Instruction Manual

Tektronix

ASG 140
Audio Signal Generator

070-8667–05

Warning
The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

CE

For product related information, phone: 800-TEKWIDE (800-835-9433), ext. TV.

For further information, contact: Tektronix, Inc., Corporate Offices, P.O. Box 1000, Wilsonville, OR 97070–1000, U.S.A. Phone: (503) 627–7111; TLX: 192825; TWX: (910) 467–8708; Cable: TEKWSGT.

WARRANTY

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

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OPERATOR'S SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

Terms In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

Terms As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property, including the equipment itself. Refer to the manual for information.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

Protective ground (earth) terminal.

SAFETY INFORMATION

Use the Proper Power Source. This product is intended to operate from a power source that will not apply more than 250 V rms between the supply conductors or between either supply conductor and ground. A protective-ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Ground the Product. This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective-ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger May Arise From Loss of Ground. Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Fuse. To avoid fire hazard, use only the fuse of correct type, voltage rating, and current rating as specified in the parts list for your product. Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres. To avoid explosion, do not operate this product in an explosive atmosphere.

Do Not Remove Covers. To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

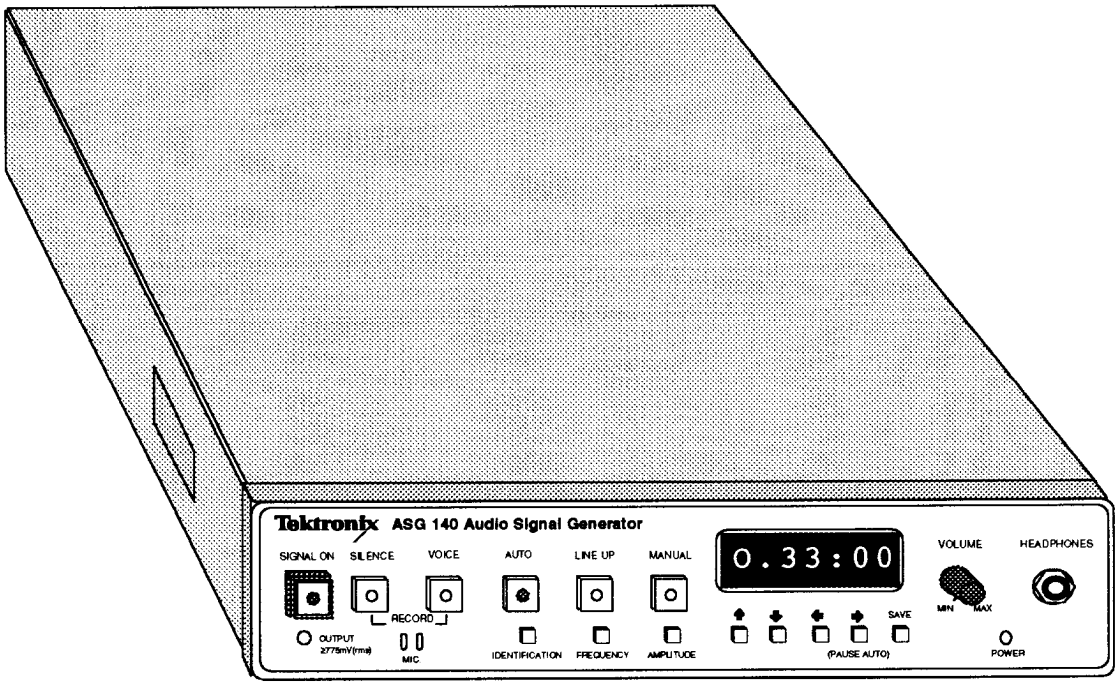
SERVICING SAFETY SUMMARY

For Qualified Service Personnel only. Refer also to the preceding Operators Safety Summary.

Do Not Service Alone. Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

Use Care When Servicing With Power On. Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections or components while power is on. Disconnect power before removing protective panels, soldering, or replacing components.

Use the Proper Power Source. This product is intended to operate from a power source that will not apply more than 250 V rms between the supply conductors or between either supply conductor and ground. A protective-ground connection by way of the grounding conductor in the power cord is essential for safe operation.



The ASG 140 Audio Signal Generator.

Section 1
INTRODUCTION AND SPECIFICATIONS

INTRODUCTION

The ASG 140 Audio Signal Generator was developed by Tektronix to meet the audio testing requirements of audio transmission systems. The ASG 140 reduces testing time by transmitting short, predefined audio test sequences that produce precise and easily reproduced results in its AUTO mode. It can also transmit source identification, a voice segment (either continually or as part of the AUTO test) and user defined tones. The user defined tones of LINE UP and MANUAL test signal operation provide the continuous signals needed for adjusting audio levels and manual checking of the left/right audio channels.

AUTOMATIC AUDIO CHANNEL TESTING

Test equipment for sound programming and the sound channels of television programming must be capable of quickly checking the audio signal path to make sure of the circuit's quality. Automatic equipment must be able to rapidly measure the test signal in ways that give repeatable and meaningful test results.

To assist in the repeatability area, standard test signal sequences have been defined. These sequences begin with the necessary components to start the measurement, identify the source of the test signals, and identify the stored automatic test that is to be done. Then the test signal portion of the sequence runs in predefined frequency, level, and timing patterns that permit automated testing of the signal path characteristics.

Each of the test signals in the automatic test sequence are used to check on the different parameters that are important to signal quality. The tests have defined sequences for both monaural and stereo audio testing, and are based on Recommendation O.33 of the *CCITT Specification For Measuring Equipment, Volume IV, Series O Recommendations–1988.*

When used with a CCITT O.33 compliant receiver, such as the Tektronix VM700A Option 40 or Option 41, the results of the AUTO testing sequence can be documented automatically without the need for human intervention (unless of course, an out–of–tolerance condition is found by the test).

The Tektronix VM700A Option 40 and Option 41 receiving and measuring equipment uses the test signals sent by the companion ASG 140 audio signal generator to measure the following parameters as defined in Recommendation O.33 for monophonic audio paths.

Insertion Gain

Frequency Response

Distortion

Signal-to-Noise Ratio

Compandor Linearity

Expanded Noise

For stereophonic audio paths, additional measurements are done to assure the A/B (left/right) channel parameters of the signal paths are sufficiently matched for proper transmission of the program audio.

The added measurements are:

Interchannel difference in gain and phase

Interchannel crosstalk and circuit transposition

MANUAL SIGNAL TESTING

Line Up

The Line Up test signal is selectable in both frequency and amplitude for use in providing a known line up signal for adjusting levels from various audio sources. This signal may be set for a house standard and then fixed (editing disabled) or it may remain controllable from the front panel. The frequency range is from 10 Hz to 20 kHz and the amplitude range is from –90 dBu to +24 dBu. As shipped from the factory (and the default if factory defaults are reloaded), the Line Up signal is 400 Hz at 0.0 dBu.

Manual

Tone

The Tone test signal comes as stereo, left tone, and right tone. The frequency and amplitude are selectable over the same range as the Line Up signal. The factory default for the Tone signals is 440 Hz at 0.0 dBu.

Polarity

Polarity also comes as stereo, left polarity, and right polarity. The polarity test signal is the sum of a fundamental sine wave of 440 Hz and its equal amplitude second harmonic sine wave of 880 Hz. The amplitude of the polarity signal is selectable from –90 dBu to +24 dBu with a fixed fundamental frequency of 440 Hz. The factory default for the amplitude is 0.0 dBu.

Multitone

The Multitone signals also come as stereo, left channel, and right channel. Multitone signals are composed of a selected set of sine wave frequencies. The amplitude of the Multitone signal is selectable from –90 dBu to +24 dBu. The output signal amplitude for the Multitone signals is the rms value of signal set, not the amplitude of any single frequency component in the set. There are presently four sets of multitone signals covering different bandwidths and providing different sine wave components. The multitone signals are used to check for response and harmonic distortion of audio circuits and devices (amplifiers, tape recorders, cables, etc.). The factory default for the amplitude is 0.0 dBu.

REMOTE CONTROL

There are two types of remote control possible with the ASG 140. The remote control connector on the rear panel of the instrument may be used as contact closure connections for minimal remote operation. Using contact closure remote, an AUTO sequence may be started and front panel editing may be enabled (if it is internally disabled). The second type of remote control uses the remote control connector as an RS-232C serial port, and the front panel operation may be controlled via a PC or terminal if serial communications is enabled in the ASG 140. The Audio/Video Timing signal synchronization feature is also controlled through the remote port. See *Appendix C* for information on the Audio/Video Timing feature.

SPECIFICATIONS

Electrical Characteristics

Table 1-1
Electrical Characteristics

Characteristic	Performance Requirement	Comment
External Power		
Voltage (Nominal)	100 to 240 Vac.	Full range, no selector.
Input Freq Range	47 Hz to 440 Hz.	
Power Consumption	20 W Typical.	
RS-232C Interface		
Baud Rates	1200, 2400, 4800, and 9600 (factory default).	Front panel selection only, no switch settings for baud rate except the factory default of 9600.
Maximum Applied Voltage	25 V (dc + peak ac).	
Signals	RXD (received data), TXD (transmitted data), and GND are used for serial remote control of the ASG 140.	RTS and CTS are not used in the ASG 140. Pins 4, 6, and 9 of the connector are not to be connected to the terminal interconnection cable. Those pins are used for contact closure remote control.
Levels	Compatible with RS-232C.	
Connector	DB-9 DTE (terminal communications device).	Requires a null modem for connection to another DTE device.
Output Signal Frequency		
Range	10 Hz to 20 kHz.	
Multitone	See Table 1-2.	
Resolution	1 Hz.	
Accuracy	± 0.1%.	
Connectors	XLR Female (4 outputs)	
Output Signal Amplitude		Multitone signal components are not sent at the specified amplitude; the amplitude specification is for the combined Multitone signal rms value.
Range	–90 dBu to +24 dBu (24.5 µV to 12.2 V_{RMS}) balanced into a load resistance of 10 kΩ or greater with 12 Ω source resistance.	
Accuracy	± 0.2 dB at 1 kHz from +24 dBu to –80 dBu into a load resistance of 10 kΩ or greater.	Output amplitude is ≈0.17 dB lower with a 600Ω load.
Resolution	± 0.1 dB.	
Flatness	±0.2 dB, 10 Hz to 20 kHz* +0.05/–0.2 dB, 10 Hz to 20 kHz (relative to 1 kHz)**	Typ. ±0.1 dB, 10 Hz to 19 kHz* Typ. +0.05/–0.1 dB, 10 Hz to 15 kHz**

* B019999 and below
** B020000 and above

Table 1-1 (cont)

Characteristic	Performance Requirement	Comment
Total Harmonic Distortion + Noise for outputs ≥ –10 dBu (245 mV_{rms}) (measured over an 80 kHz bandwidth)	< 0.01% (–80 dB), 20 Hz to 18 kHz*; < 0.0.25% (–72 dB), 18 kHz to 20 kHz*; < 0.015% (–76.5 dB), 10 Hz to 19 kHz**; < 0.056% (–65 dB), >19 kHz to 20 kHz**	< 0.005% at 1 kHz at full output, measured over a 22 KHz bandwidth (see typical curve in Figure 1–1). This typical specification will also hold at +14 dBu and +4 dBu.
Signal–to–Noise, measured over a 22 kHz bandwidth.	> 90 dB at 1 kHz at 0 dBu output level.	$S/N = 20 \log \frac{V_{Manual}}{V_{Silence}}$ S/N improves as the output signal increases and decreases as output reduces, proportionally.
XLR Outputs	Balanced.	
Output Impedance	12 Ω; balanced.	
Level Difference Between Channels	≤0.2 dB at +14 dBu.	
Phase Difference Between Channels	≤1°, 10 Hz to 20 kHz.	
Typical Crosstalk + Noise measured over 80 kHz bandwidth at +24 dBu Generator to Output	<–90 dB at 1 kHz and 20 kHz.	Left tone into Right output or Right tone into Left output; generator source resistance 12 Ω and load termination either open or 600 Ω.

* B019999 and below
** B020000 and above

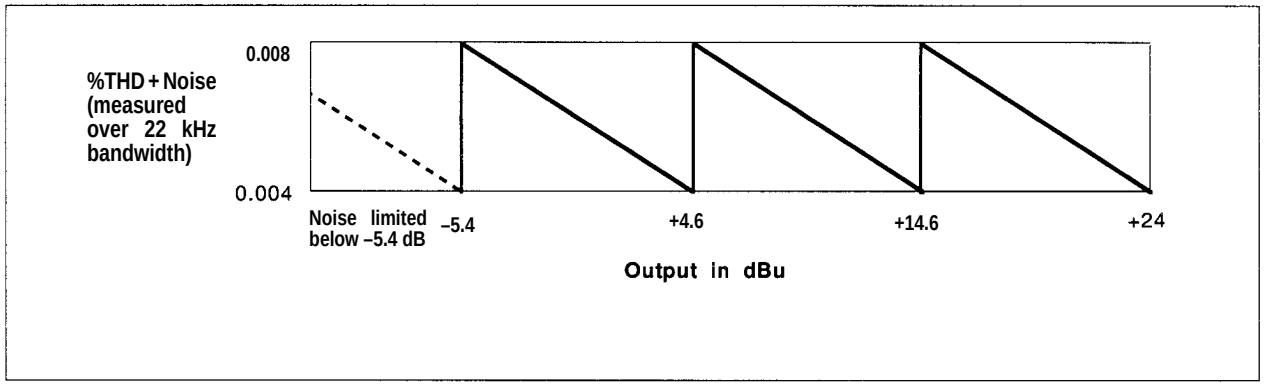


Figure 1-1. Typical 1 kHz THD + Noise versus Output Level.

Table 1-2
ASG 140 Multitones

Multitone 1	Multitone 2	Multitone 3	Multitone 4
59	23	47	23
117	94	141	117
187	141	281	234
246	223	656	750
293	270	1031	867
375	352	2016	1758
422	562	4031	3492
949	879	8019	6984
1184	1113	15000	13992
1512	1395		20015
1887	1758		
2391	2227		
3000	2789		
3785	3516		
4758	4430		
6012	5590		
7570	7043		
9539	8871		
12012	11180		
15000	14074		
	17742		
	19992		

NOTE

The Multitone signals are combined in repetitive blocks. At the end of the block time, all the signals are in phase again for a seamless transition into the next signal block.

Environmental Characteristics

Table 1–3
Environmental Characteristics

Characteristic	Limits
Operating Temp.	0° C to +50° C.
Non–Operating Temp.	–40° C to +65° C.

Mechanical Characteristics

Table 1–4
Physical Characteristics

Characteristic	Value
Length	18.0 in. (458 mm).
Width	8.1 in. (206 mm).
Height	1.7 in. (43 mm).
Weight	3.25 lb. (1.48 kg).

Table : Certifications and compliances

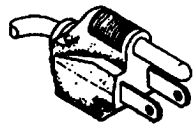
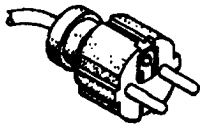
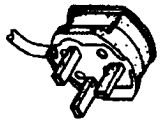
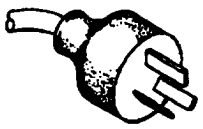
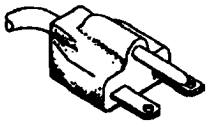
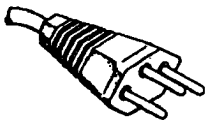
Category	Standards or description
EC Declaration of Conformity – EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Union: EN 50081-1 Emissions: EN 55022 Class B Radiated and Conducted Emissions EN 50082-1 Immunity: IEC 801-2 Electrostatic Discharge Immunity IEC 801-3 RF Electromagnetic Field Immunity IEC 801-4 Electrical Fast Transient/Burst Immunity Must use high quality shielded cables to ensure conformance with EMC regulations.
Australia/New Zealand Declaration of Conformity – EMC	Complies with EMC provision of Radiocommunications Act per the following standard(s): AN/NZS 2064.1/2 Industrial, Scientific, and Medical Equipment: 1992 AN/NZS 3548 Information Technology Equipment: 1995
EMC Compliance	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility when it is used with the product(s) stated in the specifications table. Refer to the EMC specification published for the stated products. May not meet the intent of the directive if used with other products.
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.
EC Declaration of Conformity – Low Voltage	Compliance was demonstrated to the following specification as listed in the Official Journal of the European Union: Low Voltage Directive 73/23/EEC, amended by 93/69/EEC EN 61010-1:1993 Safety requirements for electrical equipment for measurement control and laboratory use.
U.S. Nationally Recognized Testing Laboratory Listing	UL3111-1 Standard for electrical measuring and test equipment. UL1244 Standard for electrical and electronic measuring and testing equipment
Canadian Certification	CAN/CSA C22.2 No. 231 , CSA safety requirements for electrical and electronic measuring and test equipment.
Additional Compliance	IEC61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Installation (Overvoltage) Category	Terminals on this product may have different installation (overvoltage) category designations. The installation categories are: CAT III Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location. CAT II Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected. CAT I Secondary (signal level) or battery operated circuits of electronic equipment.
Pollution Degree	A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.

Table : Certifications and compliances (cont.)

Category	Standards or description	
	Pollution Degree 1	No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
	Pollution Degree 2	Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
	Pollution Degree 3	Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
	Pollution Degree 4	Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

POWER CORD OPTIONS

Table 1-5
Voltage, Fuse,[a] and Power Cord Data

Plug Configuration	Category	Power Cord and Plug Type	Voltage Range	Reference Standards [b]
	U.S. Domestic Standard	U.S. 120 V 15 A	115 V Nominal 90 V to 132 V	ANSI C73.11 NEMA 5-15-P IEC 83 UL 198.6
	Option A1	EURO 240 V 10-16 A	230 V Nominal 180 V to 250 V	CEE(7), II, IV, VII IEC 83 IEC 127
	Option A2	UK [c] 240 V 6 A	230 V Nominal 180 V to 250 V	BS 1363 IEC 83 IEC 127
	Option A3	Australian 240 V 10 A	230 V Nominal 180 V to 250 V	AS C112 IEC 127
	Option A4	North American 240 V 15 A	230 V Nominal 180 V to 250 V	ANSI C73.20 NEMA 6-15-P IEC 83 UL 198.6
	Option A5	Switzerland 220 V 6 A	230 V Nominal 180 V to 250 V	SEV IEC 127

[a]All options listed come with a factory-installed fuse for the selected operating voltage range.

[b]Reference Standards Abbreviations:

ANSI–American National Standards Institute
AS–Standards Association of Australia
BS–British Standards Institution
CEE–International Commission on Rules for the Approval of Electrical Equipment
IEC–International Electrotechnical Commission
NEMA–National Electrical Manufacturer's Association
SEV–Schweizervischer Elektrotechnischer Verein
UP–Underwriters Laboratories Inc.

[c]A 6 Ampere, type C fuse is also installed inside the plug of the Option A2 power cord.

Section 2
OPERATION AND SETUP

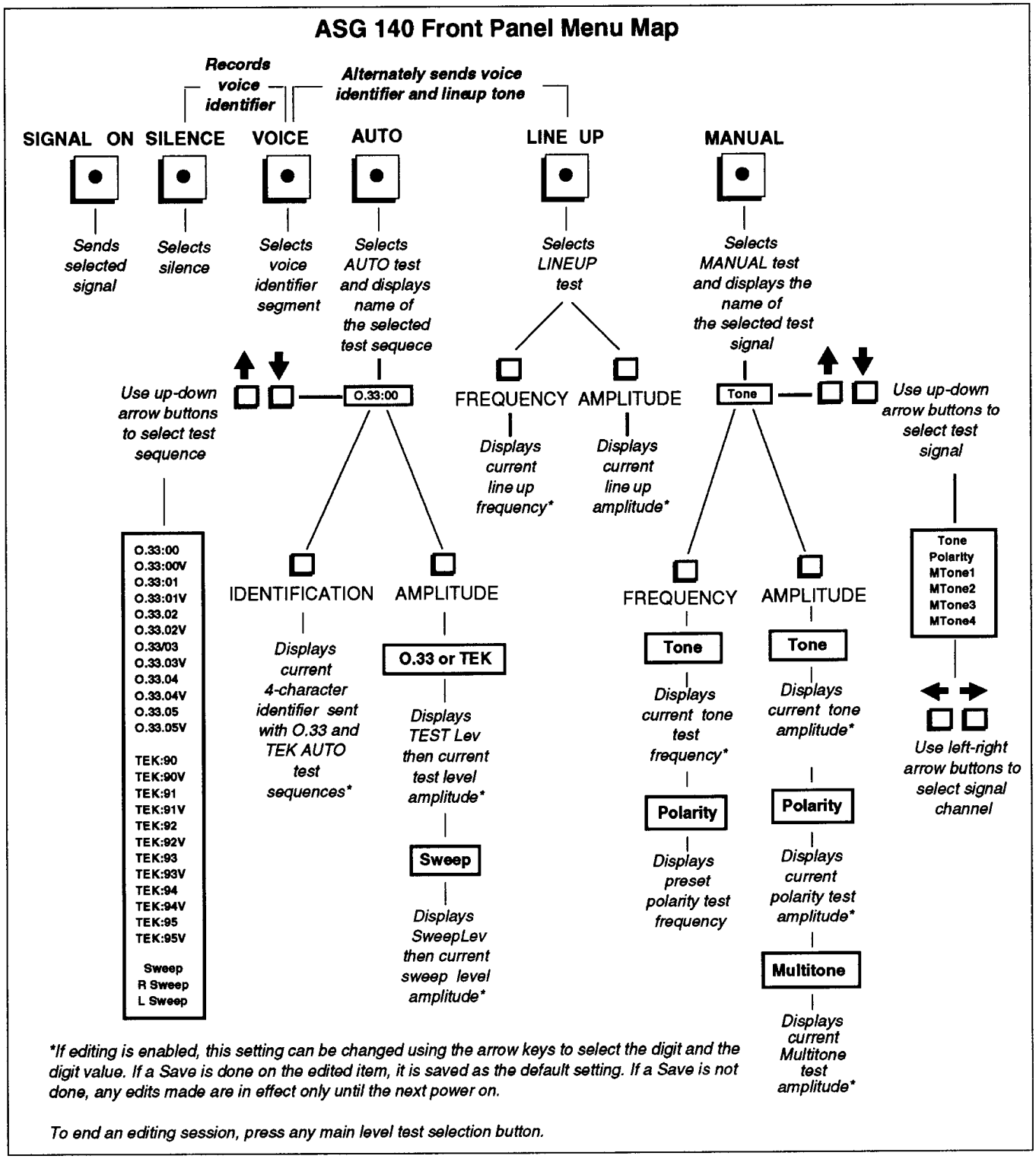


Figure 2-1. ASG 140 menu map.

SAFETY

Before connecting the ASG 140 to a power source, read both this section and the Operator's Safety Summary at the front of this manual.

INSTALL THE POWER CORD

Connect the detachable three-wire power cord to the power connector on the rear panel of the ASG 140. Various power cord options are available to match the various international ac mains. The power cord supplied with the ASG 100 is as ordered from the factory. See Section 1, *Introduction and Specifications*, for the power cord options.

MAINS VOLTAGE

WARNING

To avoid electrical shock, the ground safety lead of the power cord must be properly connected to earth ground.

Plug the power cord into the outlet for any voltage source between 140 and 240 volts. You do not need to make any adjustments on the ASG 140 to accommodate different source voltages in the rated operating range.

CONNECT TO THE AUDIO PATH

Install the ASG 140 at the head end of the audio path where you want to initiate the test sequence. Connect cables from the equipment to be tested to the Output ports observing the correct left/right channel placement.

When powered off, or off-line (the SIGNAL ON LED not lit), the ASG 140 outputs no signal.

When on-line, the ASG 140 inserts the test sequence you select into the downstream audio equipment.

INSTALL REMOTE CONTROL CABLE

The remote connector is used when controlling the instrument remotely using the commands available via the RS-232C interface. See Appendix A, *Remote Control*, for using the remote commands. The connections and wiring for a remote control cable are also found in Appendix A.

There is also a simple contact-closure type of remote control available via the REMOTE connector. If you want to initiate AUTO test sequences from an operating position using a this type of remote control, connect pins 4 and 9 in the REMOTE port on the ASG 140 to some contact closure, such as a relay on a control panel. When the relay closes and connects pins 4 and 9 together, the ASG 140 goes ON LINE and sends the selected AUTO test sequence. A momentary contact causes the sequence to be sent once and then return to the previously selected operation. Continuous contact will cause the AUTO test sequence to be repeated until the contact is opened. The editing feature, if it is internally disabled, may also be enabled via the remote connector. This feature permits editing of the signal settings without the need to remove the side panel of installed equipment to reset the editing switches.

