

Note that this clipper is used to clip transients only; it does not normally clip the program audio, only occasional peaks which would otherwise escape the AGC system.

The program which appears at TP20 will have been pre-emphasized if the HF AGC switch is in the HF AGC position. To counter this pre-emphasis and restore the unit to flat response (below the threshold of HF AGC), internal de-emphasis is used. This de-emphasis network is formed by series resistance R183 (and adjustable control R219) operating in conjunction with shunt capacitance C85. De-emphasis may be defeated by operating the internal switch S3 to its off position. De-emphasis is also removed when the pre-emphasis is removed by the rear-panel switch S3. S3 is a double-pole switch which simultaneously inserts or removes both the pre-emphasis and the de-emphasis.

The output of the de-emphasis network is applied to the linear amplifier using U29 and affiliated circuitry. The input to this amplifier is adjustable in a coarse manner by the use of control R184 and in a vernier manner by operating the front panel control R190.

The output of amplifier U29 is applied to a power amplifier using U30, Q4 and Q5 in a non-inverting configuration. The output of U29 is also applied to a second power amplifier using U31, Q6 and Q7, which operate in an inverting configuration. Both of these amplifiers have a voltage gain of two from their input to their output. The output impedance of these amplifiers is inherently very low; the actual output impedance of the TGR-340 is determined by the series resistors R199 and R210.

These amplifiers drive the load in a push-pull fashion, also known as a bridge configuration, for a maximum output level of +18 dBm. The output of the non-inverting amplifier is observed at TP21 while the inverting amplifier may be monitored using TP22.

The outputs of the program amplifiers appear at terminals 12 and 13 and are routed to the rear-panel barrier strip output connections via RF filtering consisting of L203, L204, C205 and C206.

6.7 POWER SUPPLY

The TGR-340 requires positive and negative voltages of ± 12 volts, regulated and ripple-free. This is obtained by rectifying the output of transformer T201 with a pair of rectifier circuits (CR28 and CR30 for the positive voltage, CR29 and CR31 for the negative voltage). The rectified voltages are then regulated by U20 (positive) and U202 (negative).

The front-panel POWER lamp is driven from the positive regulated line via a series resistor.

7. INTERNAL ADJUSTMENTS

The following discussion of the adjustments internal to the TGR-340 is keyed to schematic drawing 91D7166 and component layout 20D2745.

7.1 LEVEL MATCH (R15)

The allpass network has an insertion loss of a few dB and if it were switched out of the circuit the apparent gain of the TGR-340 would increase by that amount. The level-match control is set so that it has the same loss as the allpass network.

It is best that the tuning of the three stages of the allpass network be confirmed prior to adjustment of the level-match circuit. Refer to section 7.2.

To set the level-match adjustment properly, apply a test tone of a level which causes about 10 dB of limiting as observed on the TGR-340 panel meter, using a test tone at 2000 Hz. (This frequency was chosen to avoid the area where the allpass network is most active.) When the allpass is switched in and out, the indicated degree of limiting should not change. If it does, readjust the level-match control R15 until the two readings are the same.

7.2 ALLPASS TUNING CONTROLS (R20, R27 and R33)

Each stage of the allpass network has a tuning control. If misadjusted, the frequency response of the TGR-340 will have a dip or peak at the frequency of a particular allpass stage. The first stage is resonant at a frequency of 150 Hz, the second stage is at about 300 Hz and the third is resonant at about 600 Hz.

Apply a test tone of a level which causes about 10 dB of limiting as observed on the TGR-340 panel meter. As the tone is swept (manually, or at least slowly) from 100 to 1000 Hz, the front-panel limiting meter on the TGR-340 should show no variation in its reading. Should a particular stage be mistuned, there will be either a dip or a peak in the limiting meter reading. Adjust the controls as necessary for a flat response. R20 affects the response in the vicinity of 150 Hz, R27 affects the response near 300 Hz and R33 affects the response near 600 Hz.

The time delay of each stage has been held within tight tolerances in order that pairs of TGR-340s may be used for stereophonic transmission with no need to be concerned about inter-unit phase tracking. This has been accomplished by using 1% resistors and 3% capacitors in the allpass circuitry.