POWER-UP STATE

At power up, the normal state of the ASG 140 is off line with the AUTO test sequence selected. There are two front-panel setup options: factory default and user selected default, default meaning the front panel state that is automatically present on power-on. Factory defaults for the selected tests, test levels, and frequencies are restored each time the ASG 140 is turned on if user selected defaults are not enabled. When user selected defaults are enabled, the "saved" setups for the selected auto and manual tests, and the selectable frequencies and test levels are restored. The front-panel defaults in effect at power on depend on the settings of an internal dip switch. One of the switch settings determines whether the factory default settings are recalled or the user programmed settings that have been saved are recalled. Editing and saving of the changes are discussed later in this section of the manual.

When power is lost (either through a power failure or a normal power), the ASG 140 reverts to the off line state. The ASG 140 remains off line and defaults to AUTO when power is restored. Any LINE UP or MANUAL test that was in progress at power off will have to be reselected and restarted.

DIAGNOSTICS

The ASG 140 performs several self tests each time you power it up. If it fails one, the display indicates the failed self test and the other functions are disabled. Refer your instrument to a qualified service person or consult your local Tektronix representative for service information if a diagnostic failure occurs.

INITIAL SETUP

All ASG 140s are shipped with factory settings as listed in Table 2-1.

Initial setup before operation in your system may include changing some or all of the factory settings to settings appropriate for your application. As shipped from the factory, full editing is enabled, and the following functions may be changed:

- Auto test sequence selection (CCITT O.33, TEK, or Sweep)
- Auto-test reference level (for CCITT O.33 and TEK sequences)
- Sweep-test reference level (for Sweep, Sweep Left, and Sweep Right)
- Auto-test four-character identifier (ID)
- Voice identifier (4-seconds of digitally recorded audio)
- Line up frequency and amplitude (local control only)
- Manual Test selection (Tone, Polarity, Multi-tone)
- Tone, Right Tone, or Left Tone
- Tone frequency and amplitude
- Polarity, Left Polarity, or Right Polarity
- Polarity amplitude
- Multi-tone (1, 2, 3, or 4), Left Multi-tone (1, 2, 3, or 4) or Right Multi-tone (1, 2, 3, or 4).
- Multi-tone amplitude
- Source impedance selection (10 Ω from the factory, requires component changes)
- Control enabling/disabling (local and remote disables with internal switch settings)
- Editing capability (internal switch settings)

Table 2-1
Factory Settings for the ASG 140

Function	Factory Setting	Comments
AUTO	O.33:01	
TEST LEV CCITT O.33 and TEK Sequences	0.0 dBu	
SweepLev Sweep, R Sweep, and L Sweep	0.0 dBu	
MANUAL	TONE	
Tone and Polarity Amplitude Frequency	0.0 dBu 440 Hz	
Multitone Amplitude	0.0 dBu	
LINE UP Amplitude Frequency	0.0 dBu 400 Hz	Line Up signal parameters are not editable via remote control. This preserves the Line Up signal definition.
IDENTIFICATION	TEK1	
VOICE IDENTIFIER	Blank	Restoring Factory Defaults does not erase a recorded identifier.
COMMUNICATIONS PARAMETERS		
Baud Rate	9600	Rate are 9600, 4800, 2400, and 1200 baud; selectable at power on.
Parity	None	Parity, Stop Bits, and Data Bits are fixed.
Stop Bits	1	
Data Bits	8	
CONTROL ENABLING		
Front Panel Controls	Enabled	These are switch settings that are not controlled by firmware at power on.
Remote Control	Enabled	
POWER UP DEFAULTS	User Defaults Enabled	These will be the factory defaults until they are edited.
EDITING	Enabled	There are 3 sections of editing enables to permit customization for different levels of operating features accessible to the user.

RACK MOUNTING

The ASG 140 Audio Signal Generator is a half-rack wide instrument. For mounting a single ASG 140 signal generator in a standard 19-inch equipment rack, use the full-rack mounting adapter that is only one rack unit high. A dual half-rack mounting adapter permits stacking two ASG 140 generators in a three rack unit high space. There is also a full-width rack adapter for side-by-side installation of two ASG 140 generators in a two rack unit high space. For information on available rack adapters, refer to the Tektronix Television Products Catalog or contact your local Tektronix Field Office or representative.

FREEDOM OF OPERATION

The user-definable states of the ASG 140 may be totally accessible or set to preselected setups that can not be accidentally altered in normal use. As shipped from the factory, the total range of user-definable features are available. Once the application needs are determined and programmed, the editing feature may be selectively disabled to prevent accidental changes to the frequency and output levels of the test signal. Refer to *Internal Settings and Setup Editing* for information on enabling and disabling the editing function.

SETTING UP AND EDITING TEST SIGNALS

The user-definable variables vary for the different tests. When editing is enabled, all the definable choices may be accessed for customizing the frequencies and levels of the test signals for your applications. The default test sequence in the AUTO test, the default MANUAL test type, and the encoded IDENTIFICATION may also be defined and saved. The user-defined defaults are recalled at power on.

When editing is disabled, the various test are still selectable, but the frequency and level of the test signals are unalterable from the front panel.

Selective disabling of the editing function permits a fairly wide range of customization choices for front panel editing of and amplitude choices for the test signals. For instance, the Line Up signal frequency and level may be set to the house standard and fixed to prevent accidental editing from the front panel while leaving the user full access to the MANUAL test editing functions. A second option would be to define the level and frequency of the MANUAL TONE tests for specific applications and then disable the editing feature for those test as well. You would then have a dedicated test frequency and level defined for the MANUAL test choices as well as the LINE UP signal.

Editing enabling and disabling are controlled by setting internal switch positions. An access panel must be removed to make the appropriate switch settings. Refer all internal adjustments to a qualified service person. Information on controlling the editing feature is found later in this section of the manual.

When the contact-closure remote control cable is attached, the editing feature can be temporarily enabled by connecting pins 6 and 9 of the connector together. Make the changes needed, then disconnect the pins. Using RS-232C serial communications remote control, any the test signals and their variable settings may be edited (but not saved as the user defined defaults). See Appendix A, *Remote Operation,* for using the remote commands.

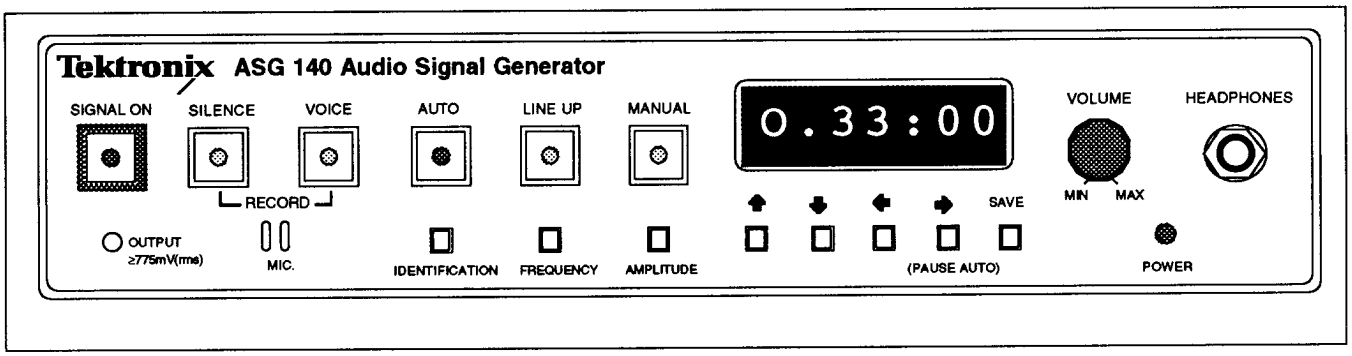


Figure 2-2. ASG 140 front panel controls.

FRONT PANEL CONTROLS

The following text details the operation of the front panel controls and indicators. A front-panel illustration is shown in Figure 2-2 for reference.

FUNCTIONS

The ASG 140 is powered on and off with the power switch to the right of the power receptacle on the back panel.

The ASG 140 functions are enabled from the front panel through the six larger buttons. These "main selection" buttons have a LED in the center that indicates the choice is selected. The SIGNAL ON LED is red; the remaining five are green. The smaller buttons are controls that let you display and adjust the values associated with the various test functions.

The test signal functions initiated by the five main selection buttons to the right of the SIGNAL ON button are mutually exclusive in most cases; enabling one of these five signal functions automatically disables the previously selected function. There are two exceptions to this:

- To initiate a continuously alternating voice ID and line-up tone, press the VOICE and LINE UP buttons simultaneously. (Both LEDs will be on and the display is **Voi + Lnup**.)
- To record four seconds of voice for identification purposes, press the VOICE and SILENCE buttons simultaneously. The recording process is cued with **Record:, Ready . . .** , and **Begin**; then a four-second countdown is displayed to time the recording. After that time, the selected function returns.

The ASG 140 outputs the selected signal only when the SIGNAL ON function is enabled. The lighted SIGNAL ON button indicates that the ASG 140 is sending a signal to the connected audio equipment. When the SIGNAL ON button LED is off, the SILENCE level is applied to the output connectors. The ASG 140 sends a sample of all the signals it generates to the headphones jack on the front panel.

SIGNAL ON

When the SIGNAL ON function is enabled (indicated by the red LED in the center of the button), the ASG 140 sends the currently selected test tone or pattern to the connect audio equipment. Selecting any signal choice while the signal is on is permitted. However, when AUTO is selected, that test must be completed before any other choice except turning the signal off is permitted. Signal off is selected from the front panel by pressing the SIGNAL ON button a second time.

When one of the AUTO mode automatic test sequences is selected, the ASG 140 reverts to signal-off status (the red LED turns off) when the selected test sequence is finished. An AUTO test

completion message is sent out over the RS-232 serial port when the test sequence is finished. Signal off applies the SILENCE level to the audio output connectors.

NOTE

The ASG 140 will not turn on a signal when the front panel SIGNAL ON button is pressed when the AUTO ID, TESTLev, or SweepLev is being displayed. You must return to the AUTO Test Selection display or select another test signal.

SILENCE

The SILENCE function makes the ASG 140 generate *no* signal. The output attenuators are set to their maximum attenuation level and signal generation circuitry is turned off. With SILENCE enabled, any signal shown on the VM700A Option 40 and Option 41 or other monitoring equipment is the noise picked up along the audio path following the ASG 140. The ASG 140 sends silence while SIGNAL ON is enabled and SILENCE is selected and when the signal is off.

VOICE

The VOICE function continuously replays the 4-second voice identifier the ASG 140 is currently programmed to send. The voice signal level follows the setting of the LINE UP signal amplitude setting.

RECORD (PRESS SILENCE + VOICE)

The RECORD function records 4 seconds of voice input through the built-in microphone.

You enable this function by pressing the SILENCE and VOICE buttons simultaneously; there is no remote RECORD command. While the two buttons are held in, the display window shows the prompt **Record:**. When the buttons are released, the display changes to **Ready. . .** , then **Begin**, and a countdown from **4.0** to **0.0**. During the 4-second countdown, the ASG 140 records any sounds made within several feet of the microphone; but for the best results when recording a VOICE identification, speak directly into the microphone. When RECORD is started, the front panel controls are disabled until the recording has finished. Upon finishing, the front panel state returns to the state in effect when the recording session was started except SIGNAL ON.

NOTE

If the ASG 140 signal is on when a recording session is started, it is switched off; it remains off until SIGNAL ON is again selected, either locally or remotely.

AUTO

The AUTO function generates the currently selected automatic predefined test signal sequence, such as CCITT O.33 and TEK or one of the sweep signals, when SIGNAL ON is enabled.

AUTO Test Level

While the ASG 140 signal is off, you may display the test level to which the amplitudes of the tones of the CCITT O.33 and Tek AUTO test sequences are referenced.

For the O.33 and TEK test sequences, the actual output levels in dBm0 of the ASG 140 test signals (to a 600 Ω load) equals the sum of the test level and the step levels specified in Appendix B, *Test Sequences*. For example, the first step of the 0.33 test sequence is specified at –12 dBm0 However, if the test level is set to be +4.0 dBu, the actual output level of this signal will be (–12 + 4) = –8.0 dBm0. The test level can be set from a minimum of –6 dBu to a maximum of +14 dBu. The factory default test level is 0 dBu. This level is one that is usually made uneditable from the front panel so that the known reference for the automatic testing sequences is not easily changed.

Typically, if a TESTLev change is needed, editing is enabled by a technician to allow an adjustment, then editing is disabled again to lock in the new values for use by operators in the field. For more information on enabling editing, refer to *Internal Settings and Setup Editing*.

NOTE

When monitoring the test signals with test equipment, such as a VM700A Option 40 or Option 41, to get correct readings of insertion gain, be sure the Test Level setting on the VM700A matches the Test Level setting on the ASG 140.

To display the current **TESTLev** value, from AUTO with an O.33 or TEK AUTO Test selected, press the AMPLITUDE button. The TESTLev label is displayed while the button is held in, and the test level setting is displayed when the AMPLITUDE button is released. When editing is enabled and you want to change the TESTLev setting, move the blinking cursor to the digit you want to change by pressing the ⇐ or ⇒ buttons. Then change the value of the digit by pressing the ⇓ button or ⇑ button. If you wish to make the new setting your default value, you must also press the SAVE button after making the edit. You can not select SIGNAL ON from the TESTLev display; you can either press the AMPLITUDE button again or make another selection to clear the TESTLev display.

Sweep Test Level

The Sweep sequence test level determines the signal level of sweep signals. When setting the **SweepLev** value, one of the sweep signals (Sweep, R Sweep, or L Sweep) must be the selected AUTO test. Editing is done as above for TESTLev when editing is enabled. As with TESTLev, you cannot select SIGNAL ON with the SweepLev displayed.

LINE UP

The LINE UP function generates a single tone at a standard frequency and amplitude. The factory default setting is 400 Hz at 0 dBu.

Once you have pressed the LINE UP button, you can display the frequency or amplitude of the tone by pressing the FREQUENCY or AMPLITUDE button. For information on adjusting their values (when editing is enabled to to allow this), refer to the *FREQUENCY* and *AMPLITUDE* descriptions.

The frequency and amplitude of the LINE UP tone may be programmable from the front panel. If you change the line-up parameters and want to lock in the new values so they cannot subsequently be changed from the front panel, the editing function can be disabled. For more information, refer to *Internal Settings and Setup Editing*.

ALTERNATING VOICE AND LINE UP

This feature is not indicated on the front panel of the ASG 140. Pressing the VOICE and LINE UP buttons together makes the ASG 140 continuously send the recorded voice pattern alternated with the specified Line Up tone when SIGNAL ON is active. The voice amplitude level follows the level setting of the Line Up signal.

MANUAL

The MANUAL function offers Tone, Polarity, and Multitone signals. Each of these has right and left channel only choices. The factory default option is **Tone**. To choose one of the other options, press either the up arrow button or down arrow button until the desired test name appears in the display window. Left and right channel signals are selected using the left-right arrow buttons. The first press of a left or right arrow button selects the left or right channel test signal. If a left or right channel test signal is selected, pressing the opposite arrow returns to the stereo test signal. A second press then selects the opposite channel test signal (see Figure 2-3).

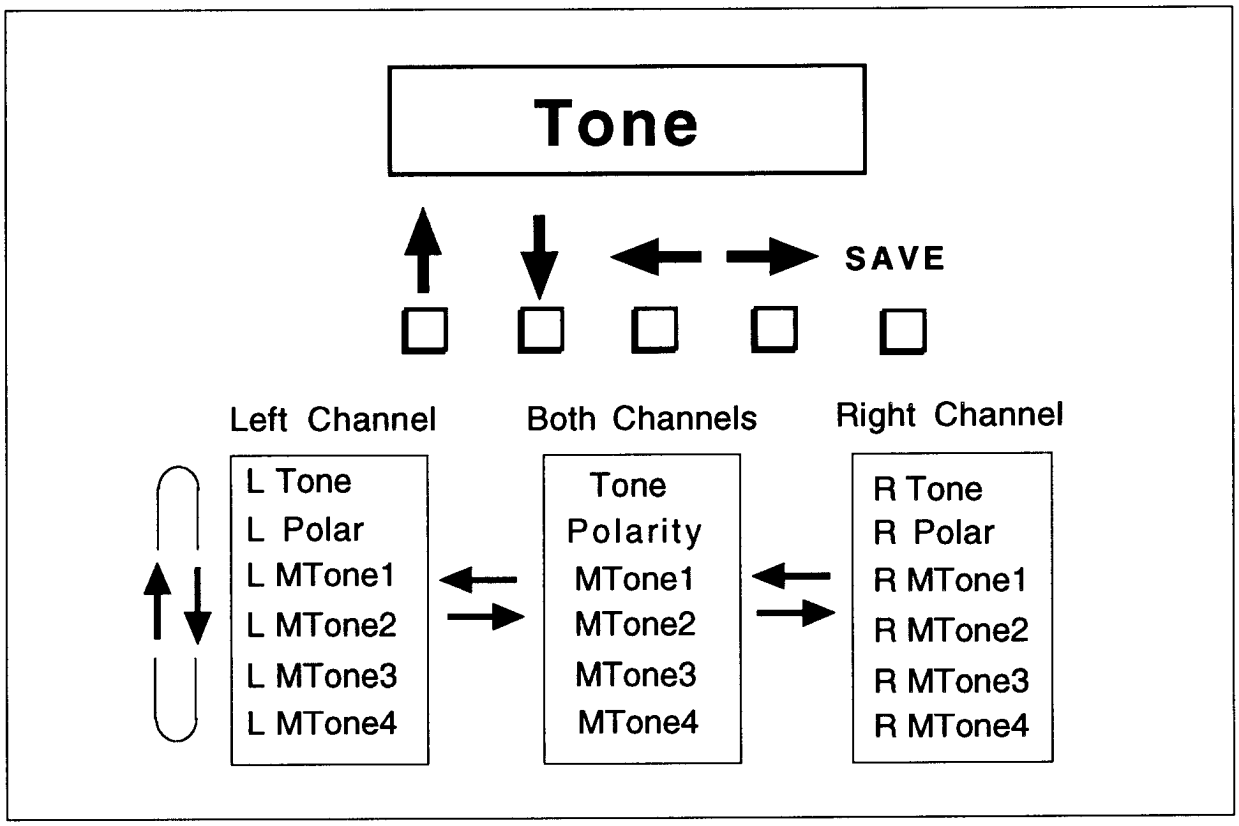


Figure 2-3. Manual test signal selection using arrow keys.

Tone

The Tone selections (**Tone, L Tone, and R Tone**) generate a single, continuous sine-wave tone at a specified frequency and level. With a tone choice displayed, you can display the frequency or amplitude of the tone by pressing the FREQUENCY or AMPLITUDE button. When editing is enabled you can edit the frequency or amplitude values for the tone signal using the arrow buttons. For information on enabling editing, refer to *Internal Settings and Setup Editing*. For

more information on adjusting frequency and amplitude values, refer to the *FREQUENCY* and *AMPLITUDE* descriptions.

Polarity Tests

Most audio systems require signal polarity to be preserved through the distribution system. In stereo systems, polarity is especially important for stereo imaging and for monaural compatibility. If polarity is reversed in one channel of the stereo pair, monaural signals cancel.

The Polarity selections (**Polarity**, **L Polar**, and **R Polar**) generate special polarity signals that make it easy to test polarity in the audio path and assure correct wire connections for balanced audio output. This polarity signal is included in the TEK automatic test sequence.

Multitone Tests

The Multitone selections (**MTone1**, **MTone2**, **MTone3**, and **MTone4**) and their right and left channel choices, **R MTone*n*** and **L MTone*n***) provide signals that are composed of selected sets of sine-wave frequencies. These signals are used to check frequency and phase response, total harmonic distortion, and noise levels in audio circuits.

Manual Test Level

You can display the amplitude of the manual signals by pressing the AMPLITUDE button when a manual test name is displayed. You can edit the amplitude of any of the manual tests using the arrow buttons when manual test editing is enabled. In normal use, editing of the Manual Test may most often be enabled simply because of the nature of the testing being done when using one of the Manual Test signals. For information on enabling or disabling editing, refer to *Internal Settings and Setup Editing*. For more information on adjusting amplitude values, refer to the *AMPLITUDE* control description.

Manual Test Frequency

You can display the frequency of the manual signals by pressing the FREQUENCY button when a manual test name is displayed. The frequency of the polarity signal is 440 Hz and can not be changed. There is no frequency indication for Multitone signals. You can edit the frequency of the Tone tests (Tone, R Tone and L Tone) using the arrow buttons when editing is enabled. For information on enabling editing, refer to *Internal Settings and Setup Editing*. For more information on adjusting the signal frequency, refer to the *FREQUENCY* control description.

VOLUME

The VOLUME knob controls the level of the audio output through the headphones. It does *not* affect the level of the signal output through the other signal ports. To increase the volume, turn the knob clockwise.

MIC. (MICROPHONE)

When you enable the RECORD function, the microphone picks up sound made in the vicinity of the ASG 140 during the 4-second recording period. Automatic gain control is built into the microphone circuit.

You can then make the ASG 140 replay the recorded sound pattern, either repeatedly with the VOICE function, or at the beginning of one of the standard test signal sequences with the AUTO function.

The AUTO test sequences that include a voice segment before the test sequence preamble are identified by a "V" suffix on the sequence name. For example the TEK mono test sequence that includes a voice segment is displayed as **TEK:90V**.

IDENTIFICATION

The identification code, consisting of four alphanumeric characters and various punctuation characters, provides a way to identify the source of the test signals generated. This feature is very useful when there may be multiple signal sources arriving at a central control point for testing audio signal paths.

The IDENTIFICATION control is active only when the signal is off with an AUTO test sequence selected. It displays the current four-character code that is transmitted as part of the *preamble*. The preamble is a set of initializing data the ASG 140 prefixes to some of its standard test signal sequences.

To view the current identification code, press the AUTO button, then the IDENTIFICATION button.

When editing is enabled, you can change the identification code using the arrow buttons. For information on enabling editing, refer to *Internal Settings and Setup Editing*. For more information on adjusting values using the arrow buttons, refer to *Arrow Buttons*.

FREQUENCY

The FREQUENCY control displays either the frequency of the LINE UP signal or the frequency of the MANUAL function signals of Tone and Polarity (there is no single frequency associated with Multitones). To display the signal frequency, press either the LINE UP button to view the line up signal frequency, or the MANUAL button to view the Tone or Polarity signal frequency. When viewing a manual test signal, use the ⇑ or ⇓ buttons to display the Tone or Polarity selection, then press the FREQUENCY button. All the Tone signals (Tone, R Tone, and L Tone) are set to the same frequency, but the LINE UP signal and the Tone signals are separately settable.

NOTE

The Polarity signal is the sum of two equal-amplitude sine waves. One has a fundamental frequency of 440 Hz (the displayed frequency for Polarity) and the other is the second harmonic of that frequency, 880 Hz. The frequency of the Polarity signal may not be edited.

When the DIP switches are set to allow editing, you can change the signal frequency of the line up or manual Tone signals using the arrow buttons. The frequency of the tone signal may also be changed remotely as an argument to asking for the Tone signal via the serial interface. For information on enabling editing, refer to *Internal Settings and Setup Editing*. For more information on adjusting values using the arrow buttons, refer to *Arrow Buttons*.

AMPLITUDE

The AMPLITUDE control displays the amplitude of the tone generated by the LINE UP function, the MANUAL Tone function, and the MANUAL Polarity function. To display these amplitudes, press the LINE UP button, or the MANUAL button and the ⇑ or ⇓ buttons to display the Tone or Polarity function, then press the AMPLITUDE button.

As with FREQUENCY (discussed in the preceding subsection), once you display the LINE UP, MANUAL Tone or Polarity amplitude, if editing is enabled, you can change the amplitude using

the arrow buttons. For information on enabling editing, refer to *Internal Settings and Setup Editing*. For more information on adjusting values using the arrow buttons, refer to *Arrow Buttons*.

When the ASG 140 signal is enabled (SIGNAL ON), and you press the ⇑ button to increase the amplitude, if the displayed value is greater than or equal to 0 dBu, the cursor automatically locks onto the least significant digit and increases the level by that increment only. This protects against sudden, unintended jumps in volume.

ARROW BUTTONS

The arrow buttons let you select options and specify values for the AUTO, LINE UP, and MANUAL functions.

For example, the AUTO function offers many standard test signal sequences you can choose. Similarly, the MANUAL function lets you choose a test signal or specify a number of parameters to make the ASG 140 generate a desired test signal. The arrow buttons let you cycle through the available choices and specify characters or numbers.