7.3 VARIOLOSSER PRE-BIAS (R105)

This control is used to set the idling or quiescent gain-reduction of the variolosses to about 3 dB. To set this control, apply an audio tone to the TGR-340 at a level 5 to 10 dB below the threshold of limiting. Operate the rear-panel AGC switch to the DEFEAT position. Now measure the output level of the TGR-340. When the pair of terminals near TP11 are shorted, the gain of the TGR-340 will be at maximum. When the pair of terminals is unshorted, the gain should drop 3 dB. If the gain drops other than this figure, readjust R105 as required for a gain-reduction of 3 dB when the terminals are unshorted. The limits on the gain-reduction due to the pre-bias are 2 dB minimum and 4 dB maximum, with the target at 3 dB.

When misadjusted, this control will cause (audibly insignificant) lack of gain-tracking in stereophonic systems, and will change the scale linearity on the front-panel limiting meter on the TGR-340.

7.4 THUMP BALANCE (R116)

This control allows suppression of the thump or pedestal components which would possibly otherwise appear along with the program on the output. If severe enough this is clearly audible as a thump (hence the name), or pop or even as a hole in the program audio following a transient application of audio.

This control is best adjusted by listening to the program output while applying and then removing a test tone in the low-frequency (200 Hz) region. Alternatively the program may be observed on an oscilloscope (use TP7). If the AGC line tends to 'lock up' during this test, use a clip-lead to connect the wiper of R91 (recovery time) to the chassis. If the thump control is misadjusted a thump or pop may be heard along with the program audio when a tone is applied.

7.5 METER ZERO (R107)

This control allows the front-panel meter to show no deflection when the AGC voltage is not present, i.e., when the TGR-340 gain is at maximum. To adjust it, apply program or test signals to the TGR-340 audio input at a level which is slightly below the threshold of limiting, to 'coax' the gain to maximum. Then adjust the meter zero control for a zero reading on the panel meter. Alternatively, remove the program input signal and operate the rear-panel AGC switch to DEFEAT. Then adjust the zero control.

This control also zeros the remote-metering output.

Restore the AGC defeat switch to normal following this adjustment.

7.6 METER CALIBRATION (R111)

This control adjusts the scale length of the panel meter on the TGR-340. Apply a test tone to the audio input on the TGR-340 and set the source to a level which just barely causes the panel meter to deflect. Then increase the tone level by 10 dB. At this point the AGC system is generating sufficient signal to cause almost exactly 10 dB of limiting. Under these conditions the panel meter should read 10 (dB of limiting). If the meter does not read correctly, adjust R111 until it does.

The meter calibration accuracy in this procedure is dependent largely on the accuracy of the 10 dB gain-change used in the first paragraph.

There is no calibration control for the remote or extension meter. This calibration is meant to be accomplished externally, presumably with the calibration control on the remote-control or logging system, or with the control which is part of the extension meter assembly. The schematic of the extension meter assembly is given in this manual immediately after the text.

7.7 CLIPPER DRIVE (R119)

This control is set so that program audio is nearly clipped. Under these conditions only transients will be clipped when tone bursts are applied to the TGR-340.

To adjust this control, apply a low-frequency tone (200 Hz) to the TGR-340 audio input at a level which causes 10 dB of limiting as read on the panel-meter on the TGR-340. Switch off (defeat) the treble (HF) AGC. Observe TP14 with an oscilloscope. About 5 volts peak-to-peak of audio should be seen. Adjust R119 until clipping is almost visible and then reduce the setting until the level drops about 15% (or about 1.5 dB).

The HF drive control, R128, if incorrectly set, can mask the setting of R119. If in doubt about the setting of R128 during the setting of R119, reset R128 until the signal at TP14 is reduced in level. Then readjust R119 as described. The resetting of R128 to the correct setting is described in section 7.9.

7.8 PRE-EMPHASIS ADJUSTMENT (C58)

This capacitor is used to trim the internal pre-emphasis to exactly the chosen value. The standards in North America call for 75 microseconds on most frequency-modulated broadcast transmitting equipment. The remainder of the world uses 50 microsecond pre-emphasis for most broadcast service. But remember that the purpose of the TGR-340 is to control the drive into an intermediate transmission system, not to control the final modulation product. Hence it is entirely conceivable that the TGR-340 is set for 75 microsecond service (to allow freedom from overmodulation in an aural STL using 75 microsecond pre-emphasis) while the final broadcast product is set for 50 microsecond service.