⇑(Up Arrow), ⇓ (Down Arrow)

When the currently selected function offers a set of choices, pressing the ⇑ or ⇓ button cycles up or down through those choices, displaying them in the display window.

If the currently selected function displays a value that may be edited, such as frequency, test level, or the identification code, a blinking cursor indicates the currently editable character. Pressing the ⇑ or ⇓ button cycles up or down through the available characters or numerals.

When editing numbers or alpha characters, pressing and immediately releasing the button increments or decrements the value by one number or alpha character. Pressing and holding the button for 1 second initiates automatic incrementing or decrementing, which continues until you release the button. The frequency and level settings have upper and lower limits and cease changing when those limits are reached. The list of character selections for ID is circular and returns to the starting point when continuing a change in the same direction.

When making test name selections, the buttons must be pressed and released for each new choice. The list of test names is also circular and returns to the starting point when continuing a change in the same direction.

⇐(Left Arrow), ⇒(Right Arrow)

The ⇐ and ⇒ buttons are used to select the left or right manual test signal and allow you to select a digit for editing when editing is enabled.

If a value you can edit is displayed, pressing the ⇐ or ⇒ buttons moves a blinking cursor one character to the left or the right. When the cursor is on a character, the character blinks off and on, indicating you can edit it. When editing the alphanumeric encoded IDENTIFICATION, the character to edit must be explicitly selected to be controlled by the ⇑ and ⇓ buttons. When editing a number value, the selected digit to edit will increment and decrement the total value of the displayed value, not just the digit column selected. If editing is not enabled, there will be no flashing digit or space in the display.

PAUSE AUTO

During an AUTO test signal sequence, pressing the PAUSE AUTO (⇒) button pauses the sequence at the current signal step.

For example, suppose you press the ⇒ (PAUSE AUTO) button during the step of the O.33 sequence when the ASG 140 is generating a tone of 80 Hz at –12 dB. The ASG 140 will continue generating that tone, rather than progressing to the next step in the sequence.

Once you have paused the test sequence, you can advance it one step at a time by pressing the ⇑ button. You can reverse the sequence steps by pressing the ⇓ button. You can advance to the last test in the sequence or reverse to the first test in a sequence, but you cannot step the test sequence off line. To resume automatic generation of the rest of the test sequence, press the (PAUSE AUTO) button a second time.

SAVE

If SAVE is pressed when saving is not enabled, the word **Disabled** will be displayed.

If the SAVE function is enabled, pressing the SAVE button stores the function value currently displayed as the default and **Saved** will appear in the display. Once you save a function value, powering on the unit restores that value if user-defined settings are enabled. If user-defined settings are not enabled, the new value saved will be in effect for the time the power is on only. When the power is turned off and back on, the factory defaults will be returned. The normal setting is for user-defined settings to be enabled and recalled on power on.

NOTE

When the factory defaults are restored, all user-selected values are written over in the NVRAM, and the user defaults become the same as the factory defaults.

Saving can be done either from the main selection level or at the level of the individual parameter. For example, if the LINE UP function is currently displayed and you press the SAVE button, the frequency and the amplitude parameters currently specified for the line up tone are stored. If the frequency value itself is displayed and you press the SAVE button, only the frequency value is stored.

A selected auto test sequence may be saved as the power-on choice as well as a selected manual test signal. Just select the one you want the start-up setting to be and press SAVE. The ASG 140 powers up each time with the AUTO choice selected, and the selected test will be the one that you saved. When MANUAL is selected, the test name you selected and saved will be the one that appears.

For more information on the enabling edits and saves refer to *Internal Settings and Setup Editing*.

STATUS FEEDBACK

POWER

When the ASG 140 is powered on, the POWER LED lights up.

POWER-ON DIAGNOSTICS

When you power on the ASG 140, it performs a numbered series of tests of its memories and their interconnections, and then tests the backup battery.

The display window shows the number of each test as the ASG 140 performs it, in the format shown below:

DSP 1/4. . . 2/4. . . 3/4. . . 4/4

The sequence of messages above indicates the ASG 140 is performing the self tests, but only the first and last will be evident in the display for a normal power-on. When it completes the numbered tests, the ASG 140 tests its backup battery. A status message is displayed if the battery is not good.

If the ASG 140 fails one of the numbered self tests, it keeps trying to perform that test and displaying its number. When the ASG 140 indicates a failed self test, you cannot make it perform its other functions. Contact your Tektronix representative for service information.

After repeated iterations, the unit may pass a test it failed initially, and proceed to the next test in the sequence. However, you should still stop using the unit and have it serviced.

OUTPUT ≥775MV(RMS)

The LED above this label blinks when the amplitude of the selected signal is greater than or equal to 0 dBu, as required by the CCITT 0.33 Standard. This is to alert you to the possibility of levels that could overload or damage equipment. Whenever this LED is blinking, the signal level is increased in tenth dBu steps only when you raise the level using the front panel controls. It may be decreased normally.

DISPLAY WINDOW

The ASG 140 lets you set a number of parameters affecting the signal it generates. Using the panel controls you can specify the parameter you want to check or modify. The display window shows the current signal pattern for whatever signal parameter you last chose. When you select the RECORD function, the window also displays cues for recording a four-second voice identification.

When you power up the ASG 140, the display window shows the name of the default automatic test sequence (either the factory default of O.33:01 or a user-selected automatic test sequence).

HEADPHONES

The stereo HEADPHONES port may be used to monitor the output signal. If the ASG 140 signal is on, this is the signal pattern currently selected on the ASG 140. If it is turned off, the SILENCE level (no output) is present. The VOLUME knob controls the level of the signal through this port.

CAUTION

It is possible to set levels and adjust the volume so the output through the headphones is excessively loud. For safety, set the volume level control to minimum when making level adjustments.

REAR PANEL, POWER SWITCH, AND SIGNAL CONNECTORS

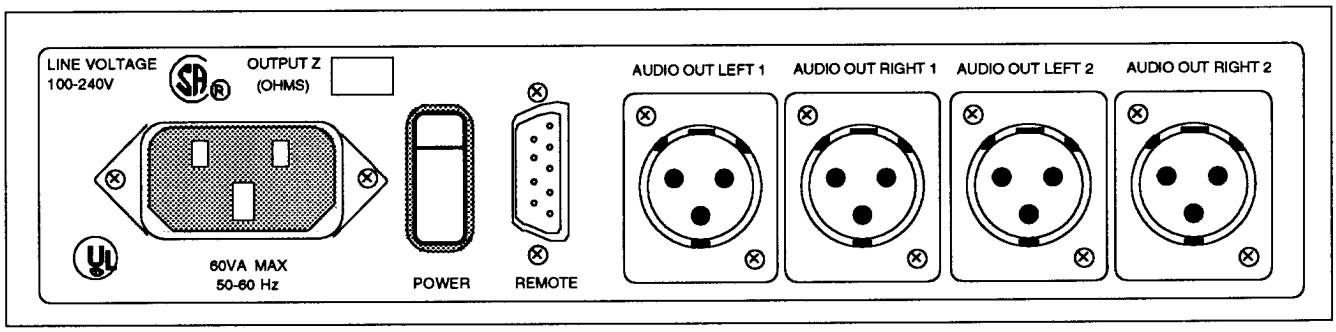


Figure 2-4. ASG 140 rear panel connectors.

POWER SWITCH

The ASG 140 power switch is immediately to the right of the power plug receptacle on the back panel (see Figure 2-4). In the off position, the top of the switch, which has a red "O" engraved in it, is out. When the ASG 140 is connected to a power source, power it up by pressing the top of the switch. Power it off by pressing the bottom of the switch.

NOTE

When power is turned on, the selections for the settings will be determined by the stored defaults that are recalled.

AUDIO SIGNAL CONNECTORS

The AUDIO OUT LEFT (1 and 2) and AUDIO OUT RIGHT (1 and 2) for the left and right channels are female XLR connectors. When the ASG 140 signal is on, the selected test signal is available at the connectors. The output test signal may be monitored at the front panel stereo headphone jack. When the signal is off, the SILENCE level is applied to the output connectors.

REMOTE CONNECTOR

This DB-9 connector is used to access two types of remote control. It may be used to connect switching contacts that are used to start the AUTO Test or to override the editing locked feature so new setups may be saved without removing the ASG 140 from a rack installation to reset the internal DIP switches. Its second purpose is to provide an RS-232C interface for remote control of all the instruments functions. See Appendix A, *Remote Control*, for using the RS-232C interface to control the operation of the ASG 140 remotely. An additional feature controlled via the remote connector is the Audio/Video Timing measurement signal synchronization. See Appendix C, *Audio / Video Timing*, for information on how this feature is used.

INTERNAL SETTINGS AND SETUP EDITING

The ASG 140 allows you to enable and disable editing of various signal features, such as amplitude, frequency, and signal identification. Front panel control or remote control or both may also be either enabled or disabled. This section describes how to make these changes.

You control signal editing through the 10-pole DIP switch labeled "S1" on the circuit board. The settings of the first four switches control editability of the user-definable test variables and the default values used when the ASG 140 is powered on.

ENABLING AND DISABLING SIGNAL EDITING

On the ASG 140 circuit board is a DIP switch you can set to enable or disable editing of ASG 140 functions, and to select the type of values used as the defaults for user-definable functions.

As you face the ASG 140, on the left side, near the front is a small screw-on access panel. Removing the side panel reveals the DIP switch, as shown in Figure 2-5. The individual switches that affect editing and what each does are shown in Figure 2-6.

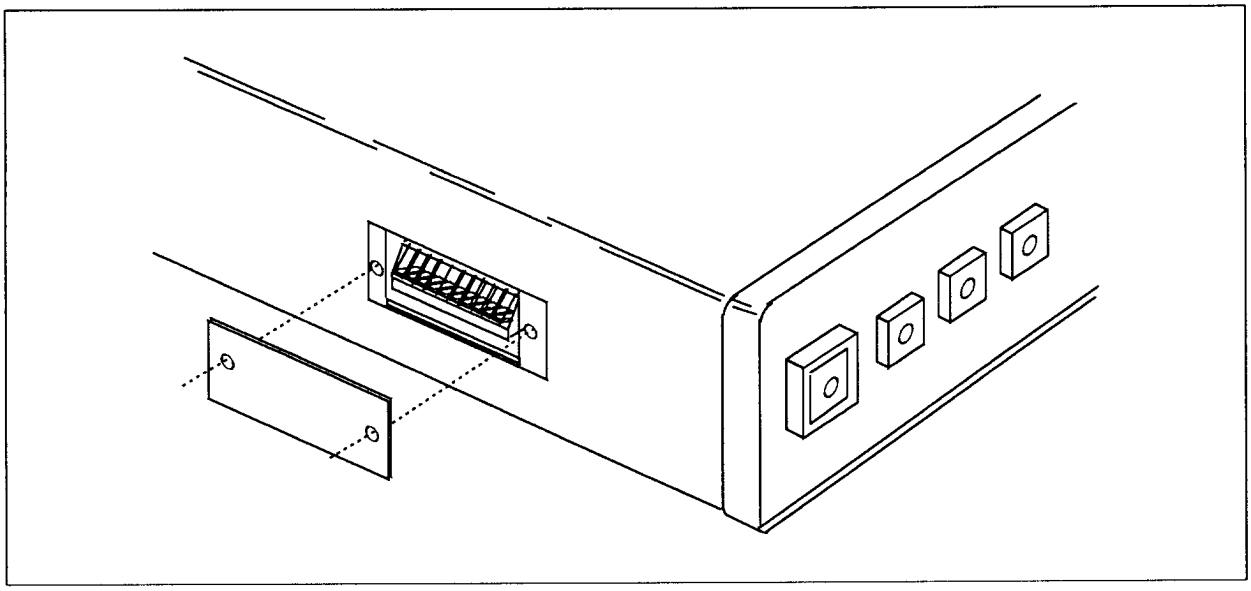
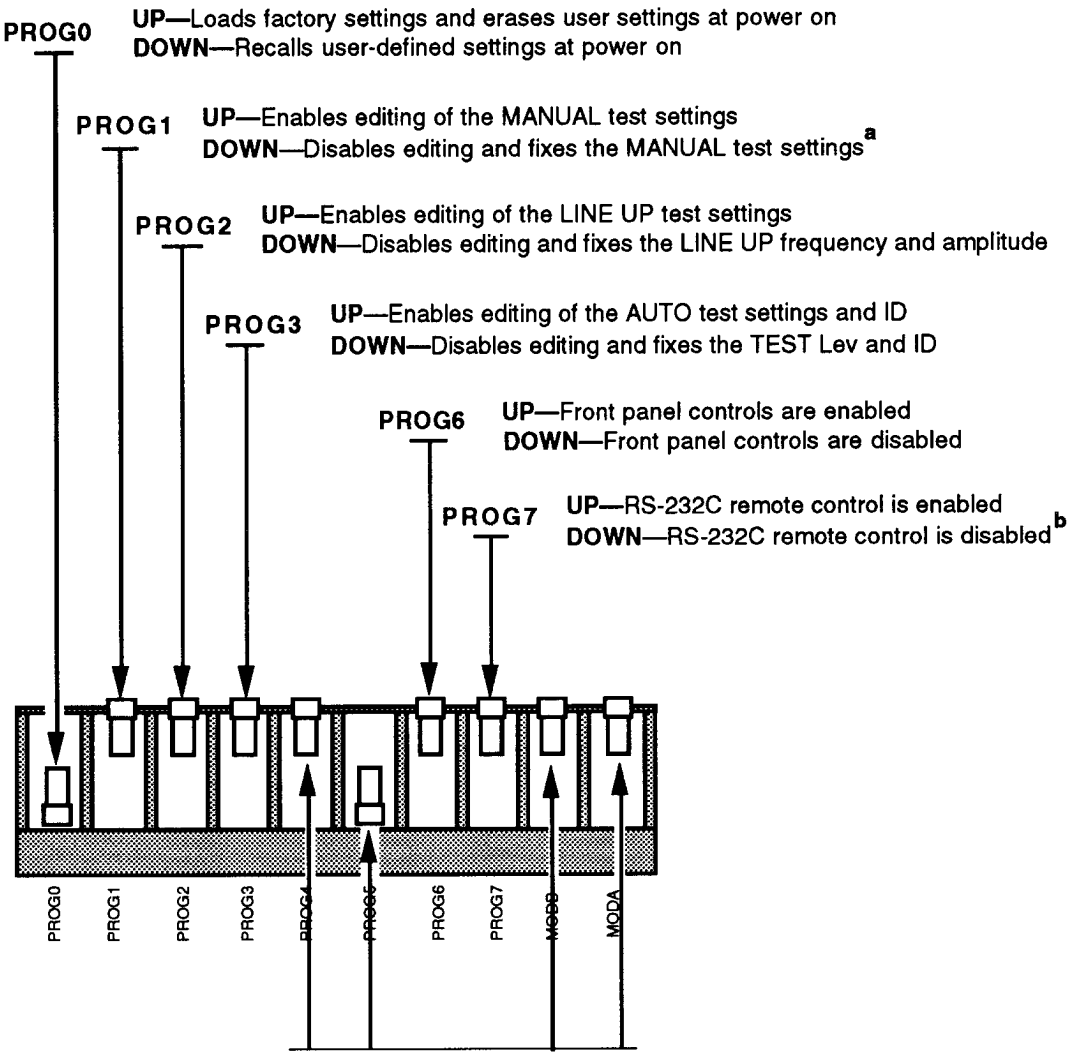


Figure 2-5. Remove the side panel access cover to set the DIP switch.



[a] Editing may be enabled via the remote connector by using contact closure to connect pin 6 and pin 9 of the rear panel remote control connector. While the pins are connected, the disables are overridden. Edits and saves may then be done to make the needed change(s). When the contacts are opened, editing is again controlled by the settings of switches PROG1 – PROG3.

[b] With PROG6 and PROG7 both down, the contact closure remote operation for sending an AUTO TEST sequence and enabling editing when editing is internally disabled are still operational.

Figure 2-6. DIP switch settings for editing.

EDITING SIGNAL PARAMETERS

After you enable editing of a signal parameter, you can adjust that parameter value from the front panel. To edit a signal parameter, press the front panel buttons required to display the current value. For example, to edit the frequency of the line up tone press the LINE UP button, then press the FREQUENCY button.

The digit currently active for editing is indicated by a blinking character, numeral or underscore. To change the active digit, use the ⇐ and ⇒ buttons. To change the value of the active digit, press either the ⇑ or ⇓ button to increment or decrement the value until you get the desired character or number.

SAVING SIGNAL PARAMETERS

When you have changed the parameter to the value you want, save it as the default by pressing the SAVE button.

If a top-level function (**Line Up** or one of the **Manual** test signals) is displayed, pressing the button saves as defaults the values of all parameter settings beneath that function (both frequency and amplitude in the case of **Line Up**).

If it is a test signal parameter, such as the frequency, that is displayed, pressing the SAVE button saves only that parameter value as a default; the default values of any other parameters under the function (such as the amplitude) are not updated.

To leave a signal parameter you have been editing, press any of the main-level function buttons: SILENCE, VOICE, AUTO, LINE UP, or MANUAL.

When you finish editing signal parameters and saving the desired default values, ensure the DIP switches are set as follows:

PROG0 **Down**. This preserves the saved values as defaults that will be restored whenever the operator powers up the instrument. (Placing DIP switch S-1 in the up position erases all user-defined settings and returns factory settings when the operator powers up the instrument.)

PROG1
PROG3 **Down.** This prevents further editing of signal parameters.

NOTE

You may choose to leave all, any, or none of the user-definable frequency and level choices of a testing option editable from the front panel by the technician or engineer using the ASG 140. A normal choice may be to fix the AUTO and LINE UP test to known settings and leave the MANUAL test editable for setting levels and frequencies that may be needed for manual testing. Your application will determine how you decide to customize the test signals and the freedom of operation for the user.

Table 2-2 shows the present assignment of all the switches of the DIP switch package, and the factory setting of each switch.

Table 2-2
DIP Switch Functions

Switch Name	Switch Action		Factory Setting
	Up	Down	
Prog 0	At power up, ASG 140 recalls factory settings for all functions.	At power up, ASG 140 recalls values last saved (with the SAVE button) for user-definable functions.[a]	Down
Prog 1	MANUAL functions can be edited.	MANUAL functions can NOT be edited.	Up
Prog 2	LINE UP function can be edited.	LINE UP function can NOT be edited.	Up
Prog 3	AUTO TEST Level and SOURCE ID can be edited.	AUTO TEST Level and SOURCE ID can NOT be edited.	Up
Prog 4	Normal operating state.	Reserved.	Up
Prog 5	Reserved.	Normal operating state.	Down
Prog 6	Front Panel Controls Enabled.	Front Panel Controls Disabled.	Up
Prog 7	Remote Control Enabled.	Remote Control Disabled.	Up
MOD B	Factory setting required for correct performance. DO NOT CHANGE.		Up
MOD A	Factory setting required for correct performance. DO NOT CHANGE.		Up

[a] As shipped from the factory, the factory default settings are stored in the memory reserved for custom settings. This means that when you use the ASG 140 for the first time, the factory defaults will be used, even if DIP switch 1 is in the DOWN (user-defined settings enabled) position.

EXTERNAL EDIT ENABLE

When the editing features are disabled internally, they may be enabled via the rear-panel REMOTE connector. This method of operation permits editing from the front panel when needed without having to remove the installed equipment to access the side panel and internal switches. Editing is enabled by connecting pins 4 and 6 of the Remote connector together. This connection may be made via a jumper, switch, or remote-controlled relay contact.

If activation of the AUTO test sequence using external contact closures is a part of your normal operation, you may also want to add the Remote Edit enable capability. If the need to change a programmed frequency, amplitude, or ID, etc., arises, the feature can be enabled, the edit made by the on-site operator, and then disabled again. When the connection between pin 4 and pin 6 is removed, the settings of internal DIP switches again control the state of the editing and saving function for the AUTO, LINE UP, and MANUAL test settings. Note however, that the settings that were edited will now be in effect for the remainder of the test session. If those edits were also SAVED, they will be in effect when the ASG 140 is again turned on.

Front-panel editing may not be enabled via the RS-232C serial commands. However, even with front-panel editing disabled, the remote command arguments for editing still function.

NOTE

There is no remote command for saving an edit to make it a new default, so at the next power on of the ASG 140, the previously "saved" defaults are restored.

FRONT PANEL AND REMOTE CONTROL ENABLING

Depending on the mode of operation needed, you may choose to disable the control capabilities of the ASG 140. If remote control alone is needed, and you want no local front panel access, you may disable the front panel controls by setting PROG6 (switch section 7) of S1 to the down position. This effectively prevents any changes from the front panel of the instrument; the front panel is locked out.

The remote control capability of the ASG 140 may be locked out by setting PROG7 (switch section 8) of S1 to the down position. If access is attempted when the RS-232C serial port is shut off, a message is sent to that effect. The ASG 140 still responds to the control signals it recognizes (control C, control Q, and control S) and sends out the sign on messages, but it will not respond to any commands.

Even if both the front panel and the remote access are disabled, the contact closure operation via the remote connector for sending an AUTO test sequence and enabling the editing features still works. This state of the controls provides minimal access to making any signal level or auto test type changes, and may be used when those sort of changes to operation are to be restricted.

OUTPUT IMPEDANCE

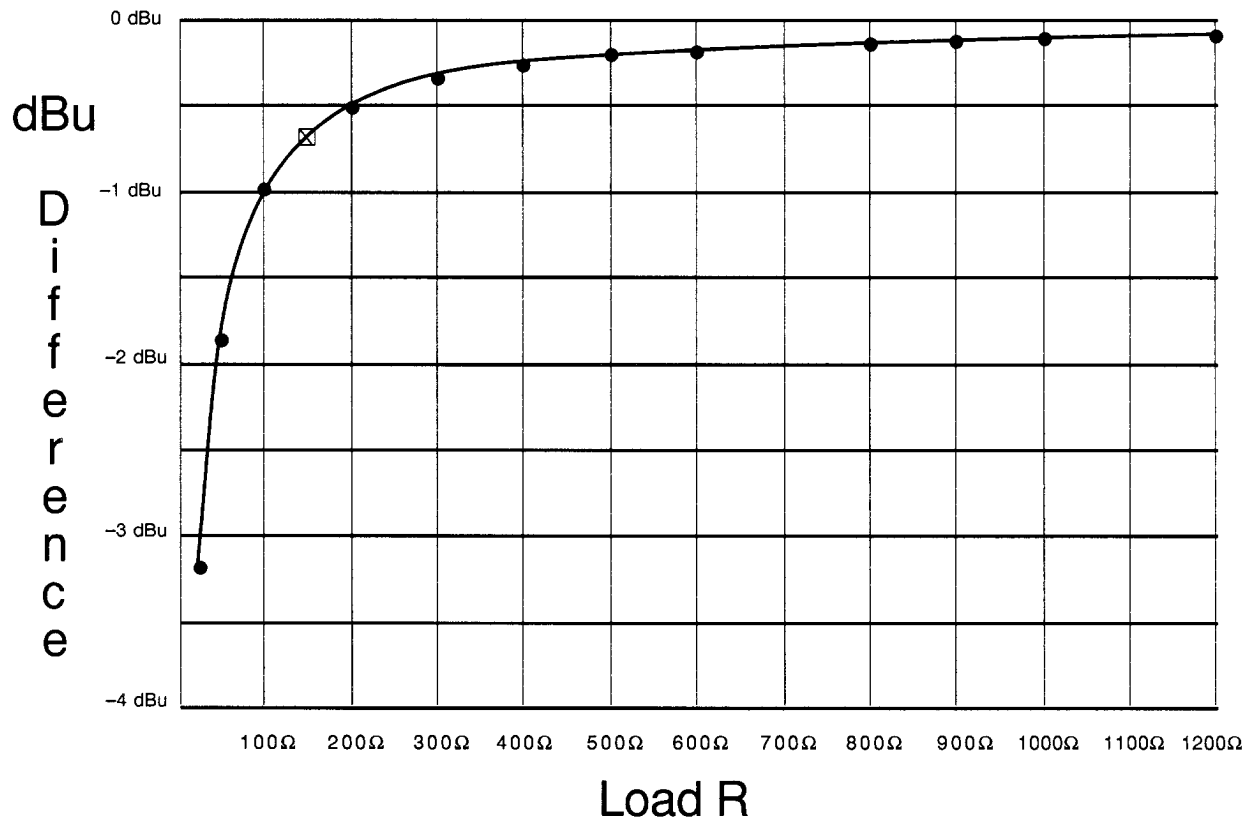
The output impedance is 12 Ω and is not switchable.