The pre-emphasis system in the TGR-340 is normally set for a time-constant of 75 microseconds. This corresponds to a frequency-response rise of 3 dB at a frequency of 2122 Hz when the pre-emphasis is switched on while the de-emphasis is switched off. While operating several dB below the threshold of treble AGC, switch on the pre-emphasis. The gain at the turnover frequency should increase 3 dB. If it does not, adjust C58 until it does. If, during this adjustment, the front-panel HF AGC lamp comes on, then reduce the level of the audio tone; the HF AGC system is active, and will give erroneous indications of a treble roll-off.

In stereophonic systems, adjust one channel as a master as described. Then adjust the second audio channel for in-phase operation by monitoring the stereophonic system subchannel (adjust for a null in the subchannel) or by using a Lisajous pattern (adjust the pre-emphasis control for a straight line).

Restore the setting of the internal de-emphasis on/off switch following the adjustment of the pre-emphasis.

The pre-emphasis network, as normally shipped, is set for a time-constant of 75 microseconds. Should another time-constant be more appropriate, see section 8.3 for the required changes.

7.9 HF DRIVE (R128)

The clipper drive control, R119, should be adjusted prior to the setting of R128. See section 7.7.

This control (R128) allows the excitation to the HF AGC system to be set in a manner such that the HF AGC system is on the verge of AGC activity. Since low-frequency program material must not activate the HF AGC system (bass notes could modulate the amplitude of the treble notes), a clipper is used to catch transients. Under these conditions the only time the HF AGC system is activated is when the pre-emphasis is switched on and when the program material has high-frequency material of significant amplitude. The HF drive control R128 is then used to ascertain that the HF AGC is on the verge of gain-reduction. With the HF AGC switch in the DEFEAT position, apply a 400 Hz audio tone to the input of the TGR-340. Adjust the tone level so that the panel meter indicates 10 dB of limiting. Monitor TP14 with an oscilloscope. Adjust R128 until the threshold of limiting is reached. When this happens, the output level as seen on the oscilloscope will reach a plateau beyond which further adjustment of R128 has no effect, and at this time the front-panel HF AGC lamp should come on. Back off the setting of R128 until the lamp goes out and the output drops about 1 dB.

7.10 HF THUMP BALANCE (R172)

As with the wideband AGC thump balance, this control allows suppression of the thump or pedestal components which may otherwise appear along with the audio under treble AGC conditions. Because the treble variollosser has a restricted effect below 1 kHz, the circuit will not 'thump' as much as it can 'pop.'

The best method of adjustment of this control is to apply a 5 kHz test tone to the TGR-340 audio input and set the level so that the front-panel meter is indicating 10 dB of limiting. Observe the output of the HF AGC system at TP14. When the pre-emphasis is switched on, by operating the HF AGC switch on the rear of the unit, the treble AGC system will be activated. If R172 is misadjusted, the output waveform envelope will not be balanced, top to bottom, in its appearance. While operating the HF AGC switch at a one-per-second rate, observe TP14 and adjust R172 for the best-appearing output waveform.

7.11 OUTPUT CLIPPING (R177)

This control allows precision control over the absolute maximum output of the TGR-340, even on a transient basis. Those transients escaping the wideband AGC are caught by the clipper using CR12 and CR13. Those transients escaping the HF AGC are caught by the clipper using CR22 and CR23. This latter clipper is normally operative on transient material only, and normally does not have significant effect on program audio. The degree of clipping caused by this circuit is determined by the setting of R177, the output clipping control.

This control is best adjusted by applying a tone to the TGR-340 in the 5 kHz region, with the HF AGC switched on, and at a level such that the front-panel meter is indicating 10 dB of limiting. Under these conditions the front-panel HF AGC lamp should be on. Observe the output of the output clipper by monitoring TP20 with an oscilloscope. Or, operate the de-emphasis on/off switch to the off position and monitor the output of the TGR-340. Adjust the output clipping control R177 until clipping is observed, and then adjust that control until clipping is almost seen.

When legitimate program material is applied instead of tones, then this control can be adjusted so that program is hardly clipped. If the degree of clipping is observed at TP20, bear in mind that it will be subsequently de-emphasized; it will 'look worse than it sounds.'

7.12 DE-EMPHASIS TRIM (R219)

This control is used to make the overall response of the TGR-340 flat when the pre-emphasis is on and the de-emphasis is on and the test tone level is below the threshold of HF AGC.