The output level indicated by the ASG 140 display is in dBu (a voltage reference), not dBm (a power reference), and is not compensated for load impedance changes. The voltage output of the ASG 140 is shown for a range of dBu indications in Table 2-3. The dBu output level displayed by the ASG 140 is calibrated for open circuit voltage. The voltage decreases below the dBu readout indicated as the output is loaded. A 600 Ω load reduces the output voltage of the ASG 140 by approximately 0.17 dBu.

Table 2-3
dBu Voltage

dBu	Voltage (unterminated)	dBu	Voltage (unterminated)
12	3.084 V	–3	0.5484 V
9	2.183 V	–6	0.3882 V
6	1.5455 V	–9	0.2748 V
3	1.094 V	–12	0.1946 V
0	0.7746 V	–15	0.1377 V

If you use a lower impedance load, the actual voltage to the load will decrease slightly as the load impedance decreases due to the voltage drop across the internal resistance. Use the curve of Figure 2-8 to compensate the dBu readout for a lower load impedance. From Figure 2-8, you can see that a 150 Ω load will cause about a –0.67 dBu difference between the readout and the actual voltage from the ASG 140.



The general formula for calculating the dBu difference when the source resistance is held at 12 Ω and the load resistance varies is:

$$dBu_{diff} = 20 \log\left(1 - \frac{12\ \Omega}{R_{Load} + 12\ \Omega}\right)$$

Using the above formula it can be seen that the front panel ASG 140 dBu reading approximately corresponds to dBm when driving a 600 Ω load. The difference between actual dBm and the ASG 140 readout is -0.17 dB with a 600 Ω load.

The output amplifiers of the ASG 140 are current limited. The load resistance should not be less than 150 Ω.

Figure 2-8. Effects of a changing load resistance on the dBu output indication of the ASG 140.

A dBu is referenced to the voltage developed across a 600 Ω load that is dissipating 1 mW (0 dBm). That calculates out to 0.7746 volt. It is also 0.7746 volt to a 1200 Ω load at 0 dBu. While dBu and dBm are the same when a 600 Ω load is used, changing the load impedance changes the power in the load when the voltage is held constant. Hence, a 1200 Ω load at 0 dBu is 0.5 mW. If a 300 Ω load is used, the voltage is still 0.7746 volt, but the actual power in the load is now 2 mW. This effect is illustrated in Figure 2-9.

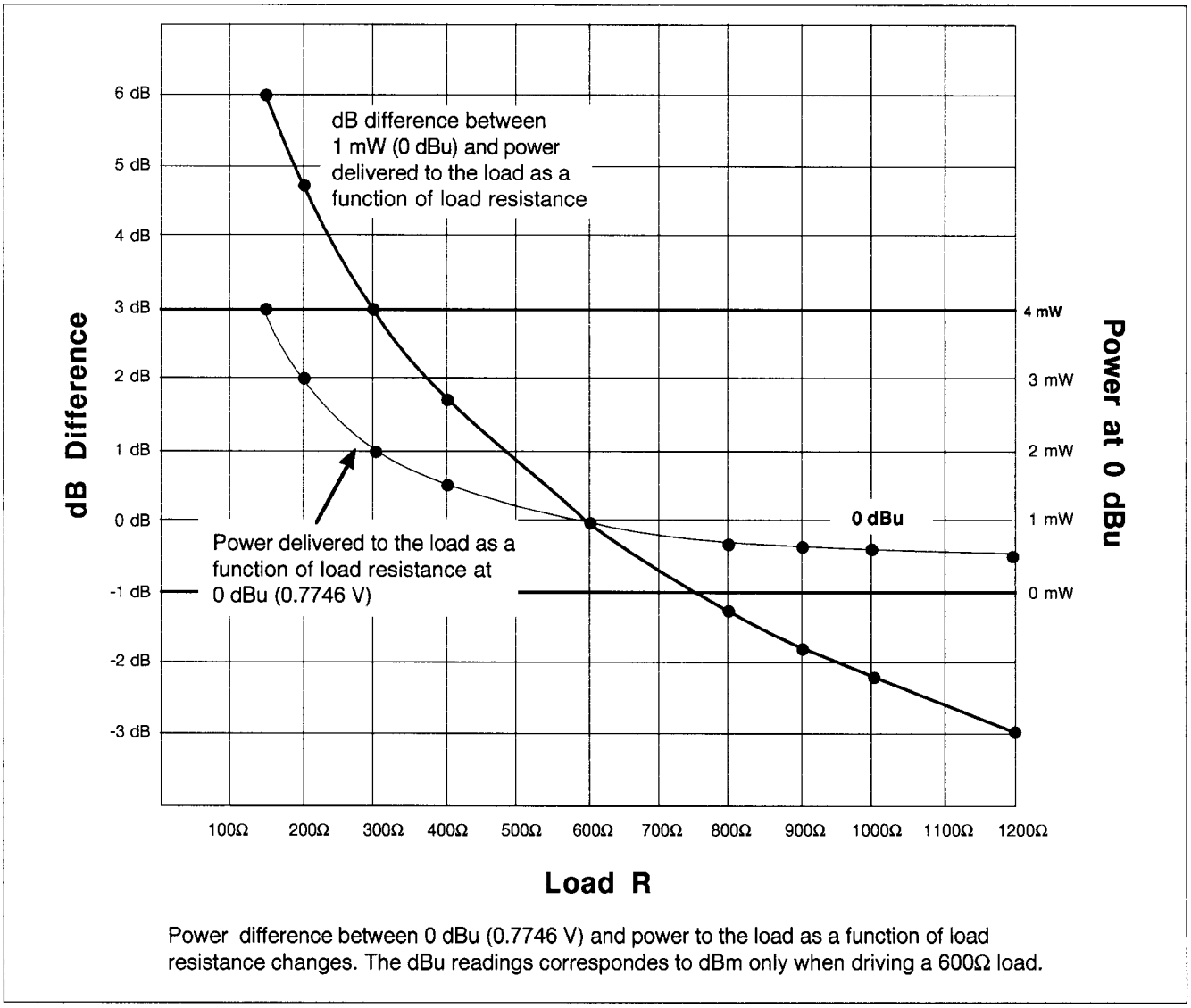


Figure 2-9. Effects of varying the load resistance on the actual power to the load with the ASG 140 output set at 0 dBu (0.7746 V). The effect of the internal drop is neglected for the graph.

Section 3
APPLICATIONS

AT REMOTE LOCATIONS

Place an ASG 140 at each remote location, and use remote control via a modem to send the repeating voice ID to identify each line to the control operator. Initiate any of the ASG 140 test signals to test for path signal loss or frequency response.

NOTE

The voice identifier has to be recorded from the front panel of the ASG 140.

To document correct audio transmission, transmit an AUTO test sequence to a VM700A Option 40 or Option 41 at the control site. To further verify the identity of the source, program the four-character test sequence ID to include a site number or other unique designator. Full remote control of the ASG 140 via an RS-232C interface permits a control operator to ask for the full range of test signals available from the ASG 140.

IN THE SHOP

To test the performance of recording equipment, record the output of the ASG 140 onto audio or video tape, then measure the output of the tape machines with a VM700A Option 40.

Monitoring the polarity signal makes it easy to check audio wiring polarity.

When troubleshooting equipment, you can step through the AUTO sequences using the PAUSE function, or you can send tones at levels and frequencies you specify using the MANUAL tone function.

The AUTO test sequences and the measurement report the VM700A Option 40 and Option 41 provides make it easy to keep a log of equipment performance and to verify repairs have been made.

MULTITONE TEST SIGNAL

Most audio tests consist of measuring a sine-wave audio tone, then stepping the frequency and repeating the test. These type of checks for frequency response flatness take some time to complete even when done automatically using one of the ASG 140 AUTO test signals. When the time required to make these tests is a factor, a faster method for obtaining the needed measurements is needed. The time factor comes into play when the available time to perform the measurement is only a few seconds or when you are making circuit adjustments and need immediate feedback to determine the correct settings.

The multitone test signal is composed of a set of sine-wave signals across the audio spectrum. The frequencies are selected to provide predictable circuit responses. Four different multitone signals are available from the ASG 140. See Table 1-2 in Section 1 for a list of the frequencies contained in each set. When coupled with the VM700A Option 40 or Option 41 View Level measurement, the multitone signals provide rapid response curve measurements and continuous, near real-time updates for making circuit adjustments.

When processed by the measurement device, digital filtering can remove the known multitone test sequence frequency components. The remaining frequency components are then analyzed to determine the noise and distortion products produced by stimulating the circuit with the multitone test signal.

POLARITY TEST SIGNAL

Distortion Analyzer Check Signal

The ASG 140 polarity signal consists of the sum of a fundamental frequency (440 Hz) with equal amplitude and its second harmonic (880 Hz), with the relative phases chosen to produce the waveform shown in Figure 3-1. Inversion of this signal is easy to recognize with an oscilloscope.

The polarity signal is a source of a known amount of total harmonic distortion, so you can use it for a quick check of a distortion analyzer. Because the signal is composed of two frequencies, one twice the magnitude of the other, a distortion analyzer will interpret the higher frequency wave as a harmonic of the lower frequency wave. This correspond to a total harmonic distortion of 70.7%. Thus, if the distortion analyzer is calibrated correctly, it should indicate 70.7% when the TEK polarity signal is applied.

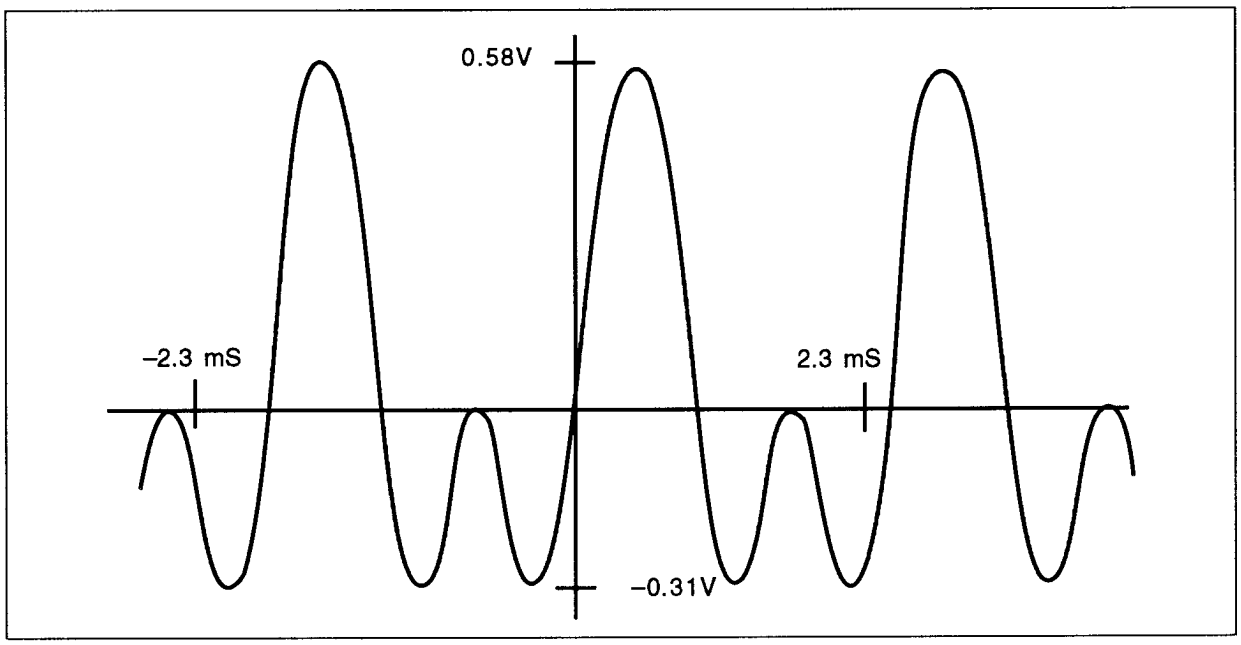


Figure 3-1. MANUAL polarity signal.

Polarity Checks

Using the polarity signal, it is also easy to check for correct audio circuit polarity with a Lissajous pattern stereo monitor, such as the Tektronix 760. In fact, this method provides more information than an oscilloscope, simultaneously showing the status of polarity and phase in both channels.

Figure 3-2 illustrates the Lissajous pattern displayed by a Tektronix 760 stereo monitor for equal left and right channel signals with correct polarity preserved.

Notice that the upper part of the line (above the horizontal axis) is longer than the lower part, which indicates correct polarity. Alignment with the vertical (L=R) axis indicates equal amplitudes on left and right channels.

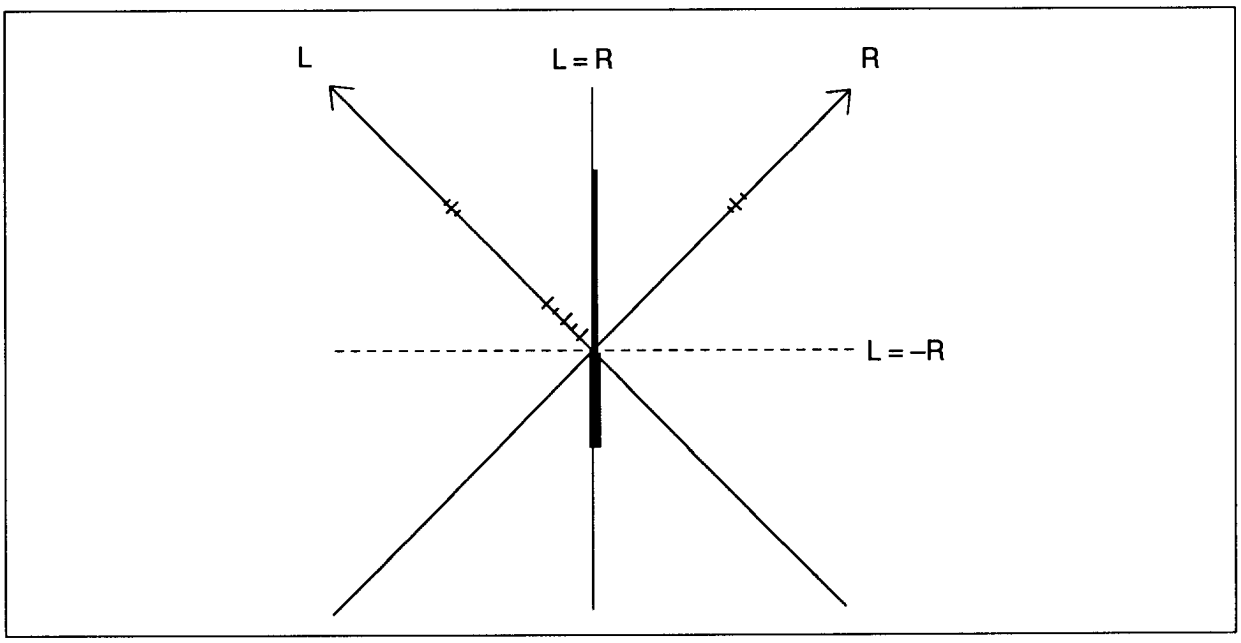


Figure 3-2. Lissajous pattern for correct polarity.

The Lissajous pattern shown in Figure 3-3 indicates reversed polarity on both channels.

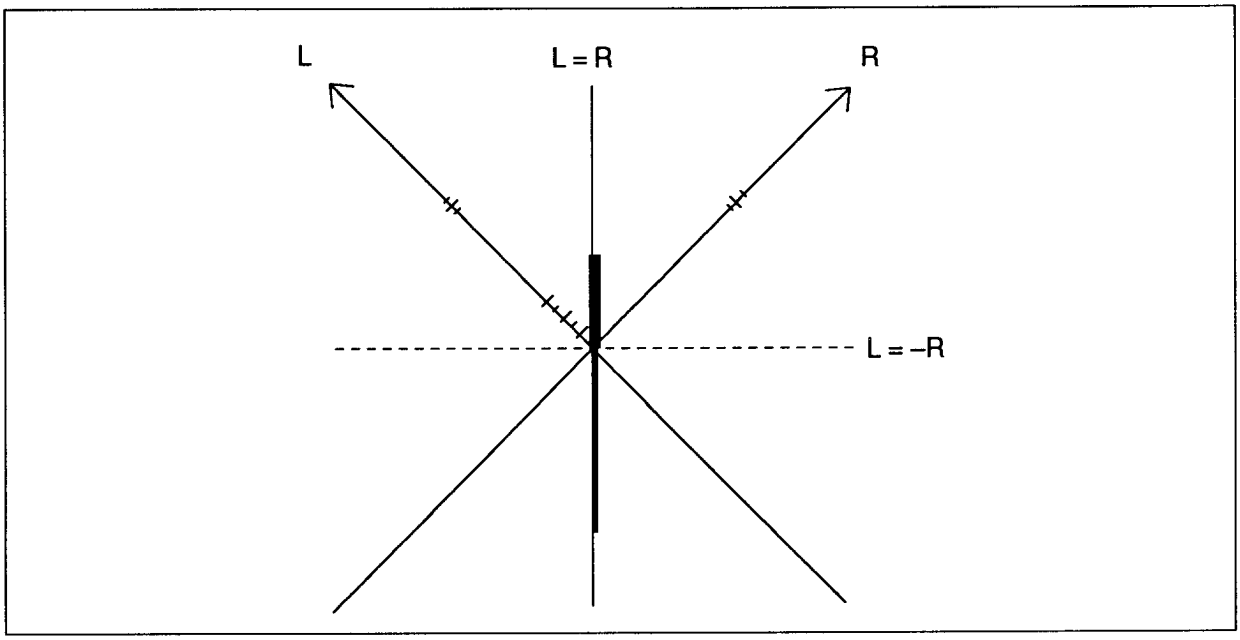


Figure 3-3. Lissajous pattern for left and right channel reversed polarity.

The Lissajous pattern shown in Figure 3-4 below indicates reversed polarity on the *left* channel only.

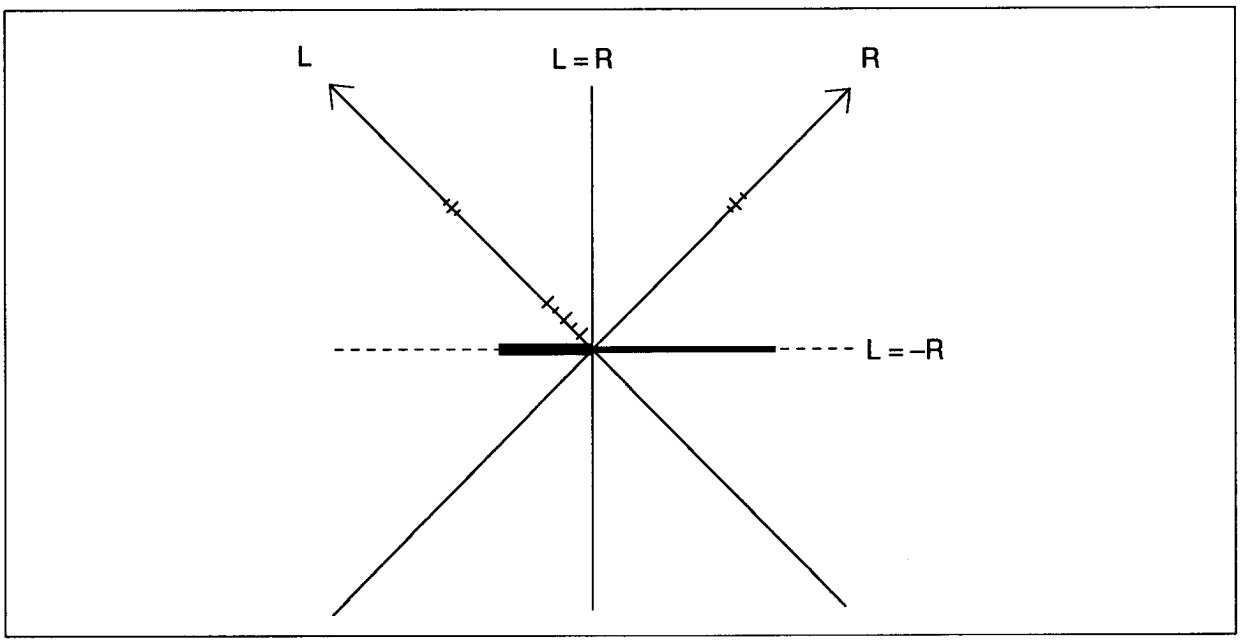


Figure 3-4. Lissajous pattern for left channel reversed polarity.

The horizontal line in Figure 3-4 indicates the signals on the two channels are out of phase (L = –R). The shorter part of the line appearing to the left of the origin indicates that the left channel is inverted.

The Lissajous pattern shown in Figure 3-5 below indicates reversed polarity on the *right* channel only.

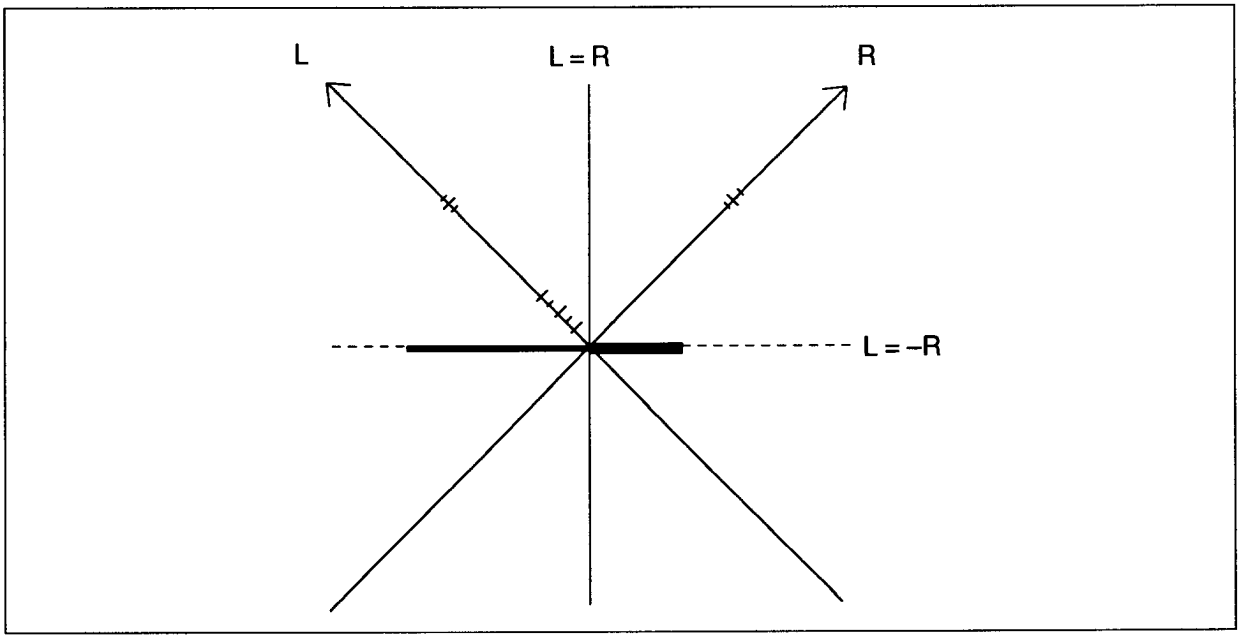


Figure 3-5. Lissajous pattern for right channel reversed polarity.

If the Lissajous pattern appears rotated between the vertical and horizontal axes as shown in Figure 3-6, it indicates unequal gains in the transmission path. An elliptical pattern as shown in Figure 3-7 indicates unequal phase shifts in the two channel signals. Combinations of unequal gain and phase shift plus noise can create many variations of the illustrations used here to show some possibilities.

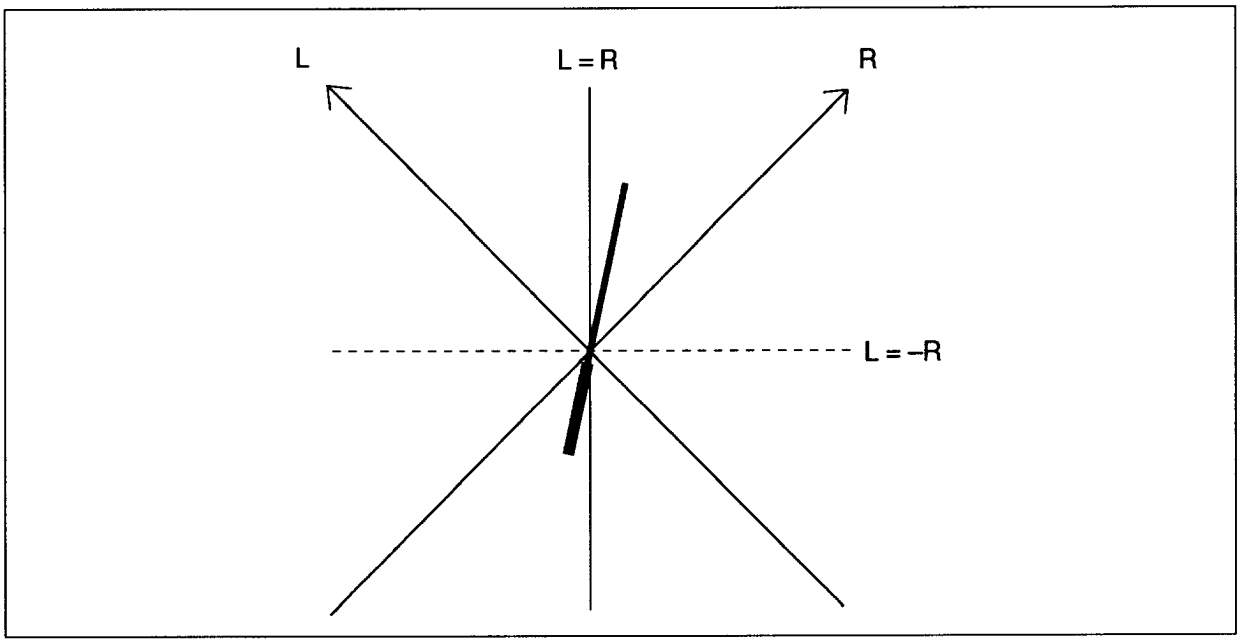


Figure 3-6. Lissajous pattern for unequal gain between right and left channels.

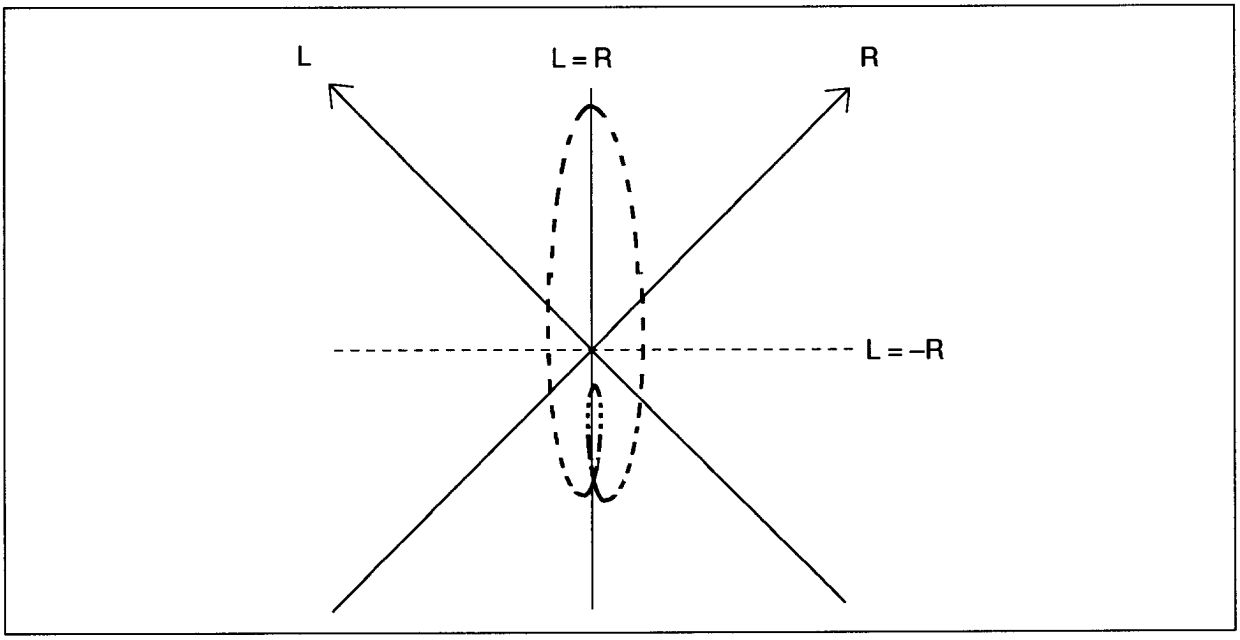


Figure 3-7. Lissajous pattern for unequal phase shift between right and left channels.

WARNING

The following servicing instructions are for use only by qualified personnel. To avoid injury, do not perform any servicing other than that stated in the operating instructions unless you are qualified to do so. Refer to all Safety Summaries before performing any service.

Section 4
MAINTENANCE

This section contains instructions for preventive maintenance, general troubleshooting, and corrective maintenance. If the instrument does not function properly, troubleshooting and corrective measures should be taken immediately to circumvent additional problems.

LITHIUM BATTERY

Battery Disposal

The ASG 140 stores default values when powered off by means of its lithium battery, located on the circuit board, immediately behind the headphones jack. If you need to replace the battery, observe the warnings and instructions in this section.

WARNING

Improper handling may cause fire, explosion, or severe burns. To avoid personal injury, observe proper procedures for the handling of lithium batteries. Do not recharge, crush, disassemble, heat the battery above 212°F (100°C), incinerate, or expose the contents to water.

If you replace the ASG 140 lithium battery, dispose of the old battery as required by local, state and federal agencies.

NOTE

Typically, small quantities of the batteries (less than 20) can be safely disposed of with ordinary garbage in a sanitary landfill.

Larger quantities must be sent by surface transport to a hazardous waste disposal facility. The batteries should be individually packaged to prevent shorting. Then, pack them into a sturdy container that is clearly labeled as follows:

Lithium Batteries - DO NOT OPEN

Battery Emergency and First Aid Information

Manufacturer: Eagle Picher

Battery Type: Lithium

In case of emergency, follow the instructions given in Table 4-1.

Table 4-1
Emergency Procedures for Contact with Lithium Battery Contents

Contact	Procedure
Skin	Wash promptly with plenty of water.
Eyes	Flush immediately with plenty of water and use an emergency eye wash, if available. Report to a medical professional for treatment.
Inhalation	Leave the area and get fresh air. Report to a medical professional for treatment.
Ingestion	Non-toxic according to laboratory testing. However, report to a medical professional for advice.

In case of venting, clear the immediate area. Venting will usually last only a few seconds.

FUSE

The power supply for the ASG 140 is internally fused. Refer all internal servicing to a qualified service person.

Use only the specified fuse or equivalent if replacing the fuse. Physically, the fuse is a DIN metric size fuse; but electrically, it is UL and CSA rated for correct protection of the fused circuitry.

Specified Replacement Fuse

Tektronix part number 159-0296-00

Replacement Fuse Description

Fuse, Cartridge: MT4, 2A, 5.2 X 20 mm, NORMAL blow.

Electrical Characteristics

Rating: 250 V maximum, 2A.

Blow Time at 25°C Ambient:

110% of rated current	4 hours minimum
135% of rated current	60 minutes maximum
200% of rated current	5 seconds

Interrupting Capacity (short circuit current)

10,000 A at 125 V; 100 A at 250 V.

PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning, visual inspection, performance checking, and, if needed, readjustment. The preventive maintenance schedule established for the instrument should be based on the environment in which it is operated and the amount of use. Under average conditions, scheduled preventive maintenance should be performed every 2000 hours of operation.

Cleaning

The instrument should be cleaned often enough to prevent dust or dirt from accumulating. Dirt acts as a thermal insulating blanket that prevents effective heat dissipation, and can provide high-resistance electrical leakage paths between conductors or components in a humid environment.

Exterior — Clean the dust from the outside of the instrument by wiping with a soft cloth or small brush. A brush is especially useful to remove dust from around the selector buttons, knobs, and connectors. Hardened dirt may be removed with a cloth dampened in water that contains a mild detergent. Abrasive cleaners should not be used.

Interior — Clean the interior of the instrument by loosening the accumulated dust with a dry, soft brush. Once the dirt is loosened remove it with low-pressure air (high-velocity air can damage some parts). Hardened dirt or grease may be removed with a cotton-tipped applicator dampened with a solution of mild detergent and water. Abrasive cleaners should not be used. If the circuit board assemblies must be removed for cleaning, follow the instructions for removal/replacement under the heading of Corrective Maintenance.

After cleaning, allow the interior to thoroughly dry before applying power to the instrument.

Do not allow water to get inside any enclosed assembly or component. Do not clean any plastic materials with organic cleaning solvents, such as benzene, toluene, xylene, acetone, or similar compounds, because they may damage the plastic.

Visual Inspection

After cleaning, carefully check the instrument for defective connections, damaged parts, and improperly seated transistors or integrated circuits. The remedy for most visible defects is obvious; however, if heat-damaged parts are discovered, determine the cause of overheating before replacing the damaged part, to prevent additional damage.

Periodic checks of the transistors and integrated circuits are not recommended. The best measure of performance is the actual operation of the component in the circuit.

STATIC-SENSITIVE COMPONENTS

This instrument contains electrical components that are susceptible to damage from static discharge. Static voltages 1 kV to 30 kV are common in unprotected environments. Table 4-2 shows the relative static discharge susceptibility of various semiconductor classes.

Table 4-2
Static Susceptibility

Relative Susceptibility Levels[a]	Voltage
MOS and CMOS	100 - 500 V
ECL	200 - 500 V
Schottky Signal Diodes	250 V
Schottky TTL	500 V
HF Bipolar Transistors	400 - 600 V
JFETs	600 - 800 V
Linear microcircuits	400 - 1,000 V (est.)
Low-Power Schottky TTL	900 V
TTL	1,200 V

[a]Voltage discharged from a 100 pF capacitor through a 100Ω resistance.

Observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.
2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive components or assemblies.
3. Discharge the static voltage from your body, by wearing a wrist grounding strap, while handling these components. Servicing static-sensitive assemblies or components should be done only at a static-free work station by qualified personnel.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Keep the component leads shorted together whenever possible.
6. Pick up the components by the body, never by the leads.
7. Do not slide the components over any surface.
8. Avoid handling components in areas that have a floor or work surface covering capable of generating a static charge.
9. Use a soldering iron that is connected to earth ground.
10. Use only special antistatic, suction, or wick-type desoldering tools.

TROUBLESHOOTING

The material contained here is general and is not intended to cover specific cases. Note that the manual itself is considered a troubleshooting aid, and as such a brief discussion of its contents is in order.

Troubleshooting Aids

Foldout Pages

The foldout pages at the back of the manual contain information that is useful in troubleshooting the instrument. Schematic diagrams, circuit board illustrations, and parts locating charts are found there.

Diagrams - Schematic diagrams are the most often used troubleshooting aids. The circuit number and electrical value of each component is shown on the diagram. The first page has definitions of the symbology used on the schematic diagrams. Refer to the Replaceable Electrical Parts list for a complete description of each component. Circuits that are mounted on circuit boards or assemblies are enclosed in a border, with the name and assembly number shown on the border.

NOTE

Check the Change Information section in the rear of the manual for corrections and modifications to the instrument and the manual.

Board Illustrations - Electrical components, connectors, and test points are identified on circuit board illustrations, which are located on the back of a preceding schematic diagram.

Parts Locating Charts - Generally, components mounted on etched circuit boards are assigned circuit numbers according. The schematic diagrams are assigned location grids, and a parts locating chart (for each schematic diagram) gives grid locations of components on that schematic.

Parts Lists

There are two separate parts lists in this manual. The Replaceable Electrical Parts List precedes the schematic diagrams and circuit board illustrations. The Replaceable Mechanical Parts List, accompanied by exploded view drawings, follows the schematic diagrams and circuit board illustrations.

Replaceable Electrical Parts List - This list is arranged by assembly as designated in ANSI Standard Y32.16-1975. The list begins with the part numbers for the major assemblies (etched circuit boards). Each circuit board is identified by an A# (Assembly Number).

The circuit numbers of the individual components in the parts list is made up by combining the assembly number with the individual circuit number.

EXAMPLE: R117 on Assembly (circuit board) A3 would be listed in the Replaceable Electrical Parts List as A3R117.

NOTE

Always consult the parts list for part numbers and descriptions when ordering replacement parts. Some parts may have been replaced or have a different part number in an individual instrument. Also check the "Change Information" at the back of the manual for the most recent changes.

Replaceable Mechanical Parts List - This list is arranged so that it corresponds to the exploded view drawing for major instrument components. Standard Accessories, which are included in the parts list, are also included in the exploded view drawing.

Major Assembly Interconnection

Signals and power supply voltages are passed through the instrument by a system of interconnecting cables. The connector holders on these cables have numbers that identify terminal connectors; numerals used are from 2 up. A triangular key symbol is used to identify pin 1 on the circuit board to assist in aligning connectors with correct square pins.

General Troubleshooting Techniques

The following procedure is designed to assist in isolating problems, which in turn expedites repairs and minimizes down time.

1. Ensure that the malfunction actually exists. This is done by making sure that the instrument is operating as intended by Tektronix.
2. Determine and evaluate all trouble symptoms. This is accomplished by isolating the problem to a general area such as an assembly. The block diagram is a valuable aid in signal tracing and circuit isolation.

CAUTION

Use extreme care when probing with meter leads or probes, because of the high component density and limited access within the instrument. The inadvertent movement of leads or a probe could cause a short circuit or transient voltage capable of destroying components.

3. Determine the nature of the problem. Attempt to make the determination of whether the instrument is out of calibration or if there has been a component failure. Once the type of failure has been determined, proceed on to identify the functional area most likely at fault.
4. Visually inspect the suspect assembly for obvious defects. Most commonly these will be broken or loose components, improperly seated components, overheated or burned components, chafed insulation, etc. Repair or replace all obvious defects. In the case of overheated components, determine the cause of overheating and correct the cause before re-applying power.
5. Use successive electrical checks to locate the source of the problem. At times it may be necessary to change a calibration adjustment to determine if a circuit is operational, but since this can destroy instrument calibration, care should be exercised. Before changing an adjustment, note its position so that it can be returned to its original setting.
6. Determine the extent of the repair. If the necessary repair is complex, it may be advisable to contact your local Tektronix field office or representative before continuing. If the repair is minor, see the parts list for replacement information.

Power-On Diagnostics

When you power on the ASG 140, it performs a numbered series of tests of its memories and their interconnections, and then tests the backup battery.

The display window shows the number of each test as the ASG 140 performs it, in the format shown below:

DSP 1/4. . . 2/4. . . 3/4. . . 4/4

The sequence of messages above indicates the ASG 140 is performing the self tests. The 2/4 and 3/4 tests normally occur too quickly to be seen in the display. The tests performed are described in Table 4-3.

Table 4-3
Self Diagnostic Tests

Test Number	Description
DSP 1/4	Read-only memory
DSP 2/4	Data Bus
DSP 3/4	Address Bus
DSP 4/4	Non-volatile memory

When it completes the numbered tests, the ASG 140 tests its backup battery. A status message is displayed if the battery is discharged.

If the ASG 140 fails one of the numbered self tests, it keeps trying to perform that test and displaying its number. When the ASG 140 indicates a failed test, you cannot make it perform its other functions. Contact your Tektronix representative for service information.

After repeated iterations, the unit may pass a test it failed initially and proceed to the next test in the sequence. However, you should still stop using the unit and have it serviced.

CORRECTIVE MAINTENANCE

NOTE

Repair should not be attempted by the customer during the warranty period.

Obtaining Replacement Parts

Replacement parts are available through the local Tektronix, Inc. field office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components, as they become available, and to improve circuit performance. Therefore, it is important to include the following information when ordering parts:

1. Part Number
2. Instrument Type or Number
3. Serial Number
4. Modification or Option Number (if applicable)

If a part has been replaced with a new or improved part, the new part will be shipped (if it is a direct replacement). If the part is not directly replaceable, the local Tektronix field office or representative will contact the customer concerning any changes. After any repair, circuit readjustment may be required.

WARNING

The power supply for the ASG 140 is internally fused. Refer all internal servicing to a qualified service person.

Use only the specified fuse or equivalent if replacing the fuse. Physically, the fuse is a DIN metric size fuse; but, electrically, it is UL and CSA rated for correct protection of the fused circuitry.

Specified Replacement Fuse

Tektronix Part Number 159-0296-00

Replacement Fuse Description

Fuse, Cartridge: MT4, 2A 5.2 X 20 mm, Normal blow.

Electrical Characteristics

Rating: 250 V maximum, 2A.

Blow Time at 25°C Ambient

110% of rated current	4 hours minimum
135% of rated current	60 minutes maximum
200% of rated current	5 seconds

Interrupting Capacity (short circuit current)

10,000 A at 125 V; 100 A at 250 V.

Removal and Replacement Procedures

Tools required:

1/2 inch open-end wrench
3/32 inch flat-bit screwdriver
3/16 inch nutdriver
1/16 inch hexagonal wrench
1P Pozidriv® screwdriver

Cabinet Removal and Replacement

1. Disconnect the power cord from the rear of the instrument.
2. Remove the six Pozidriv® screws holding the top cover to the chassis. Do not remove the two screws that hold the small access plate on the left side. Lift the top cover off the instrument.

Front Panel Removal and Replacement

1. Disconnect J20 (headphone connector) from the main board, and disconnect J2 (microphone cable) from the front panel board.
2. Use a small, flat-bit screwdriver to pry gently on both ends of connector J8 (the large ribbon cable to the front panel) to disengage the connector from the main board mating pins.
3. Turn the instrument over and remove the two Pozidriv® screws that hold the front panel assembly to the chassis.
4. If you wish to further disassemble the front panel board assembly, remove the four Pozidriv® screws holding the circuit board to the front panel ring. The circuit board may then be separated from the ring.
5. Remove the 1/2 inch retaining nut and washer on the headphone jack and the volume control knob to separate the front panel from the front panel circuit board. A 1/16 inch hexagonal wrench is needed to loosen the retaining screw in the volume control knob.

To reinstall the front panel assembly use the following procedure.

1. Reassemble the front panel to the front panel circuit board. Reinstall the retainer nut on the headphone connector and the volume control knob.
2. Insert the assembled front panel and front panel circuit board into the front panel ring and reinstall the four holding screws. Make sure that the headphone connector ground lug is connected to the front panel ring by the holding screw near that connector.
3. Position the front panel assembly on the front of the chassis and reinstall the two holding screws on the bottom side of the chassis. Start both screws then tighten firmly. Do not over tighten.

Buffer Board Removal and Replacement

1. Disconnect connector J33 from the main board,
2. Use a 3/32 inch flat-bit screwdriver to release the four XLR connectors from their housings on the rear panel. Insert the screwdriver into the small slot in the center of the XRL connectors and turn counterclockwise (less than 1/4 turn required) to release the latch.
3. Remove the two Pozidriv® screws holding the buffer board to the stand offs.
4. Slide the buffer board toward the front of the ASG 140 to remove the connectors from their housing on the rear panel and remove the buffer board.

To reinstall the buffer board use the following procedure.

1. Slide the buffer board XLR connectors straight into the connector housing on the rear panel.
2. Reconnect J33 from the buffer board to the main board making sure it is fully engaged.
3. Align the screw holes in the buffer board with the mounting studs, and start the two retaining screws. Do not tighten.
4. Use the 3/32 inch small bit screwdriver to re-engage the XLR connector release by inserting the bit into the small slot in the center of the connectors and turning clockwise until the latch is engaged (less than 1/4 turn).
5. Tighten the two retaining screws; do not over tighten.

Main Board Removal and Replacement

1. Remove the front panel assembly (see the Front Panel Removal and Replacement procedure).
2. Remove the buffer board (see the Buffer Board remove and replace procedure).
3. Disconnect connectors J23 (to the power supply) and J25 (to the rear panel) from the main board.
4. Remove the eight Pozidriv® screws holding the main board to the chassis.
5. Remove the main board from the chassis.

To reinstall the main board use the following procedure.

1. Align the screw holes in the main board with the mounting studs, and start all eight retaining screws. After all the screws are started, tighten all eight screws. Do not over tighten.
2. Reconnect J23 and J25 to the main board.
3. Reinstall the buffer board assembly.
4. Reinstall the front panel assembly.

Power Supply Removal and Replacement

1. Disconnect connector J23 from the main board.
2. Remove the three Pozidriv® screws holding the power supply to the chassis.
3. Slide the plastic shield forward and off the power supply.
4. Disconnect connector J1 (ON/OFF switch) from the power supply board and remove the power supply from the instrument.

To reinstall the power supply use the following procedure.

1. Position the power supply board over the mounting studs and reconnect J1 to the board.
2. Slide the plastic shield back in place, aligning the holes in the bottom of the shield to the mounting stud holes.
3. Reinstall the three retaining screws in the power supply board. Start all three, then tighten firmly. Do not over tighten.

Serial Connector EMI Board Removal and Replacement

1. Disconnect connector J25 (1/2 inch wide ribbon cable) from the main board.
2. Use a 3/16 inch nutdriver to remove the connector retaining screws.
3. Remove the serial connector, EMI board, and attached ribbon cable from the instrument.

To reinstall the serial connector EMI board assembly use the following procedure.

1. Place the serial connector through the hole in the rear panel and reinstall the two connector retaining screws. Tighten the two screws firmly, but do not over tighten.
2. Reconnect J25 to the main board.

Section 5
VERIFICATION AND ADJUSTMENT

This section is divided into two sets of procedures. Use the first set to verify the operation of the ASG 140. Use the second and shorter procedure that follows to return the ASG 140 to specification, if it needs adjustment. Use the test equipment shown in Table 5-1 or an equivalent to do verification and adjustment procedures. If the example test equipment is not available, check the minimum specifications to determine if you can use another piece of test equipment. If you use other test equipment, the controls and connectors for that equipment may be different from those called out for the example test equipment. Refer to the appropriate operator's manuals for operation of the test equipment.

Table 5-1
Test Equipment Required for Verification and Adjustment

Equipment	Minimum Specification	Purpose	Example
Distortion Analyzer	Balanced input, THD + N residual typically 0.002%, 22 Hz to 22 kHz audio bandpass.	Check/Adjust signal.	Tektronix AA5001A[a] or AA501A.[a]
Digital Multimeter with test leads	Accuracy 0.5%, 4-1/2 digit display.	Check power supply.	Tektronix DM504A.[a]
Frequency Counter	Accuracy 0.01%, 8-digit display.	Check frequency accuracy.	Tektronix DC 503A[a] or equivalent.
RMS Meter	Accuracy 1%, resolution 5 digits; balanced input.	Check amplitude accuracy and flatness.	Fluke 8506A or 8505A-09.
Test Oscilloscope	Dual Channel: 60 MHz bandwidth.	Check channel phase difference.	Tektronix 2465B or 2246A.
Stereo Headphones	10 Hz to 20 kHz response standard stereo phono plug connector.	Check headphone output and auto test sequences.	
Serial Communications Terminal with RS-232C interconnection cable	RS-232C serial ASCII communications.	Check RS-232C serial port and remote operation.	IBM or compatible with terminal software program.
Audio Signal Cable (2 required)	XLR-female-to-triple-banana-connector adapter cable.	Signal connections for frequency checks.	EZ-Hook® 5023F-24.
Adapter	BNC-male-to-dual-binding-post-banana-connector adapter.	Signal interconnection for channel phase check.	Tektronix Part Number 103-0035-00.

[a] A Tektronix TM500 power supply is required to power the plug-in test equipment.

VERIFICATION PROCEDURE

These verification procedures are designed to be done with the cover of the ASG 140 installed, using the normal operating controls only. If a verification check fails, it may mean that the instrument needs repair and/or adjustment. Refer any repairs or adjustments to a qualified service person.

Preparation

Remove the small access plate on the left side of the ASG 140 to set the internal DIP switch for performing the verification procedure.

Set the switch sections of S1 as follows to enable the editing and save features of the ASG 140 so they can be checked. Note the switch positions prior to setting them if it is necessary to restore the setup.

PROG0 (section 1)	up
PROG1 through PROG3 (sections 2, 3, 4)	up
PROG4 (section 5)	up
PROG5 (section 6)	down
PROG6 (section 7)	up
PROG7 (section 8)	up
MODA and MODB (sections 9, 10)	up

Procedures

1. Power Up Check

a. Connect the power cord to the ASG 140 and turn on the ASG 140.

b. Check that the ASG 140 initializes normally and finishes with the AUTO LED lit.

c. Set PROG0 (section 1) of the internal DIP switch to the down position. This enables the user's front panel settings to be restored on power up. With PROG0 in the up position, factory defaults for front panel settings are stored in the NVRAM at each power up.

2. Check Frequency Accuracy (±0.1%)

a. Connect the AUDIO OUT LEFT 1 signal to the frequency counter BNC input via the XLR-female-to-triple-banana connector adapter and the BNC-male-to-dual-binding-post-banana-connector adapter. Connect pin 1 of the XLR connector (green) to ground of the BNC dual-binding-post adapter. Connect pin 2 of the XLR connector (black) to the red post of the BNC dual binding post adapter. Do not connect pin 3 of the XLR connector.