This control is simply adjusted by sweeping the audio oscillator from 50 Hz to 15 kHz and setting R219 for a flat response when operating below the threshold of HF AGC. If in doubt about whether or not the unit is operating above or below the threshold of HF AGC, reduce the input level a few dB; if the output level also drops a few dB, then the assumption can be made that the unit is not under the influence of HF AGC. The wideband AGC is not frequency-conscious, and its response does not change with input level or degree of limiting.

The de-emphasis network, as normally shipped, is set for a time-constant of 75 microseconds. Should another time-constant be more appropriate, see section 8.3 for the required changes.

7.13 COARSE OUTPUT LEVEL (R184)

This control is best adjusted by observing the setting of the front-panel output level control; if the front-panel output level control is at one end of its (limited) adjustment range, then readjustment of the coarse output level control is required.

Be sure that the combination of coarse and front-panel output level adjustments does not result in overdriving of the output program amplifier, which will result in a distortion increase. The maximum rated output of the TGR-340 is +18 dBm. Should a greater output be required, or should a multiplicity of outputs be required, then an external (distribution) amplifier will be required. Ideally, this amplifier should be capable of passing square-wave audio tones. Should the TGR-340 output not be adjustable to a low-enough level (i.e., should the following equipment be unusually sensitive and require a very low value of drive), then an external resistive pad should be installed between the TGR-340 and the following apparatus. Suggested pad values are shown in section 8.4.

8. OPERATIONAL CONSIDERATIONS

8.1 240 VOLT OPERATION

The TGR-340 is normally shipped from the factory set for 120 volt (50 or 60 Hz) operation. To convert the unit to 240 volt operation, remove the power cord from the connector on the rear. This will expose the fuse and the voltage-changing card. Remove the one ampere fuse and replace it with a 0.5 ampere (500 mA) fuse of the same type (slow-blow). Remove the voltage-changing card, keeping it horizontal. Rotate it so the "240" printing is visible as it is re-installed. Re-insert the card, restore the slide cover and re-install the power cord. This completes the conversion to 240 volt operation. The circuit design is such that mains voltages from 220 to 250 will be accommodated.

8.2 EXTENSION METER CIRCUIT

Immediately after the text in this manual is a schematic (91A7219) of an extension meter circuit for the TGR-340. This circuit will allow a remote indication of AGC activity in the TGR-340. The 10K calibration control will allow this meter to agree with the front-panel meter on the TGR-340. None of the components is critical.

The signal appearing at the REM MTR terminal will vary between 0 volts (no AGC activity) to about 4 volts (for 10 dB of limiting). 20 dB of limiting will yield a signal of about 7 volts. These figures are given for planning purposes for interfacing with remote-control or logging equipment.

8.3 HEADPHONE MONITORING

The output from the TGR-340 is delayed with respect to its input by a few milliseconds when the allpass network is switched in. This delay is frequency-dependent. If an announcer is monitoring his own voice while using headphones an odd sound may be noticed by him. This is due to the direct sound (from his voice) not necessarily arriving at his ear at the same time as the processed sound (via the path which includes the gain-rider). A frequency-dependent cancellation effect may be noticed by him.

This "odd sound" will not be noted on the air. If it is disconcerting to the announcer, it may be eliminated in either of two ways: by defeating the allpass network, or by monitoring from the board output rather than via a path which includes the gain-rider. Bear in mind that the allpass network can increase the volume level by as much as 6 dB. To defeat the allpass could be fairly expensive in terms of loudness. It is advisable, therefore, to monitor the board or line amplifier output rather than trying to tolerate the above-mentioned annoying sound.

The answer to knowing whether or not the station is on the air while monitoring with headphones is simple: add a set of carrier-operated relay contacts in series with the headphones. Loss of carrier will mute the headphone sound. Alternatively, drive the headphones with a sample of console audio when the announcer's microphone is active, or with a sample of off-air audio when that microphone is not active.

8.4 CHANGING PRE- AND DE-EMPHASIS

The TGR-340 as normally shipped has its internal HF (treble) AGC system set for a time-constant of 75 microseconds. This has been done in order to allow operation with most aural STL or satellite equipment without change. Should the following equipment have a different time-constant in its pre-emphasis circuitry, the HF AGC in the TGR-340 should be changed. The following table shows the component values for various commonly-encountered time-constants. When changing the pre- and de-emphasis, change both values (both C59 and C85). For stereophonic service, use 3% tolerance (or better) components. The absolute value is less important than matching between channels.