NOTE

The color of the conductors for the pins in the XLR connector apply to the example cable. If a substitute XLR to triple banana connector adapter is used, the correct pin-to-conductor color must be verified.

b. Select the LINE UP signal from the ASG 140 and check the current frequency setting (factory default is 400 Hz).

c. Press the SIGNAL ON button and check that the frequency counter is triggered correctly.

d. Check the output frequency is as noted in part b within ±0.1%. Example: 400 Hz ± 0.4 Hz (399.60 to 400.40 Hz).

e Take the ASG 140 off line and disconnect the test signal from the frequency counter.

3. CHECK AMPLITUDE ACCURACY (±0.2 dB AT 1000 Hz)

a. Connect the AUDIO OUT LEFT 1 signal to the balanced input connectors of the rms voltmeter via the XLR-female-to-triple-banana-connector adapter cable. Pin 1 of the XLR adapter cable (green) is ground, pin 2 (black) is + and pin 3 (red) is –.

b. Set the rms meter appropriately to measure 0 dBu (0.7746 V rms) unterminated. (If a 600 Ω termination is used, the amplitude will be 0.17 dB lower, 0.7594 V rms.)

c. Set the ASG 140 for a MANUAL L Tone output of 1 kHz at 0 dBu and press the SIGNAL ON button (LED indicator in the button should light).

d. Check that the amplitude is 0 dBu ±0.2 dBu (0.75697 to 0.79264 V rms).

e. Set the ASG 140 to the other dBu values given in Table 5-2 and check that the rms meter reads within the amplitude tolerance shown. Use either Auto Range or an appropriate voltage range setting of the rms meter to make the measurement.

f. Move the XLR connector to AUDIO OUT LEFT 2 and repeat parts b through e for that output.

g. Move the XLR connector to AUDIO OUT RIGHT 1, set the ASG 140 for a MANUAL R Tone output of 1 kHz at +0 dBu and repeat parts d and e, then move the XLR connector to AUTO OUT RIGHT 2 and again repeat parts d and e.

Table 5-2
Amplitude Accuracy Check Points

dBu	Volts RMS	Tolerance (±0.2 dB)
–40 dBu	0.00775 V	0.00757 to 0.00793 V
–30 dBu	0.02450 V	0.02394 to 0.02507 V
–20 dBu	0.07746 V	0.07570 to 0.07926 V
–10 dBu	0.24495 V	0.23937 to 0.25066 V
0 dBu	0.7746 V	0.75697 to 0.79264 V
+10 dBu	2.4495 V	2.39374 to 2.50656 V
+20 dBu	7.7460 V	7.5696 to 7.92643 V

4. CHECK AMPLITUDE FLATNESS (+0.05/–0.2 DB, 10 HZ TO 20 KHZ)

a. Move the XLR connector to AUDIO OUT LEFT 1, set the ASG 140 for a MANUAL L Tone output of 1 kHz at +14 dBu.

b. Note the amplitude of the AUDIO OUT LEFT 2 test signal as indicated by the rms meter (+14 dBu is 3.8822 V).

c. Set the ASG 140 MANUAL L Tone frequency to the values given in Table 5-3 and note the output amplitude as indicated on the rms meter for each frequency.

Table 5-3
Test Frequencies for Amplitude Flatness

ASG 140 Frequency	Left Tone Amplitude		Right Tone Amplitude	
	Out 1	Out 2	Out 1	Out 2
20 Hz				
100 Hz				
400 Hz				
1000 Hz (reference)				
5000 Hz				
10000 Hz				
15000 Hz				
20000 Hz				

d. Check that the amplitude is flat within +0.05/–0.2 dB at each test frequency with respect to the 1000 Hz 14 dBu amplitude noted in part a. The amplitude accuracy specification permits the 14 dBu amplitude at 1000 Hz to be 3.7938 to 3.9726 V, and the flatness has to be calculated using the measured voltage to check the actual flatness over frequency. (More or other frequencies may be checked as considered necessary. The empty columns of Table 5–3 are provided to enter the amplitude for each frequency if you wish.)

The voltage-to-dB conversion is done using the following formula:

$$dB = 20 \log \frac{Measured\ voltage}{Reference\ voltage}$$

The reference voltage value is that noted for the 1 kHz +14 dBu MANUAL tone signal. The Measured voltage is the signal amplitude at each of the other frequencies checked.

For example:

Assume the reference voltage (1 kHz, +14 dBu) is 3.87 V and that the measured voltage for a different frequency signal is found to be 3.854 V. Substituting these values into the equation gives:

$$dB = 20 \log \frac{3.854}{3.87} = -0.036\ dB$$

e. Move the XLR connector to the AUDIO OUT LEFT 2 connector and repeat the amplitude flatness checks for that output.

f. Move the XLR connector to the AUDIO OUT RIGHT 1 connector. Set the ASG 140 for a MANUAL R Tone of 1 kHz at +14 dBu and repeat the amplitude flatness checks for that output.

g. Move the XLR connector to the AUDIO OUT RIGHT 2 connector and repeat the amplitude flatness checks for that output.

h. Press the SIGNAL ON button to take the ASG 140 off line.

5. Check Channel-to-Channel Level Difference (≤0.2 dB at +14 dBu)

a. With the XLR connector on the AUDIO OUT RIGHT 2 output signal, set the ASG 140 for a MANUAL Tone output signal of 1 kHz at +14 dBu. Using the Tone test signal places the same signal on the left and right channel output amplifiers.

b. Press the SIGNAL ON button to turn on the test signal. Note the output amplitude of the right Tone 2 signal on the rms meter.

c. Move the XLR connector from the AUDIO OUT RIGHT 2 connector to the AUDIO OUT RIGHT 1 connector.

d. Check that the amplitude of the right tone 1 is the same as that of the right Tone 2 amplitude noted in part c within ±0.2 dB. The calculation for dB is as given in step 4.

e. Move the XLR connector from the AUDIO OUT RIGHT 1 connector to the AUDIO OUT LEFT 1 connector.

f. Check that the amplitude of the left tone 1 is the same as that of the right Tone 2 amplitude noted in part b within ±0.2 dB.

g. Move the XLR connector from the AUDIO OUT LEFT 1 connector to the AUDIO OUT LEFT 2 connector.

h. Check that the amplitude of left Tone 2 is the same as that of the right Tone 2 amplitude noted in part b within ±0.2 dB.

i. Set the ASG 140 for a MANUAL L Tone output signal. Using the L Tone test signal verifies the left channel signal-generating circuitry.

j. Check that the amplitude of the left Tone 2 signal is the same as that of the right Tone 2 amplitude noted in part b within ±0.2 dB. The calculation for dB is as given in step 4.

k. Check that the amplitude of the left Tone 2 signal is the same as that of the right Tone 1 amplitude noted in part c within ±0.2 dB. The calculation for dB is as given in step 4.

l. Take the ASG 140 off line and disconnect the test signal connector from the rms meter.

6. Check Total Harmonic Distortion + Noise (< 0.015%, 20 Hz to 19 kHz; < 0.056%, >19 kHz to 20 kHz)

a. Connect the AUDIO OUT LEFT 1 signal to the balanced input connectors of the audio distortion analyzer (AA5001A or AA501A) via an XLR female-to-triple-banana connector adapter cable. Pin 1 of the XLR adapter cable (green) is ground, pin 2 (black) is + and pin 3 (red) is –.

b. SET Distortion Analyzer

Input Range	AUTO RANGE
Function	THD + N
Response	RMS
Filters	AUDIO BANDPASS (or 30 kHz LOW PASS)
Attenuation	None

c. SET ASG 140

MANUAL	L Tone
AMPLITUDE	+14.0 dBu
FREQUENCY	Table 5-4
SIGNAL ON	SIGNAL ON (LED lit and OUTPUT ≥775 mV(rms) LED flashes)

d. Check for a THD + N of less than 0.015% for each of the frequencies listed in Table 5–4. At 7000 Hz and above, change the distortion analyzer filter selection to 80 kHz LOW PASS (Deselect AUDIO BAND PASS) to check for distortion harmonics of the higher signal frequencies. NOTE: The noise floor of the measurement increases with the wider bandwidth filter selection. The empty columns of Table 5–4 are provided to enter the reading if you wish.

Table 5-4
Test Frequencies for THD + Noise

Distortion Analyzer Filter	ASG 140 Frequency	Left Channel THD + N Reading		Right Channel THD + N Reading	
		Out 1	Out 2	Out 1	Out 2
Audio Band Pass	20 Hz				
	100 Hz				
	400 Hz				
	1000 Hz				
	5000 Hz				
80 kHz Low Pass	10000 Hz				
	15000 Hz				
	18000 Hz				
	19000 Hz				

e. Set the ASG 140 for a frequency of 20000 Hz and check for a THD + N of less than 0.056%.

f. Move the XLR connector to the AUDIO OUT LEFT 2 connector and repeat parts d and e. Switch the Distortion Analyzer filter setting as indicated in column 1 of Table 5-4.

g. Move the XLR connector to the AUDIO OUT RIGHT 1 connector. Set the ASG 140 for a MANUAL R Tone signal and repeat the measurements of parts d and e, again observing the Distortion Analyzer filter setting indicated in column 1 of Table 5-4.

h. Move the XLR connector to the AUDIO OUT RIGHT 2 connector and repeat the measurements of parts d and e.

i. Take the ASG 140 off line.

7. Check Signal-to-Noise Ratio (>80 dB at 0 dBu at 1 kHz)

a. Move the XLR connector to the AUDIO OUT LEFT 1 connector.

b. Set the ASG 140 for a MANUAL tone output of 1000 Hz at 0 dBu.

c. Set the distortion analyzer for dB RATIO, LEVEL, and select the AUDIO BAND PASS filter. Press the SIGNAL ON button to put the ASG 140 on line.

d. Press SET REF on the distortion analyzer. The reading should now be 0.0

e. Select SILENCE from the ASG 140.

f. Check that the noise floor is more than 80 dB down from the signal level.

g. Take the ASG 140 off line and disconnect the signal from the distortion analyzer.

8. Check Channel-to-Channel Phase Difference (≤1°, 10 Hz to 20 kHz)

a. Connect the AUDIO OUT LEFT 1 signal to the CH1 input of the test oscilloscope via an XLR-female-to-banana adapter cable and BNC-male-to-dual-binding-post-banana-connector adapter. Connect pin 1 of the XLR adapter cable (green) to ground, and connect pin 2 (black) to the + input binding post.

b. Connect the AUDIO OUT RIGHT 1 signal to the CH2 input of the test oscilloscope via an XLR-female-to-banana adapter cable and BNC-male-to-dual-binding-post-banana-connector adapter. Connect pin 1 of the XLR adapter cable (green) to ground, and connect pin 2 (black) to the + input binding post.

c. SET the test oscilloscope

Input Coupling	GND
CH 1 and CH 2 VOLTS/DIV	1 V
Trigger SOURCE	CH 2
Trigger MODE	AUTO
Vertical MODE	CH 1 and CH 2
Horizontal MODE	A
SEC/DIV	5 µs

d. SET ASG 140

MANUAL	Tone
AMPLITUDE	+14.0 dBu
FREQUENCY	20000 Hz
SIGNAL ON	SIGNAL ON (LED lit and OUTPUT ≥775 mV(rms) LED flashes)

e. Adjust the Horizontal POSITION to place the beginning of the sweep on the leftmost vertical graticule line.

f. Adjust the Vertical POSITION of both channels to align the baseline traces with the center horizontal graticule line.

g. Set the Input Coupling to DC (both channels).

h. Set the Trigger MODE to NORM and adjust the Trigger LEVEL so that the zero crossing point of the signal is at the beginning of the trace on the center horizontal graticule line.

i. Press the X10 MAG control of the oscilloscope.

j. Check that the difference between the two channel traces is less than 0.28 horizontal division. $(0.28\ div\ X \frac{36\ deg\ per\ div}{10} = 1.00\ degree)$

k. Set the ASG 140 frequency to 10 Hz and set the oscilloscope to 10 ms (with X10 MAG on). Make sure the trigger point and trace still start at the beginning of the trace on the center horizontal graticule line.

l. Check that the difference between the two channel traces is less than 0.28 horizontal division.

m. Disconnect the test oscilloscope setup.

9. Check SAVE Operation

NOTE

If the SAVE feature is enabled, the word "SAVED" appears when the SAVE button is pressed. If SAVE is disabled internally, the word "Disabled" appears when the SAVE button is pressed. The SAVE feature must be enabled to perform this check.

a. Select the MANUAL L Tone signal. Set the frequency for 2 kHz and the amplitude for −12 dBu.

b. Press SAVE (the word Saved should appear), then turn off the ASG 140 (off switch on the rear panel).

c. Turn the ASG 140 on again. When the initialization has completed, press MANUAL.

d. Check that the L Tone signal is selected, the frequency is 2000 Hz, and the amplitude is −12 dBu.

10. Check RECORD and Headphones Operation

a. Connect a set of stereo headphones to the front panel HEADPHONES connector and turn the Volume control to minimum.

b. Press and release the SILENCE and VOICE buttons at the same time.

c. Check that the recording sequence begins and record a voice test signal for the 4-second recording session. Speak normally about two or three feet from the front of the ASG 140 to record a test message during the recording period.

d. Press VOICE, then SIGNAL ON. Slowly increase the Volume control to a comfortable listening level.

e. Check that the recorded test message is continually repeated while the ASG 140 SIGNAL ON LED is lit.

f. Press SIGNAL ON again to turn off the voice test signal.

11. Check Audio/Video Timing Control

a. Set the ASG 140 for a Manual test tone of 400 Hz.

b. Listen to the signal in the headphones and ground pin 1 of the rear panel remote connector.

c. Check that the output signal turns off when pin 1 is grounded.

d. Unground pin 1 of the remote connector and checked that the signal turns on again.

12. Check AUTO test O.33 and Tek sequences and AUTO TEST LVL Operation

a. Set the ASG 140 for the O.33:01 Auto Test.

NOTE

If the editing is disabled, you will not be able to make edits to the frequency or test levels, and the word "Disabled" appears when the SAVE button is pressed. The SAVE feature must be enabled to perform this check.

b. Press Identification and edit the displayed text to a new ID.

c. Press AUTO again to return to the O.33:01 display and press and hold the AMPLITUDE button. The message TESTLev should be displayed. Release the button.

d. Check that the TESTLev maximum value is +14.0 dBu and its minimum value is –6.0 dBu. Edit the TESTLev to +1 dBu.

e. Press the AUTO button to return to the top of the menu, then press the SAVE button (Saved message should appear).

f. Reset the ASG 140 by pressing the left and right arrow buttons at the same time.

g. Check that the ASG 140 initializes with the O.33:01 test displayed in the readout window, that the TESTLev is +1 dBu, and that the Identification is as set in part b.

h. Press the SIGNAL ON button and listen in the headphones for the test sequence to occur and that at the end of the test sequence, the ASG 140 goes off line.

13. Check AUTO Test Sweep and SweepLev Operation

a. Set the ASG 140 for the Sweep Auto Test.

b. Press and hold the AMPLITUDE button. The message SweepLev should be displayed. Release the button.

c. Check that the SweepLev maximum value is +24.0 dBu and its minimum value is –90.0 dBu. Edit the SweepLev to +1 dBu.

d. Press the AUTO button to return to the top of the menu, then press the SAVE button (Saved message should appear).

e. Reset the ASG 140 by pressing the left and right arrow buttons at the same time.

f. Check that the ASG 140 initializes with the Sweep test displayed in the readout window, and that the SweepLev is +1 dBu.

g. Press the SIGNAL ON button. Listen in the headphones for the Sweep test sequence to occur, and check that the ASG 140 signal turns off at the end of the test sequence.

14. Check Remote Operation

a. Connect the ASG 140 to an ASCII terminal or PC running terminal communications software. See Appendix A for serial communications setup and remote operation, if necessary.

b. Turn the power off and back on again to check the power up messages.

c. Type `?` to obtain the ASG 140 Remote Command Menu.

d. Type `tone 1:-4 f:2000 (cr)`.

e. Check that the ASG 140 SIGNAL ON LED lights with the word Tone displayed.

f. Type `offline (cr)`.

g. Check that the ASG 140 SIGNAL ON LED turns off.

h. Type `tone? (cr)`.

i. Check that the return tone frequency is 2000 Hz and that the tone level is –4.0 dBu.

j. Turn off the ASG 140 and disconnect the serial communications cable.

k. Restore any settings and dip switch positions needed to return the ASG 140 to its needed state for operation and replace the access plate over the dip switch.

ADJUSTMENT PROCEDURE

Preparation

a. Disconnect the power cord from the ASG 140 and remove the top cover of the instrument.

b. Set the switch sections of S1 as follows:

PROG0 (section 1)	up (stores factory defaults on power up)
PROG1 through PROG3 (sections 2, 3, 4)	up (enables editing and saving)
PROG4 (section 5)	up (factory setting)
PROG5 (section 6)	down (factory setting)
PROG6 (section 7)	up (enables remote control)
PROG7 (section 8)	up (enables front panel controls)
MODA and MODB (sections 9, 10)	up (factory settings)

c. Connect the power cord to the ASG 140 and turn on the power switch. Check that DS1, near the power supply connector, comes on.

d. Set PROG0 of S1 to the down position. This enables the user-settable defaults. With the PROG0 up, the factory defaults are restored at each power on.

WARNING

Dangerous potentials exist at several points within the power supply of this instrument. When operating the instrument with the cover off, do not touch exposed connections or components.

Procedures

1. Check Supply Voltages

Test Equipment Required

Power Supply (TM5006) Digital Multimeter (DM504A)

a. Use the digital multimeter to check the power supply voltages at J23.

Voltage	Test Point	Tolerance
+15 V	Pin 1	14.55 V to 16.5 V (–3%, +10%)
–15 V	Pin 6	–14.25 V to –15.75 V (±5%)
+5 V	Pins 2 and 3	4.90 V to 5.10 V (±2%)

b. Check the following supplemental regulated voltages at the points indicated (see Figure 5-1).

Voltage	Test Point	Tolerance
+12 V	Out Pin of U68	+12 V ± 0.6 V
+12 V	Out Pin of U69	+12 V ± 0.6 V
+5 V_A	Out Pin of U7	+5 V ± 0.25 V
–5 V_A	Out Pin of U8	–5 V ± 0.25 V
–12 V	Out Pin of U70	–12 V ± 0.6 V

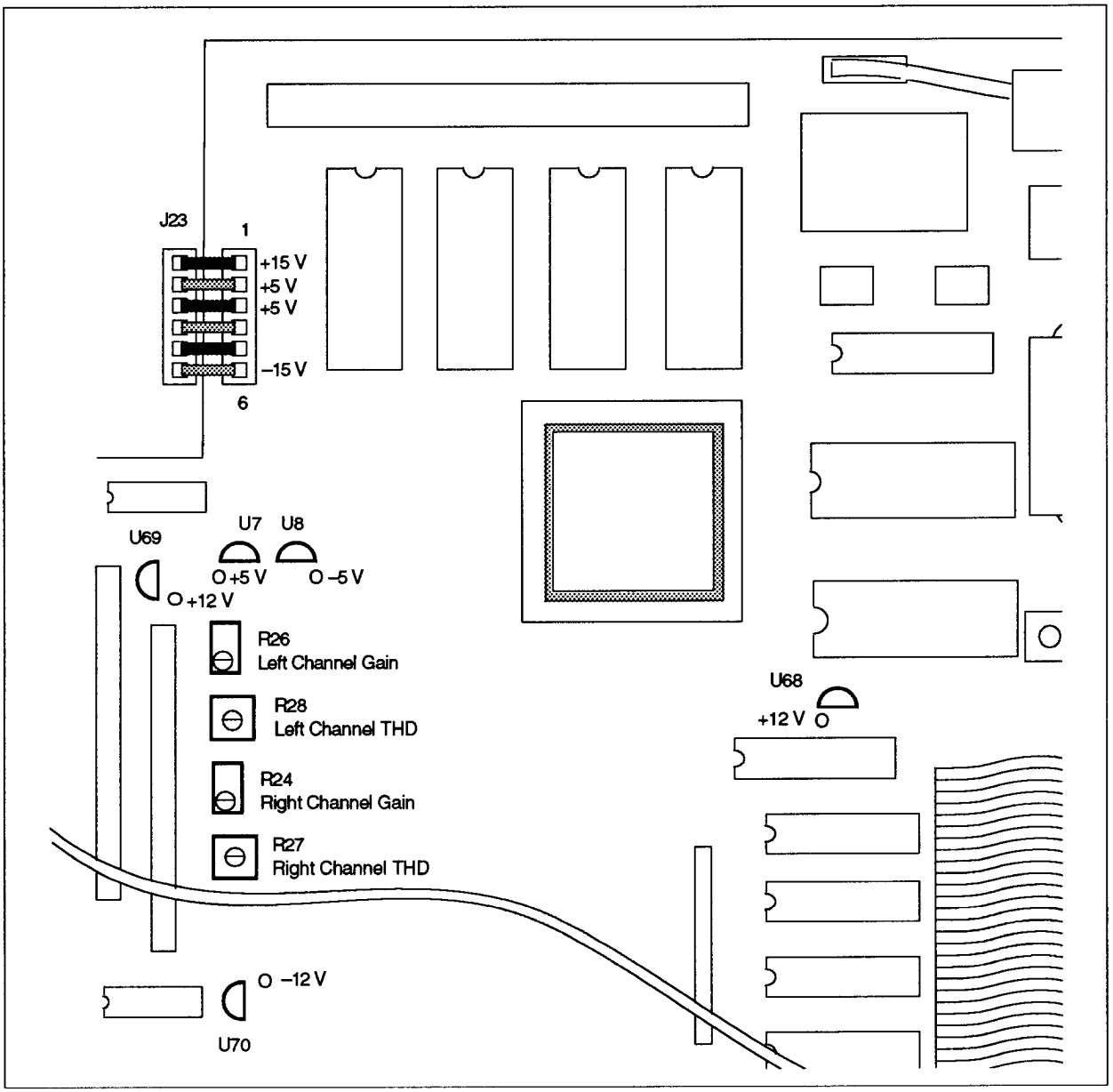


Figure 5-1. Voltage check points and adjustment locations.

2. Adjust Gain

Test Equipment Required

Distortion Analyzer (AA5001A)	RMS Meter
Power Supply (TM5006)	Audio Signal Cables (XLR-female-to-triple-banana connector)

a. Connect the ASG 140 AUDIO OUT RIGHT 1 output to the rms meter via an XLR-female-to-banana-connector adapter cable. Pin 1 is ground, pin 2 is the + output and pin 3 is the – output of the ASG 140.

b. Set the rms meter to measure rms voltage (unterminated). Use either Auto Range or an appropriate range setting to measure the expected rms voltage.

c. SET ASG 140:

MANUAL	R Tone
AMPLITUDE	+14.0 dBu
FREQUENCY	1000 Hz
SIGNAL ON	SIGNAL ON (LED lit and OUTPUT ≥775 mV(rms) LED flashes)

d. Adjust the Right Channel Gain potentiometer, R24, for an amplitude of 3.89 volts.

e. Press SIGNAL ON to turn off the test signal (SIGNAL ON LED off).

f. Disconnect the XLR connector from the right channel and move it to the AUDIO OUT LEFT 1 connector.

g. Set the ASG 140 MANUAL test signal to L Tone and press SIGNAL ON to turn on the test signal.

h. Adjust the Left Channel Gain potentiometer, R26, for an amplitude of 3.89 volts.

i. Press SIGNAL ON to turn off the test signal (SIGNAL ON LED off).

j. Disconnect the test cable from the rms meter.

3. Adjust Distortion

a. Connect the XLR-to-banana connector test cable from ASG 140 AUDIO OUT LEFT 1 output to the distortion analyzer balanced inputs. In the adapter cable, pin 1 (green) is ground, pin 2 (black) is the +output and pin 3 (red) is the –output of the ASG 140.

b. SET Distortion Analyzer:

Input Range	AUTO RANGE
Function	THD+N
Response	RMS
Filters	AUDIO BAND PASS (30 kHz LOW PASS)

c. Set the ASG 140 MANUAL test signal to L Tone at 1000 Hz, and press SIGNAL ON to turn on the test signal.

d. Adjust the Left Channel MSB potentiometer, R28, for minimum THD reading (<0.01%).

e. Press SIGNAL ON to turn off the test signal (SIGNAL ON LED off).

f. Disconnect the XLR connector from the left channel and move it to the AUDIO OUTPUT RIGHT 1 connector.

g. Set the ASG 140 MANUAL test signal to R Tone and press SIGNAL ON to turn on the test signal.

h. Adjust the Right Channel MSB potentiometer, R27, for minimum THD reading (<0.01%).

i. Press SIGNAL ON to turn off the test signal (SIGNAL ON LED off) and disconnect the test equipment from the ASG 140.

j. Restore any settings and DIP switch positions needed to return the ASG 140 to its needed state for operation and replace the top cover.

Section 6
THEORY OF OPERATION

CONTROL PROCESSOR (diagram 1)

Front Panel Processor

The front panel processor monitors the front panel buttons, lights the LED indicators as appropriate, produces the character displays in the display window, handles the serial interface processing, and commands the DSP processor to generate the requested signal or sequence.

The processor is a special purpose microprocessor with built-in RAM and bit manipulation registers. The built-in RAM can be programmed to operate the processor without the need to have further bus accesses to fetch instructions from external RAM. The bit manipulation registers are addressable, 8-bit registers, and the individual bits can be checked, compared, complemented, zeroed, etc., as needed by the task being performed.

The processor also has built in timers. One of these is used to generate the interrupts needed for the front panel scanning that checks for switch presses.

There are three main buses to and from the processor. These are the 16-bit address bus (AD0-AD7 and A8-A15), the 8-bit data bus (AD0-AD7), and the 8-bit control bus (PROG0-PROG5, /DCR and /DSR).

Notice that the lower 8 bits of the address are multiplexed with the data on the AD0-AD7 pins. The data is separated from the address information by address latch U47 when the ALE (address latch enable) bit is high. When the ALE bit is low (/PROG) the data on the bus is valid. The /PSEN control line dictates when the EPROM, U63, is enabled to output data to the data bus. It is also one of the input signals to the address decoder, U49, that are decoded to produce the various enable strobes for the digital devices on the processor buses.

Another bus to the processor is the one that handles the serial communications (/RDX, /TDX, /INT0, /RTS, /CTS, and /RI) and provides the /RD and /WR (read and write) control signals to the devices on the data bus of the processor.

Subsets of the various bus signals are used to communicate with the DSP processor and the front panel character display device.

Crystal Y2 generates the 11.059 MHz operating frequency for the front panel processor.

Reset Circuit U54 and Inverting Buffer

The Reset circuit delays processor operation until the voltage stabilizes. When the operating voltage reaches a stable level, the reset is removed from the front panel processor allowing it to access its memory for initialization commands. The output of U54 is true low, so an inverter, U40C, provides the necessary logic level to the processor's Reset input.

Address Latch (Address/Data Demultiplexer)

The eight bits of the data bus, DATA0 through DATA7, are multiplexed with the lower eight bits of the 16 address bits. Multiplexer U47 is enabled by ALE (address latch enable) when the bus has valid address data, and those eight bits are latched. The latched bits plus the remaining eight bits from the unmultiplexed address bus combine to produce the 16-bit addresses on the address bus, ADDR0 through ADDR15.

RAM

RAM U64 is a static RAM device with a 15-bit address bus and an 8-bit data bus. The RAM device is connected to a backup battery to hold the stored data in memory during power off. The backup battery makes this RAM a non-volatile device, and it is used to store the user-selectable operating states for the ASG 140. When user-selectable defaults are enabled, the state of the instrument on power up is restored from the saved data in this device.

EPROM

EPROM U63 stores the program memory. The processor gets it operating instructions from this memory device. The EPROM has a 16-bit address bus and an 8-bit data bus. When factory defaults are selected, the state of the instrument on power up is restored from data stored in this device.

Battery Backup

Level Monitor U62 checks the +5 V line. If the voltage on this line is more that 0.3 V above battery voltage (BATT), the power for operating the static RAM is supplied from the +5 V line. If the +5 V line voltage drops low enough, U62 disables the chip select to the RAM and supplies the holding power for memory from the battery.

When data is to be accessed by the processor, the NVRCE chip select is generated via address decoder U49. Until power comes up to the correct operating level the chip select is disabled through U62.

Address Decoder

The PAL address decoder, U49, decodes ADDR8 through ADDR15 plus /RESETA, /PSEN, /RD, and /WR to generate the control signals that address the individual devices on the processor's bus.

Decoded Signals:

/SW0EN and /SW1EN enable switch buffers U51 and U52 when the processor scans the front panel for switch activity.

/HPCHEN and /HPFLEN are used to control the LED alphanumeric display device (U1 on the front panel).

LEDCLK controls clocking the data about which LED is to be lit into the LED buffer (U50).

/DSPEN, /DSPRST, and /DSPWR are used to control communication between the front panel processor and the digital signal processor (U1 on the main board).

/ROMCE selects the EPROM, U63, for access by the processor.

/NVRCE selects the RAM, U64, for access by the processor.

Front Panel Interface

LED driver U50 is an octal D flip-flop register. The processor loads U50 with the LED(s) that are to be lit. There is no physical connection between the front panel button switches and the LED associated with the button. The switches are scanned for presses, and the processor determines the LED that must be turned on and off via its software instructions. Data on the input is transferred to the output on the rising edge of the LEDCLK. A reset signal (RESETA) clears the register at power on and when the front-panel reset button is pressed.

Switch buffers U51 and U52 are read at regular intervals to determine if a front panel button has been pressed. The two 8-bit buffers share the data bus and are read at different times by the processor. Each buffer has its own enable — SW0EN for U52 and SW1EN for U51. Eight switches on U52 and six on U51 provide the 14 front panel buttons. The remaining two positions on U51 are PROG6 and PROG7, which come from DIP switch S1.

The main board signals are connected to the front panel via a 50-pin connector (J8 on the main board to J1 on the front panel board).

DIP Switch

DIP switch S1 sets some instrument operating states. This switch may be accessed by removing an instrument side panel. After setting normal operating frequencies and levels, S1 may be set to disable editing and maintain a known operational state. Editing may also be enabled via the remote connector using contact closures to connect pins 6 and 9. While these pins are connected, the normally editable signals may be changed as needed. When the contact is opened to disconnect pins 6 and 9, editing is again controlled by internal switch settings. See Section 2, *Operation and Setup,* for more information on DIP switch settings.

RS-232C Port Remote Connector

Serial interface U67 is a level translator between the serial port and the rear panel remote connector. There are two types of remote control operation possible with the ASG 140: contact-closure activation and full-serial (RS-232C) interface.

When contact closure remote operation is used, just two serial lines are used for remote control: pins 4 and 6. Connecting pin 4 to pin 9 (ground) starts an AUTO test sequence; connecting pin 6 to pin 9 overrides the internal editing disable if it was set. Overriding the internal editing disable lets you change frequencies, levels, or ID numbers without having to access the internal DIP switch. This remote override is not necessary when editing is enabled, but in normal operation, the ability to edit parameters will usually be disabled after initial setup.

When RS-232C serial control is used, the serial interface accepts the remote signal and passes it to the front panel processor for translation into ASG 140 commands. Commands sent with the correct syntax are used for controlling the full range of instrument operation. The front panel processor also outputs a command list to assist the remote user in controlling the ASG 140.

Serial Filter board A8 provides individual EMI filters on each of the remote control lines. These filters keep the ASG 140 from radiating digital noise and also keep external noise from entering via the remote connector.

DIGITAL SIGNAL PROCESSOR (diagram 2)

Digital Signal Processor (DSP)

Address and Data Buses. The address and data buses of U1 are not multiplexed. The DSP has a 16-bit address bus (A0 - A15) and a 24-bit data bus (D0 - D23). Three 8-bit EPROM devices are stacked to provide the 24-bit firmware to the DSP. A set of three pull-up resistor packs (R1, R2, R3) are connected to the data bus to pull the data lines high when the lines are not being driven.

Host Port PB0 - PB14. The data handled by this port on PB0 - PB7 is 8 bits wide and 8 bytes deep. It allows communication between the DSP and the control processor without the need to do bus request/bus grant data handling. This port is mainly used to handshake control signals between the front panel processor and the DSP. Addressing of the 8 bytes of DSP to write is done by ADDR (0 - 2) from the control processor. The DSP uses the interrupt INT0 to generate an interrupt to the control processor.

Serial Ports PC0 - PC8. There are two serial ports. Pins PC0 (RXD), PC1 (TXD), and PC2 (SCLK) are unused, but are available on J310 for testing and future expansion. Serial communications via the remote connector is handled by the front panel processor. The remaining pins (PC3 - PC8) are a synchronous serial port. Output bits from this port are used to drive the data formatter/synchronizer that shifts digital data to align it properly for the digital-to-analog converters.

Bits SC0, SC1, and SC2 are called flag bits and are used by the address decoder (U12) to determine which device on the serial bus is being addressed. One of the bits, SCK, is the serial bit clock. This bit clocks the serial data in the data formatter/synchronizer and the CODEC, U9. The serial digital data from the CODEC (SRD) is applied to the DSP via pin 42 (PC7). The serial output data line from the DSP is STD (PC8). This data stream is applied to the data formatter/synchronizer to be formatted for application to the digital-to-analog converters.

Oscillator. A crystal oscillator device, Y3, produces an 18.432 MHz clock signal that is applied to the EXTAL (external clock input) pin of U1.

Address Decoder

Address decoder U12 is a programmable array logic device. It has inputs from the DSP and the control register latch. The various chip selects to the devices on the DSP bus are decoded by depending on the state of all the input signals. These control signals are:

1. CODEC: Enables the CODEC device, U9, when an audio signal is being recorded for the audio ID.
2. /CTRL: Clocks the control registers, U10 and U11, to latch new control data for the CH 1 and CH 2 gain, attenuation, and relay states.
3. /PCMLE: Enables the data latches for the left and right digital-to-analog converters, U15 and U14.
4. /CEEXTO, /CEEXT1, and /CEEXT2: Unused signals to J310.
5. /CEROM: Chip enable to the EPROM devices, U2, U3, and U4.
6. /CERAM: Chip enable to the RAM. This signal is applied to the battery backup level monitor, U5. The level monitor acts to prevent the RAM from being enabled and switches to the backup battery when power to the ASG 140 is switched off.

Control Register Latches

Control signals that select the gain, attenuation, and relay states for the CH 1 and CH 2 signal paths (diagram 4, A2) are latched from the data bus into latches U10 and U11. When control data states must be updated, the DSP places the data on the lower 16 bits of the data bus and generates a /CTRL clock output from the PAL address decoder, U12. At power up, the /DSPRST signal from the control processor circuitry goes low to clear the latches to a known state before the DSP writes the correct control data.

EPROM

The three 64-Kbyte EPROM memory devices, U2, U3, and U4, store the DSP's operating firmware. They are addressed in parallel on the 16-bit address bus, and their 8-bit data bus outputs are stacked to yield the 24-bit word used by the DSP.

DSP RAM

The DSP RAM, U6, is a 32-Kbyte memory chip. A 15-bit address selects the RAM memory space to be written to or read from. The /DWR and /DRD (write and read) signals from the DSP select the direction; the /CEO, also from the DSP via the level monitor, U5, enables the RAM to output or input data on the lower 8 bits of the data bus.

Battery Backup

The DSP RAM, U6, has its stored memory maintained during power off by a backup battery BT1. A level monitor, U5, controls the CE (chip enable) input to the RAM. When normal power is applied to the monitor, the chip enable signal from the DSP (CERAM) and the +5 V VCCI source are applied to the DSP RAM. When the +5 V power is removed, the level monitor disables the chip select to the RAM to prevent random writing or reading and applies the backup battery to the RAM to hold the stored data in memory. The RAM is held disabled until power rises to the correct operating level.

CODEC

During a record session, the 4-second audio signal from the front panel microphone is amplified and level controlled in the Mic Preamp and AGC circuitry (diagram 6, A2). That analog signal is applied to the CODEC device, U9, where it is digitized and output in a serial data stream. The digitized audio signal is processed by the DSP, U1, for storage into the RAM, U6, a battery-backed memory device. On command from the control processor, the stored digital audio data is retrieved and applied to the digital-to-analog converter (DAC) circuitry where it is converted to an analog signal for output to the CH 1 and CH 2 output connectors.

The clock signal for the digitizing rate of the CODEC is provided by the SCK clock signal developed by the DSP. The CODEC and the DACs run at different rates, but the firmware is programmed to perform sample rate conversion of the sampled audio data.

DIGITAL-TO-ANALOG CONVERTER (diagrams 3 and 3a)

Digital Formatter/Synchronizer

The serial data from the DSP section comes into U66A, pin 2, a D flip-flop used as a data synchronizer. The incoming serial data is synchronized to the PCM clock (PCMCLK) and sent to a shift register consisting of U16, 17, 18, and 19.

The first shift register (U16) takes the 24-bit DSP serial data with trailing zeros and shifts it six places. This gives the data string leading zeros for input to the 18-bit DAC. This six-place shift moves the 24-bit input data to the 18-bit data positions used by the DACs. Data exiting U16 may be jumper configured for either 18-bit or 20-bit data format (18-bit is used).

The U16 18-bit serial data goes two places: to U14 as the input data to the right channel and to three more stages of 8-bit shift registers, U17, U18, and U19. These registers shift the data another 24 bits before it goes to the left-channel DAC. The output of the DSP is interleaved right- and left-channel data. The time needed to shift the left-channel data an extra 24 bits allows the left- and right-channel data to arrive at the same time for conversion. Since both DACs (U15, left, and U14, right) have their data registers filled at the same time, they both use the same latch enable signal (PCMLE) to latch the data.

Digital-to-Analog Converters

This section discusses the right channel DAC, U14, and it associated circuitry. The left-channel circuitry (U15, U21) is identical. DAC U14 is an 18-bit digital-to-analog converter. The output is a current signal from pin 13 that has nominal values of ±1 mA peak. That current is input to the summing node of U20 where it is converted to a voltage signal at the output of U20, pin 10.

The feedback circuit that sets the loop gain of the DAC and the current-to-voltage converter is formed by resistors R24 (an adustable potentiometer) and R23.

With input data bits equal to 10000, the MSB is 1, and the output should be 0 mA. The DAC has a most significant bit adjust potentiometer, R27, called Distortion Adjust. An audio distortion analyzer must be used to set the signal distortion to its minimum value.

Low-Pass Filters

The signal voltage from U20 is applied to FL3, and 11-pole, low-pass filter with a 23 kHz cutoff. The upper output signal frequency is 20 kHz, but a 23 kHz low-pass filter is used to move the ripple effect of the filter above 20 kHz.

The DAC sends a new output every 1/(48 kHz), which approximates a sine wave. The filter smooths the steps to a sine wave.

The signal then enters buffer amplifier U13A. The buffer has a gain of four to compensate for a 6 dB loss in the filter and to provide for the proper operating amplitude. At TP7 the signal is twice the amplitude as it is at U20 pin 10.

Filter Voltage Reference Regulators

The filters are powered by +12 and –12 volts. The power source is derived from the + and –15 volt supplies by three-terminal regulators U69 and U70.

CHANNEL 1 AND CHANNEL 2 ATTENUATOR (diagram 4)

Step Attenuators

From the output of U13, the signal is applied to a stepped attenuator, U22 (left) and U28 (right). The right channel circuitry is discussed; the left channel is identical.

The signal enters at CH2. It is AC coupled through C99 to remove any DC offset that might be present in the buffer amplifier. The time constant of the AC coupling is very long, and the capacitor does not affect the lower audio frequencies.

Attenuation Range Steps

The attenuation is done by a string of resistors to ground. Each step or tap of the attenuator is 10 dB lower than the previous step, and there are five steps, making the lowest step of the attenuator at –50 dB. Multiplexer U28 selects the various taps of the attenuator under software control. Operator selection of a dBu range causes the software to locate the appropriate attenuator tap and switch the multiplexer to that tap.

There are two additional taps on the step attenuators. On U22, the left-channel step attenuator (pin 9) has a signal line that sends the output of the right channel step attenuator to the left channel. In effect, the left channel of U22 has the same signal as the right channel, and everything works off of the right-channel DAC. When a stereo signal is required for a stereo test sequence, separate channel signals are generated. The multiplexer selects between S1 and S8 for output, depending on the address sent in the control lines. The output of the multiplexers, U22 left and U28 right, is a step-attenuated sine wave of operator-selected amplitude.

Switching Control Signals

In response to request from the front panel or through the remote control port for a new signal level, the DSP generates the needed switching signals on its data bus. These control signals (CTRL4–CRTL11) are latched into U10 and U11 (diagram 2) where they are held until a different signal level is called for. The control signals switch the left and right attenuators (U22 and U28) for the needed attenuation step, and set the gain of the left and right channel output buffers.

PREVIEW (CRTL12)

The PREVIEW signal is used to switch the headphone output off during recording of the voice identification.

HEADPHONE AMPLIFIER (diagram 5)

Input Differential to Single-Ended Amplifiers

Two buffers receive the CH1PHO and CH2PHO differential signals and convert them to single-ended outputs. The left-channel buffer is U35A (channel 1) and the right-channel buffer is U38A (channel 2). The single-ended output is routed to the headphone jack, where it allows the user to monitor the ASG 140 output tones.

Signal/Preview Multiplexer

The buffer outputs (on pin 1) are routed to a multiplexer, U41, for signal selection between NORM and PREVIEW. The PREVIEW signal is used only to send silence to the headphones when making a voice identification recording.

Channel 1 and Channel 2 Voltage-Controlled Amplifiers

Multiplexer outputs are passed to voltage-controlled amplifiers U33 and U36. The dc control level (AUD_LEVEL) is applied to U39. The front panel volume control potentiometer, R5 (diagram 7), swings the voltage between ±15 V. The control voltage is buffered by U39 and filtered by series resistor R132 and capacitor C51. This circuit filters the digital signals and high frequency noise from the DC control line applied to U33 and U36.

Audio Level Control Buffer

At the output of U39, the DC control range is +0.48 V to –0.12 V. The +0.48 V corresponds to an attenuation of 80 dB when the volume control is rotated fully counterclockwise. When the DC voltage is –0.12 volts, the voltage-controlled amplifier, U36, has a gain of 20 dB that sets the headphone volume range.

Current-to-Voltage Amplifiers

The signal output of the U36 is a current that is sent to U38B and converted to a voltage. The voltage passes through series resistor R118 to drive the right side of the headphones.

The purpose of R118 is to equalize the gain difference between low- and high-impedance headphones.

Preview Termination Transistors

In Normal, the PREV1 and PREV2 signals are terminated by Q18 and Q19. The low PREVIEW control signal is inverted by U40A, and the high NORM signal forward biases Q18 and Q10. With these transistors on, the PREV1 and PREV2 signals are shunted to ground through the transistors. In Preview, Q18 and Q19 are biased off, and the PREV1 and PREV2 signals are switched to the input of the headphone amplifiers, U33 and U36. In Normal, the ASG 140 output signal is applied to the headphones.

MICROPHONE PREAMPLIFIER (diagram 6)

Microphone Input Amplifier

In the preamp and AGC part of the microphone circuitry, the front-panel microphone connects to the main board via J7. Input amplifier U42B provides relatively low-level amplification for the microphone input signal (about 12.4 dB). The gain of this stage is low to reduce extra background noise, so the user must speak directly into the microphone to record the VOICE identification signal with good amplitude.

A 5.1 V Zener diode (VR3 through resistor R137) connected to the microphone input supplies voltage to power the FET amplifier inside the condenser microphone.

AGC and Output Amplifier

The output of the microphone preamp (U42B pin 7) is applied to U46A, an AGC (automatic gain control) circuit. The AGC circuit operates with op-amp U42A to convert the signal current to a voltage.

The feedback loop of U42A has two series resistors and a 10 μF capacitor to ground from the center of the two series resistors. The feedback network gives the AGC circuit unity gain at DC for its bias. The capacitor bypasses any audio AC to ground. This forces the audio signal to pass through the AGC circuit for gain control while allowing DC to pass through the RC network to bias the op-amp. The audio output of U42A to the CODEC, U9 diagram 2, is 1 V rms and is capacitively coupled via C70.

The AGC circuit uses a pair of back-to-back clamps (VR4 and VR5) in the feedback path. This clamping prevents a large voltage overshoot that can overdrive the CODEC from being generated by abrupt volume changes.

POWER DISTRIBUTION (diagram 6)

The power supply module, A3, provides + and –15 V and +5 V to the main board via J23. From the +15 V supply, three-terminal regulator U68 develops +12 V for the RS-232 serial port device, U67 in diagram 1. The +15 V supply provides power to a three-terminal regulator, U7, that develops the analog +5 V supply, and the –15 V supply provides power to three-terminal regulator U8. That device develops the analog –5 V. These analog voltages run the DACs (U14 and U15) and the high-speed op-amp of the CODEC, U9 in diagram 2. The +5 V digital supply is filtered and decoupled by C108 and C69. An indicator LED, DS1, on the +5 V supply line is lit to show at a glance that the +5 V supply is active. The decoupling capacitors for the supplies are indicated.

FRONT PANEL (diagram 7)

Volume Control R5 adjusts the headphone volume, but has no affect on test signal output.

The front panel processor loads display data and addresses display device U1, on the processor data and address bus. A subset of addresses (ADDR0 — ADDR4) are used to address the display. The eight data bus lines are used to transfer display data to U1.

Microphone MK1 provides the audio test signal that is digitized for transmission later either when VOICE ID is selected with SIGNAL ON or during an auto test when VOICE ID is part of the selected automatic test sequence.

The LEDs associated with the front panel buttons are not directly connected. The data to control LED lighting is provided from the front panel processor via a buffer (U50, diagram 1).

The 14 front panel buttons are buffered to the front-panel processor by U51 and U52 (diagram 1). These buffers are read at intervals to check for button presses. Each button press is interpreted by programing instructions.

The main board interconnect (J1) provides 50 pins that interconnect the front panel to the main board.

SERIAL FILTER BOARD (diagram 8)

The serial filter board provides an EMI filter on each of the 8 lines of the remote control serial interface lines. These filters reduce the conducted radiation (through the serial interface) of high-frequency components.

LEFT AND RIGHT OUTPUT BUFFERS (diagrams 9 and 10)

The circuitry for the four balanced-output buffer amplifiers is on a separate circuit board, A2A1, and signals are connected to and from the main board via J33. The audio signal from the left and right gain attenuators (diagram 4) goes to four identical output buffers. Only the AUDIO OUT LEFT 1 circuitry is discussed. Like components in the remaining buffer amplifiers perform the same circuit functions for the other outputs.

On the left channel, the first stage of the output buffer for AUDIO OUT LEFT 1 is U6A, an op-amp driving a push-pull output stage that is current limited (current limit is set by R51 and R52). A 50 mA current through R51 and R52 develops 0.6 V, causing Q25 or Q26 to switch on and divert drive current away from the output transistors (Q27 and Q28). This protects the output transistors from load short circuits. Normal maximum output at unity gain is +14 dBu, which is 1.9457 V_{RMS} per side. This buffer's output is the plus polarity side of the CH2 differential output.

Inverting amplifier U6B and Q29–Q32 (audio output 1 left negative) provides the negative side of the differential audio signal to the AUDIO OUT LEFT 1 connector. At the output of the first buffer stage, R48 applies the plus polarity output signal to U6B pin 6, the inverting input pin, where it is inverted with unity gain. Together, the positive and negative buffers produce the differential audio signal output. Resistors R55 and R56 add together in series with the resistance of the EMI filters (≈0.8 Ω) across the differential output to produce the internal termination impedance of approximately 12 Ω.

GAIN SWITCHING

The gain of the buffer stages is controlled by switching in the feedback loop of the amplifiers to produce either 0 dB or +10 dB gain. The feedback for the output buffer goes through either of two FET switches, U5B or C. When U5C is closed (U5B open), unity feedback goes from pin 10 to pin 11 of the multiplexer. The output of the buffer stage is connected to the summing node of U6A, making it a unity gain buffer.

When U5C is open (U5B closed), the feedback is divided by R49 and R50, causing the gain to increase by 10 dB. This gain is switched in for outputs above +14 dBu.

POWER SUPPLY (no diagram provided)

The power supply is a high-efficiency switching supply. It produces regulated outputs of +15 V, −15 V, and +5 V from an AC mains voltage of 100 to 240 Vac. A protection fuse (F1) is located at the input of the power supply board. The power distribution and decoupling circuits shown on schematic diagram 6 provide further filtering and regulated +12 V and +5 V from the power supply's +15 V supply line. A −5 V supply is developed by a regulator (U8) on the power supply's −15 V line.

Section 7
Replaceable Electrical Parts

This section contains a list of the components that are replaceable for the ASG 140. Use this list to identify and order replacement parts. There is a separate Replaceable Electrical Parts list for each instrument.

Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc., Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order.