Time-constant (us):	Pre-emphasis (C59):	De-emphasis (C85):
50	.01 uF	.0047 uF
75	.015	.0068 or .0075
150	.03 or .033	.015

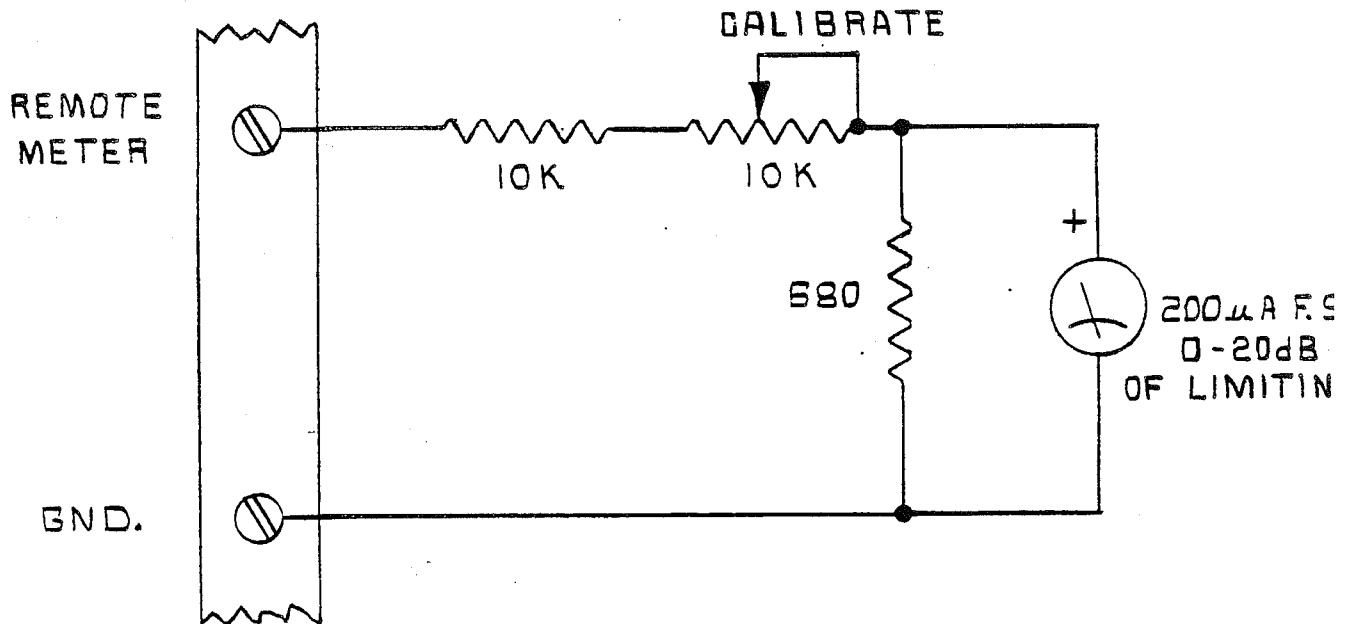
8.5 LEVEL-CONTROLLING PADS

Should the level applied to the TGR-340 be extremely high, or should the required output level be very low, then it may be advisable to install a resistive attenuator on the input (or the output, as required). The following table shows the component values for a balanced "H" pad.

Attenuation, dB:	Each Series Leg, Four Required:	Middle Shunt Leg, One Required:
5	82	1000
10	160	430
15	200	220
20	240	120
30	270	39
40	300	12

91A7219

A0



RELEASE FOR PROD.
AQ ECO1760 WPG 25 JUN 80

REVISIONS

MGMT. APPR.

DATE



MOSELEY ASSOCIATES, INC.

SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93146

EXTENSION METER CIRCUIT

TOL: FRACT. $\pm 1/32$, .XX $\pm .030$, .XXX $\pm .010$, $\leq \pm 1$

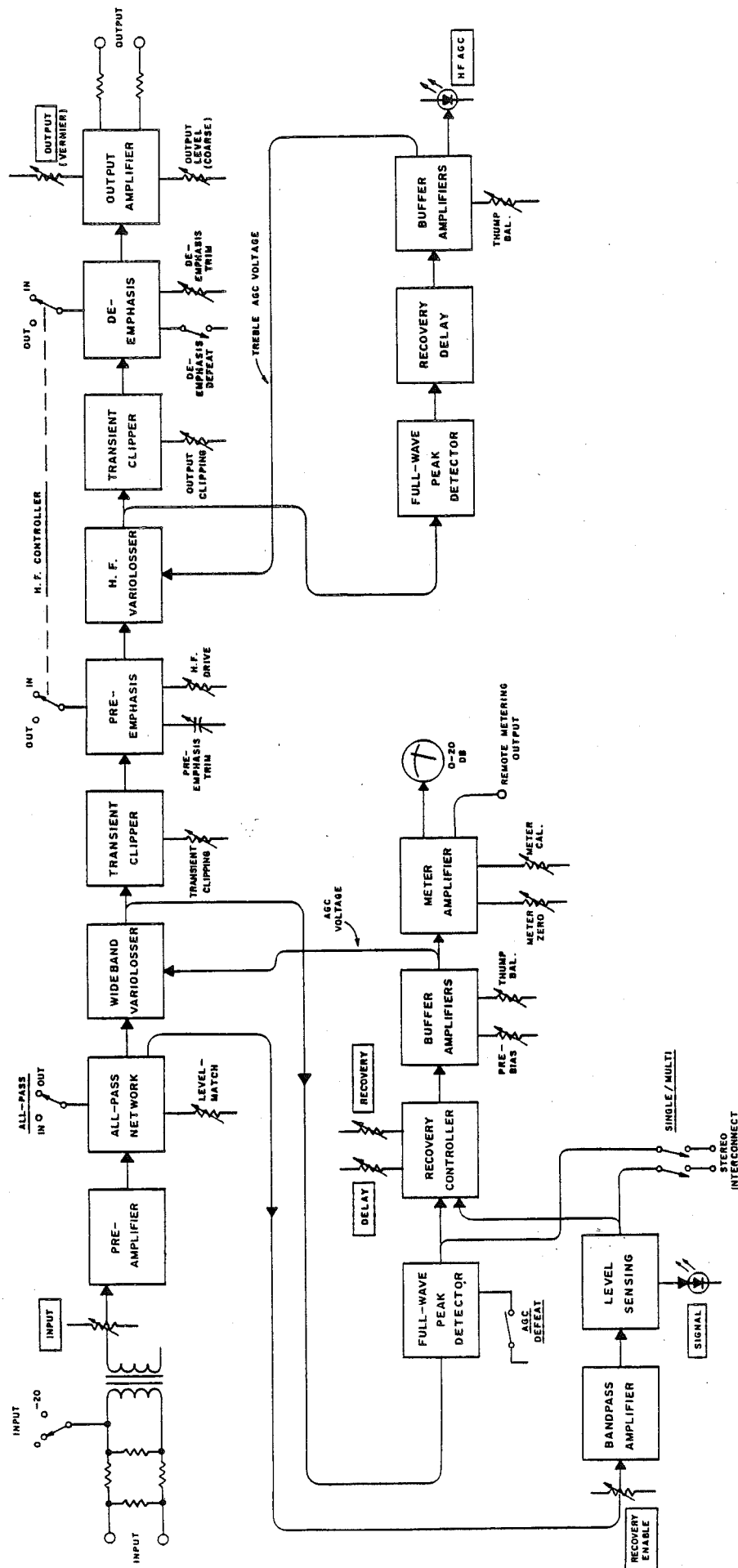
DWN D.T.W. 8 APR 80 SCALE:

CHK JCR 4-24-80

ENG JLT 25 JUN 80

91A7219

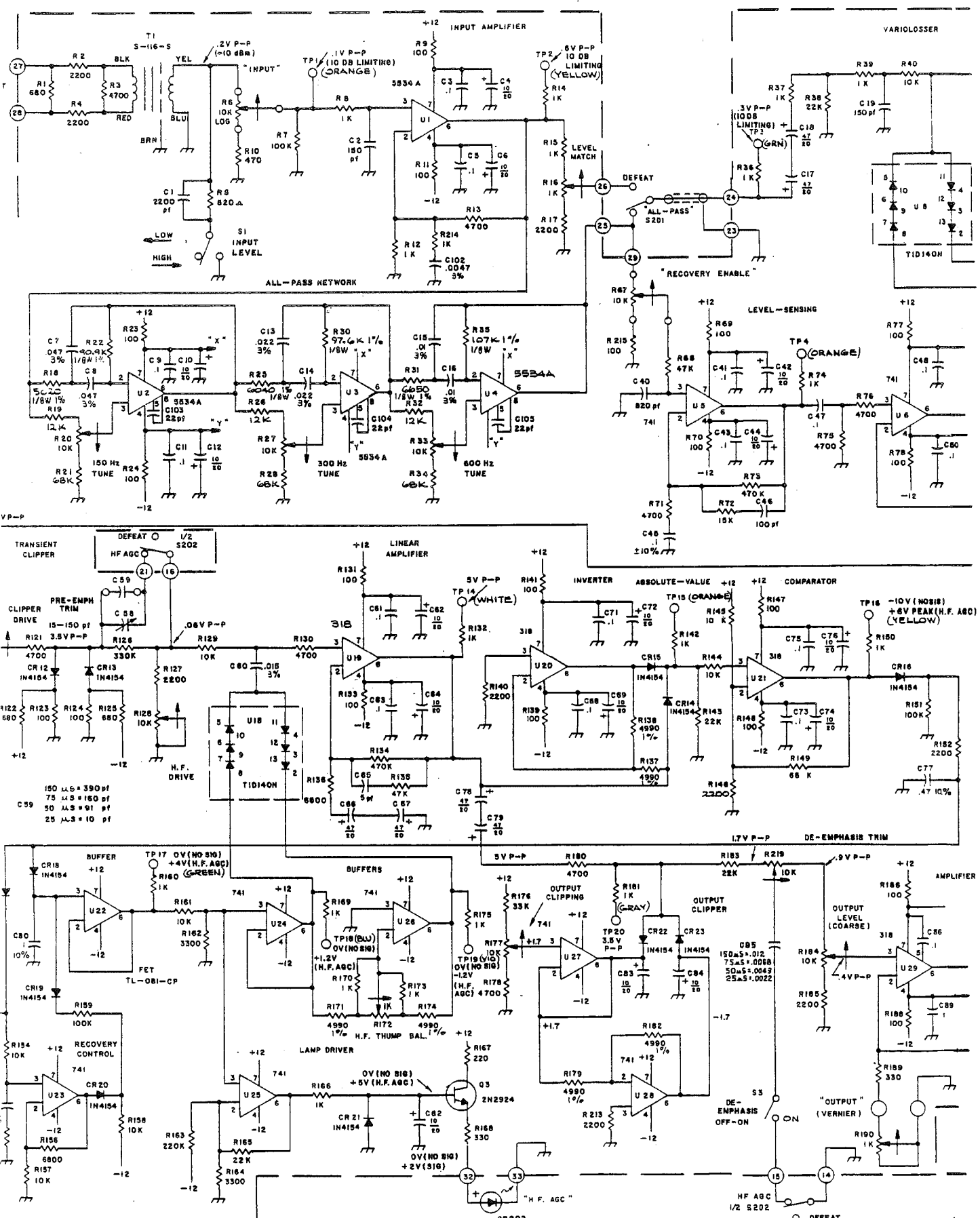
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ALL CONTROLS AND ADJUSTMENTS ARE SHOWN :

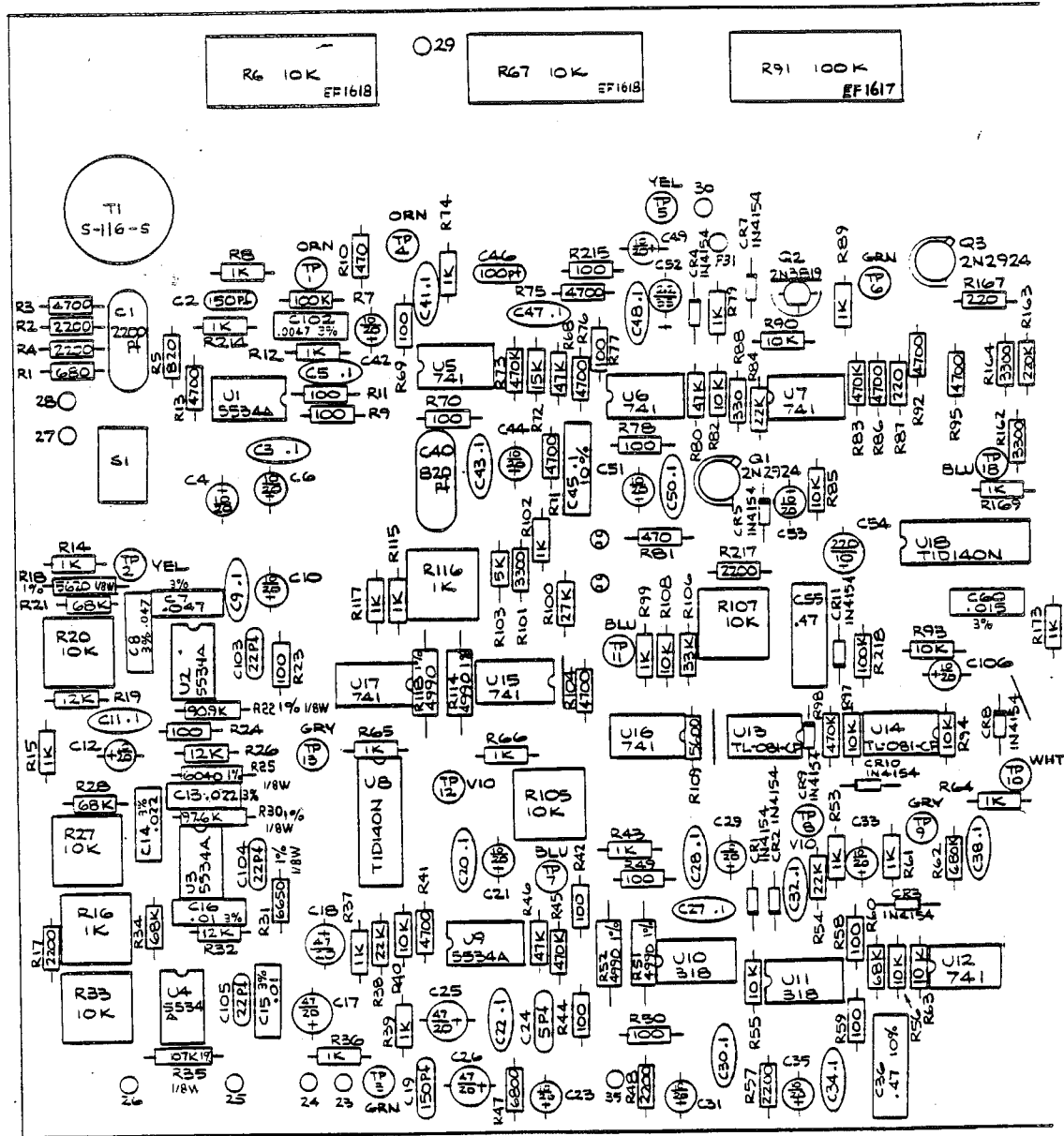
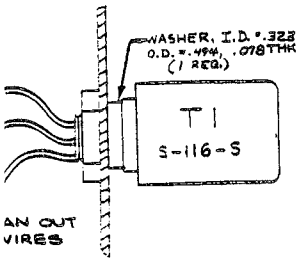
FRONT PANEL

REAR PANEL



NOTES:
 1. UNLESS OTHERWISE SPECIFIED
 RESISTOR VALUES ARE IN OHMS, 1/4 W, 10 %
 CAPACITOR VALUES ARE IN MICROFARADS
 2. P.C. BOARD 5155876
 3. COMPONENT LAYOUT 2082745

MOSELEY ASSOCIATES, INC. SANTA BARBARA RESEARCH PARK SOLITA, CALIFORNIA 93071	
SCHEMATIC AUDIO GAIN RIDER TGR-340	
TOTAL PRCT. 1/2% DIM. 1/2" X 1/2" X 1/2" DATE 1/2/77 BY 9107166	SCALE: 1/2" = 1" 9107166 CQ



NOTES

1. UNLESS OTHERWISE SPECIFIED
RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%
CAPACITOR VALUES ARE IN MICROFARADS.
2. P.C. BOARD 5185876.
3. SCHEMATIC 9107166.
4. UNLESS OTHERWISE SPECIFIED: BUILD
UNIT AS 75/13.

CHANGES P.E.C.		MOSELEY ASSOCIATES, INC.	
ECO 305 9/27/74		SANTA BARBARA RESEARCH PARK	
		GOLETA, CALIFORNIA 93077	
		COMPONENT LAYOUT	
		AUDIO GAIN RIDER TCR-340	
		TOLU FRMT. 2 1/8" X 2 1/8" X 2 1/8" X 2 1/8" X 2 1/8" X 2 1/8"	
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		SCALE: 2/1	
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