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc., Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

Using the Replaceable Electrical Parts List

The tabular information in the Replaceable Electrical Parts list is arranged for quick retrieval. Understanding the structure and features of the list will help you find all of the information you need for ordering replaceable parts.

Cross Index–Mfr. Code Number to Manufacturer

The Mfg. Code Number to Manufacturer Cross Index for the electrical parts list is located immediately after this page. The cross index provides codes, names, and addresses of manufacturers of components listed in the electrical parts list.

Abbreviations

Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1.

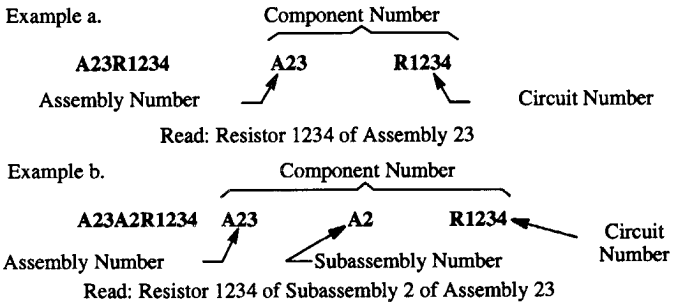
List of Assemblies

A list of assemblies can be found at the beginning of the electrical parts list. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

Column Descriptions

Component No. (Column 1)

The component circuit number appears on the diagrams and circuit board illustrations, located in the diagrams section. Assembly numbers are also marked on each diagram and circuit board illustration, in the Diagram section and on the mechanical exploded views, in the mechanical parts list. The component number is obtained by adding the assembly number prefix to the circuit number.



The electrical parts list is arranged by assemblies in numerical sequence (A1, with its subassemblies and parts, precedes A2, with its subassemblies and parts).

Mechanical subparts to the circuit boards are listed in the electrical parts list. These mechanical subparts are listed with their associated electrical part (for example, fuse holder follows fuse).

Chassis-mounted parts and cable assemblies have no assembly number prefix and are located at the end of the electrical parts list.

Tektronix Part No. (Column 2)

Indicates part number to be used when ordering replacement part from Tektronix.

Serial/Assembly No. (Column 3 and 4)

Column three (3) indicates the serial or assembly number at which the part was first used. Column four (4) indicates the serial or assembly number at which the part was removed. No serial or assembly number entered indicates part is good for all serial numbers.

Name and Description (Column 5)

An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.

The mechanical subparts are shown as *ATTACHED PARTS* / *END ATTACHED PARTS* or *MOUNTING PARTS* / *END MOUNTING PARTS* in column five (5).

Mfr. Code (Column 6)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

Mfr. Part No. (Column 7)

Indicates actual manufacturer's part number.

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code.	Manufacturer	Address	City, State, Zip Code
TK0AY	JAPAN SOLDERLESS TERMINAL MFG CO LTD	1-4-1 HIGASH I-MACHI SHINSENRI TOYONAKA-CITY	OSAKA JAPAN
TK0HU	PANASONIC INDUSTRIAL UK LTD	SLOUGH	BERKS ENGLAND
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609-3320
TK0891	MICONICS	1 FAIRCHILD AVE	PLAINVIEW NY 11803
TK0974	SANGSHIN CORP	26830 PACIFIC HWY SOUTH	KENT WA 98031
TK1146	MITSUBISHI ELECTRONICS	1050 E ARQUES AVENUE	SUNNYVALE CA 94086
TK1547	MOORE ELECTRONICS INC (DIST)	19500 SW 90TH COURT PO BOX 1030	TUALATIN OR 97062
TK1727	PHILIPS NEDERLAND BV AFD ELONCO	POSTBUS 90050	5600 PB EINDHOVEN THE NETHERLANDS
TK1741	COLMAN FASTENERS CO LTD	HATTONS ROAD OFF WESTINGHOUSE RD TRAFFORD PARK	MANCHESTER M17 1DF ENGLAND
TK1857	HIROSE ELECTRIC USA INC	2688 WESHILLS COURT	SIMI VALLEY, CA 93065-6235
TK1955	COMPUTER PRODUCTS BOSCHERT INCORPORATED	1331 CALIFORNIA CIRCLE	MILPITAS CA 95035
TK2058	TDK CORPORATION OF AMERICA	1600 FEEHANVILLE DRIVE	MOUNT PROSPECT, IL 60056
TK2073	TOKYO AMERICA INC	565 W GULF ROAD	ARLINGTON HEIGHTS IL 60005
0B0A9	DALLAS SEMICONDUCTOR CORP	4350 BELTWOOD PKWY SOUTH	DALLAS TX 75244
0FMA6	NEUTRIK USA INC	195-3 LEHIGH AVE	LAKEWOOD NJ 08701-4527
0H1N5	TOSHIBA MARCON ELECTRONICS AMERICA CORPORATION	998 FIRST EDGE DRIVE	VERNON HILLS IL 60061
0KBZ5	MORELLIS Q & D PLASTICS	1812 16TH AVE	FOREST GROVE OR 97116
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
01295	TEXAS INSTRUMENTS INC SEMICONDUCTOR GROUP	13500 N CENTRAL EXPY PO BOX 655303	DALLAS TX 75262-5303
04222	AVX/KYOCERA DIV OF AVX CORP	19TH AVE SOUTH P O BOX 867	MYRTLE BEACH SC 29577
04713	MOTOROLA INC SEMICONDUCTOR PRODUCTS SECTOR	5005 E MCDOWELL RD	PHOENIX AZ 85008-4229
07716	IRC, INC	2850 MT PLEASANT AVE	BURLINGTON IA 52601
09922	BURNDY CORP	1 RICHARDS AVE	NORWALK CT 06856
1CH66	PHILIPS SEMICONDUCTORS	811 E ARQUES AVENUE PO BOX 3409	SUNNYVALE CA 94088-3409
1ES66	MAXIM INTEGRATED PRODUCTS INC	120 SAN GABRIEL DRIVE	SUNNYVALE CA 94086
11236	CTS CORPORATION RESISTOR NETWORKS DIVISION	406 PARR ROAD	BERNE IN 46711-9506
12697	CLAROSTAT MFG CO INC	LOWER WASHINGTON ST	DOVER NH 03820
14552	MICROSEMI CORP	2830 S FAIRVIEW ST	SANTA ANA CA 92704-5948
17856	SILICONIX INC	2201 LAURELWOOD RD	SANTA CLARA CA 95054-1516
18796	MURATA ELECTRONICS NORTH AMERICA INC. STATE COLLEGE OPERATIONS	1900 W COLLEGE AVE	STATE COLLEGE PA 16801-2723
19701	PHILIPS COMPONENTS DISCRETE PRODUCTS DIV RESISTIVE PRODUCTS FACILITY AIRPORT ROAD	PO BOX 760	MINERAL WELLS TX 76067-0760
21022	CONNOR-WINFIELD CORP	114 W WASHINGTON ST PO BOX L	WEST CHICAGO IL 60185-0338
22526	BERG ELECTRONICS INC (DUPONT)	857 OLD TRAIL RD	ETTERS PA 17319
24355	ANALOG DEVICES INC	1 TECHNOLOGY DRIVE	NORWOOD MA 02062
24546	DALE ELECTRONICS A VISHAY INTERTECHNOLOGY INC CO	550 HIGH ST	BRADFORD PA 16701-3737
26364	COMPONENTS CORP	6 KINSEY PLACE	DENVILLE NJ 07834-2611
27014	NATIONAL SEMICONDUCTOR CORP	2900 SEMICONDUCTOR DR	SANTA CLARA CA 95051-0606
32997	BOURNS INC TRIMPOT DIV	1200 COLUMBIA AVE	RIVERSIDE CA 92507-2114

Mfr. Code.	Manufacturer	Address	City, State, Zip Code
34361	OMRON ELECTRONICS INC.		SUNNYVALE CA
4T165	NEC ELECTRONICS USA INC ELECTRON DIV	475 ELLIS ST PO BOX 7241	MOUNTAIN VIEW CA 94039
50139	ALLEN-BRADLEY CO ELECTRONIC COMPONENTS	1414 ALLEN BRADLEY DR	EL PASO TX 79936
50434	HEWLETT-PACKARD CO OPTOELECTRONICS DIV	370 W TRIMBLE RD	SAN JOSE CA 95131-1008
51406	MURATA ELECTRONICS NORTH AMERICA INC HEADQUARTERS AND GEORGIA OPERATIONS	2200 LAKE PARK DR	SMYRNA GA 30080
53387	3M COMPANY ELECTRONIC PRODUCTS DIV	3M AUSTIN CENTER	AUSTIN TX 78769-2963
55322	SAMTEC INC	810 PROGRESS BLVD PO BOX 1147	NEW ALBANY IN 47150-2257
55566	R A F ELECTRONIC HARDWARE INC	95 SILVERMINE RD	SEYMOUR CT 06483-3915
55680	NICHICON /AMERICA/ CORP	927 E STATE PKY	SCHAUMBURG IL 60195-4526
56845	DALE ELECTRONICS INC	2300 RIVERSIDE BLVD PO BOX 74	NORFOLK NE 68701-2242
57027	INTERNATIONAL RESISTIVE PRODUCTS INC	4222 S STAPLES	CORPUS CHRISTI TX 78411-2702
57668	ROHM CORPORATION	15375 BARRANCA PARKWAY SUITE B207	IRVINE CA 92718
61429	FOX ELECTRONICS DIV OF FOX ELECTRONICS INC	5842 CORPORATION CIRCLE	FOR MEYERS FL 33905
62643	UNITED CHEMICON INC	9801 W HIGGINS ST SUITE 430	ROSEMONT, IL 60018-4771
7W718	MARQUARDT SWITCHES INC	2711 ROUTH 20 EAST	CAZENOVIA NY 13035-1219
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
81073	GRAYHILL INC	561 HILLGROVE AVE PO BOX 10373	LA GRANGE IL 60525-5914
81855	EAGLE-PICHER INDUSTRIES INC ELECTRONICS DIV	COUPLES DEPT C AND PORTER STS PO BOX 47	JOPLIN MO 64801
82389	SWITCHCRAFT INC SUB OF RAYTHEON CO	5555 N ELSTRON AVE	CHICAGO IL 60630-1314
91637	DALE ELECTRONICS INC	2064 12TH AVE PO BOX 609	COLUMBUS NE 68601-3632
98159	RUBBER TECK INC	19115 HAMILTON AVE PO BOX 389	GARDENA CA 90247

Component Number	Tektronix Part Number	Serial / Assembly Number Effective	Discontinued	Name & Description	Mfr. Code	Mfr. Part Number
A1	671-1763-00			CIRCUIT BD ASSY:FRONT PANEL	80009	671176300
A2	671-2056-05	B010100	B010113	CIRCUIT BD ASSY:MAIN	80009	671205605
A2	671-2056-06	B010114	B010215	CIRCUIT BD ASSY:MAIN	80009	671205606
A2	671-2056-07	B010216	B019999	CIRCUIT BD ASSY:MAIN	80009	671205607
A2	671-2056-08	B020000		CIRCUIT BD ASSY:MAIN	80009	671205608
A2A1	671-2005-01			CIRCUIT BD ASSY:FOUR BALANCED OUTPUTS	80009	671200501
A3	119-4112-00			POWER SUPPLY:SWITCHING,AUTO IN 85-264VAC, 47-440HZ,OUT 5VDC 5A,+15V2A, -15V 0.5A	TK1955	NFS40-7610
A4	671-2106-00			CIRCUIT BD ASSY:SERIAL FILTER	80009	671210600
A1	671-1763-00			CIRCUIT BD ASSY:FRONT PANEL	80009	671176300
A1C1	281-0775-01			CAP,FXD,CERAMIC:MCL;0.1UF,20%,50V,Z5U,0.170	04222	SA105E104MAA
A1C2	281-0775-01			CAP,FXD,CERAMIC:MCL;0.1UF,20%,50V,Z5U,0.170	04222	SA105E104MAA
A1C3	290-1271-00			CAP,FXD ALUM:3300UF,20%,10V,ESR=0.13 OHM (120HZ,20C),0.492X1.575 INCH	62643	KME10T332M12X30
A1J1	174-2266-00			CA ASSY,SP,ELEC:RIBBON;IDC,50,28 AWG,3.0 L,2X25 PCB X 2X25 RCPT 0.1 CTR,ACCOM 0.025 SQ PIN	TK1547	174-2266-00
A1J2	131-0608-00			CONN,TERMINAL:PRESSFIT/PCB;MALE,STR,0.025SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/FERRULE (QUANTITY 3)	22526	48283-018
A1R1	307-0542-00			RES NTWK,FXD,FI:(5)10K OHM,5%,0.125W	11236	750-61-R10K OR
A1R2	307-0542-00			RES NTWK,FXD,FI:(5)10K OHM,5%,0.125W	11236	750-61-R10K OR
A1R3	307-0594-00			RES NTWK,FXD,FI:(8)220 OHM,2%,0.125WTC=250PPM/DEG	11236	750-81-R220 OR
A1R4	307-0542-00			RES NTWK,FXD,FI:(5)10K OHM,5%,0.125W	11236	750-61-R10K OR
A1R5	311-2482-00			RES,VAR,NONWW:100K OHM,20%,0.25 W,LINEAR	12697	CM45283
A1R6	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W,,MI	TK1727	SFR25 2322-181-
A1R7	307-0755-00	671-1763-00	671-1763-00	RES,FXD,CMPSN:0.5 OHM,5%,0.5W	57668	R50XJ0R5-TR
A1R7	307-0793-00	671-1763-00		RES, FXD,CMPSN:0.51 OHM, 5%, 0.25W		
A1S1	260-2384-00			SWITCH,PUSH:SPST;MOM,NO,100 GRM FRC,COND RUBBER CONTACTS,RED LED,W/KEYCAP	TK1857	HL20-LSR
				ATTACHED PARTS		
	366-0671-00			PUSH BUTTON:W/LENS,HL20-1101	TK1857	HL20-1101
				END ATTACHED PARTS		
A1S2	260-2442-00			SWITCH,PUSH:SPST;MOM,NO,100 GRM FRC,COND RUBBER CONTACTS,GRN LED,W/KEYCAP	TK1857	HL20-LSG
				ATTACHED PARTS		
	366-0671-00			PUSH BUTTON:W/LENS,HL20-1101	TK1857	HL20-1101
				END ATTACHED PARTS		
A1S3	260-2442-00			SWITCH,PUSH:SPST;MOM,NO,100 GRM FRC,COND RUBBER CONTACTS,GRN LED,W/KEYCAP	TK1857	HL20-LSG
				ATTACHED PARTS		
	366-0671-00			PUSH BUTTON:W/LENS,HL20-1101	TK1857	HL20-1101
				END ATTACHED PARTS		
A1S4	260-2442-00			SWITCH,PUSH:SPST;MOM,NO,100 GRM FRC,COND RUBBER CONTACTS,GRN LED,W/KEYCAP	TK1857	HL20-LSG
				ATTACHED PARTS		
	366-0671-00			PUSH BUTTON:W/LENS,HL20-1101	TK1857	HL20-1101
				END ATTACHED PARTS		
A1S5	260-2442-00			SWITCH,PUSH:SPST;MOM,NO,100 GRM FRC,COND RUBBER CONTACTS,GRN LED,W/KEYCAP	TK1857	HL20-LSG
				ATTACHED PARTS		
	366-0671-00			PUSH BUTTON:W/LENS,HL20-1101	TK1857	HL20-1101
				END ATTACHED PARTS		
A1S6	260-2442-00			SWITCH,PUSH:SPST;MOM,NO,100 GRM FRC,COND RUBBER CONTACTS,GRN LED,W/KEYCAP	TK1857	HL20-LSG
				ATTACHED PARTS		
	366-0671-00			PUSH BUTTON:W/LENS,HL20-1101	TK1857	HL20-1101
				END ATTACHED PARTS		
A1S7	260-2300-00			SWITCH,SIG:SPST;PUSH,MOM,NO,W/GROUND TERM,MANUAL INSERTION,100 GRAMS,SILVER,SEALED	34361	B3F1152
				ATTACHED PARTS		
	366-0716-00			PUSH BUTTON:	0KBZ5	366-0716-00

Component Number	Tektronix Part Number	Serial / Assembly Number Effective	Discontinued	Name & Description	Mfr. Code	Mfr. Part Number
				END ATTACHED PARTS		
A1S8	260–2300–00			SWITCH,SIG:SPST;PUSH,MOM,NO,W/GROUND TERM,MANUAL INSERTION,100 GRAMS,SILVER,SEALED	34361	B3F1152
				ATTACHED PARTS		
	366–0716–00			PUSH BUTTON:	0KBZ5	366–0716–00
				END ATTACHED PARTS		
A1S9	260–2300–00			SWITCH,SIG:SPST;PUSH,MOM,NO,W/GROUND TERM,MANUAL INSERTION,100 GRAMS,SILVER,SEALED	34361	B3F1152
				ATTACHED PARTS		
	366–0716–00			PUSH BUTTON:	0KBZ5	366–0716–00
				END ATTACHED PARTS		
A1S10	260–2300–00			SWITCH,SIG:SPST;PUSH,MOM,NO,W/GROUND TERM,MANUAL INSERTION,100 GRAMS,SILVER,SEALED	34361	B3F1152
				ATTACHED PARTS		
	366–0716–00			PUSH BUTTON:	0KBZ5	366–0716–00
				END ATTACHED PARTS		
A1S11	260–2300–00			SWITCH,SIG:SPST;PUSH,MOM,NO,W/GROUND TERM,MANUAL INSERTION,100 GRAMS,SILVER,SEALED	34361	B3F1152
				ATTACHED PARTS		
	366–0716–00			PUSH BUTTON:	0KBZ5	366–0716–00
				END ATTACHED PARTS		
A1S12	260–2300–00			SWITCH,SIG:SPST;PUSH,MOM,NO,W/GROUND TERM,MANUAL INSERTION,100 GRAMS,SILVER,SEALED	34361	B3F1152
				ATTACHED PARTS		
	366–0716–00			PUSH BUTTON:	0KBZ5	366–0716–00
				END ATTACHED PARTS		
A1S13	260–2300–00			SWITCH,SIG:SPST;PUSH,MOM,NO,W/GROUND TERM,MANUAL INSERTION,100 GRAMS,SILVER,SEALED	34361	B3F1152
				ATTACHED PARTS		
	366–0716–00			PUSH BUTTON:	0KBZ5	366–0716–00
				END ATTACHED PARTS		
A1S14	260–2300–00			SWITCH,SIG:SPST;PUSH,MOM,NO,W/GROUND TERM,MANUAL INSERTION,100 GRAMS,SILVER,SEALED	34361	B3F1152
				ATTACHED PARTS		
	366–0716–00			PUSH BUTTON:	0KBZ5	366–0716–00
				END ATTACHED PARTS		
A1U1	150–1253–00			DIO,OPTO:DSPLY;GRN,5BY7,8 DIGIT,CMOS,RAM,ASCII DCDR	50434	HDSP–2113
				MOUNTING PARTS		
	136–0971–00			SKT,PL–IN ELEK:DIP,16 PIN,2 X 8,0.3 X 0.1SP,T/G,0.095 H X 0.1 TAILMINIMUM TEMP RATING100 DEG C,ACCOM 0.015–0.022	55322	ICO–316–NGT
	136–0972–00			SOCKET,DIP:PCB;FEMALE,STR,2 X 10,0.1X 0.3CTR,0.095 H X 0.105 TAIL,GOLD/TIN,ACCOM 0.015–0.020 DIA 0.15 L PIN	55322	ICO–320–NGT
				END MOUNTING PARTS		
A1DS1	150–1259–00			DIODE,OPTO:LED;YELLOW,585NM,3.0VF @ 10MA	50434	HLMP–1819
A1DS2	150–1258–00			DIODE,OPTO:LED;GREEN,569NM,3.0VF @ 10MA	50434	HLMP–1840
A1FL2	174–2266–00			CA ASSY,SP,ELEC:RIBBON;IDC,50,28 AWG,3.0 L,2X25 PCB X 2X25 RCPT 0.1 CTR,ACCOM 0.025 SQ PIN	TK1547	174–2266–00
A1MK1	119–4087–00			MICROPHONE:CARTRIDGE ELECTRET TYPE,LOW IMPEDANCE,SENSITIVITY –62DB @ 1KHZ,OPERATING VOLTAGE4.5–10V,W/TERMINALS	TK0HU	WM–034BY
A2	671–2056–05	B010100	B010113	CIRCUIT BD ASSY:MAIN	80009	671–2056–05
A2	671–2056–06	B010114	B010215	CIRCUIT BD ASSY:MAIN	80009	671–2056–06
A2	671–2056–07	B010216	B019999	CIRCUIT BD ASSY:MAIN	80009	671–2056–07
A2	671–2056–08	B020000		CIRCUIT BD ASSY:MAIN	80009	671–2056–08
				ATTACHED PARTS		
	129–1394–00			SPACER,POST:1.05 SPACING,4–40 INT & 4–40 X0.187 EXT THD,0.250 HEX,STAINLESS STEEL (QUANTITY 2)	55566	4542–440–SS–20
				END ATTACHED PARTS		

Component Number	Tektronix Part Number	Serial / Assembly Number Effective	Discontinued	Name & Description	Mfr. Code	Mfr. Part Number
A2C3	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C4	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C5	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C6	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C7	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C8	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C9	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C11	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C12	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C13	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C14	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C15	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C16	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C21	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C22	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C23	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C24	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C25	290–1311–00			CAP,FXD,ALUM:10UF,20%,50V,ESR=1.4 OHM(100KHZ,20C),5X11MM,105C,5000HRS	55680	UPL1H100MDH1TD
A2C26	290–1311–00			CAP,FXD,ALUM:10UF,20%,50V,ESR=1.4 OHM(100KHZ,20C),5X11MM,105C,5000HRS	55680	UPL1H100MDH1TD
A2C27	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C28	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C29	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C30	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C31	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C32	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C34	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C39	283–0599–00			CAP,FXD,MICA DI:98PF,5%,500V	TK0891	RDM10FD980J03
A2C40	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C41	283–0642–00			CAP,FXD,MICA DI:33PF,2%,500V,0.370 X 0.340	TK0974	DM10E330G5
A2C42	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C43	290–0848–00			CAP,FXD,ALUM:47UF,+100%–20%,16V,NONPOL,0.681X0.414	0H1N5	CEBPM1E470M
A2C45	283–0599–00			CAP,FXD,MICA DI:98PF,5%,500V	TK0891	RDM10FD980J03
A2C46	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C47	283–0642–00			CAP,FXD,MICA DI:33PF,2%,500V,0.370 X 0.340	TK0974	DM10E330G5
A2C48	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C49	290–0848–00			CAP,FXD,ALUM:47UF,+100%–20%,16V,NONPOL,0.681X0.414	0H1N5	CEBPM1E470M
A2C51	290–1313–00			CAP,FXD,ALUM:10UF,20%,50V,8 X 11MM;105 DEG,RDL	55680	UET1H100MPH1TA
A2C52	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C53	290–0848–00			CAP,FXD,ALUM:47UF,+100%–20%,16V,NONPOL,0.681X0.414	0H1N5	CEBPM1E470M
A2C54	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC	0H1N5	CEUSM1E101
A2C55	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C56	290–0778–00			CAP,FXD,ALUM:1UF,20%,50V,5 X 11 MM	0H1N5	CEBPM1H010M(Q)
A2C57	281–0765–00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A2C59	290–0891–00			CAP,FXD,ELCTLT:1UF,+75 –10%,50V	0H1N5	CEUSM1H010
A2C60	290–0891–00			CAP,FXD,ELCTLT:1UF,+75 –10%,50V	0H1N5	CEUSM1H010
A2C61	290–1311–00			CAP,FXD,ALUM:10UF,20%,50V,ESR=1.4 OHM(100KHZ,20C),5X11MM,105C,5000HRS	55680	UPL1H100MDH1TD
A2C62	290–0891–00			CAP,FXD,ELCTLT:1UF,+75 –10%,50V	0H1N5	CEUSM1H010
A2C63	290–0891–00			CAP,FXD,ELCTLT:1UF,+75 –10%,50V	0H1N5	CEUSM1H010
A2C64	290–1311–00			CAP,FXD,ALUM:10UF,20%,50V,ESR=1.4 OHM(100KHZ,20C),5X11MM,105C,5000HRS	55680	UPL1H100MDH1TD
A2C65	283–0167–00			CAP,FXD,CER DI:0.1UF,10%,100V	04222	SR211C104KAA
A2C66	290–1311–00			CAP,FXD,ALUM:10UF,20%,50V,ESR=1.4 OHM(100KHZ,20C),5X11MM,105C,5000HRS	55680	UPL1H100MDH1TD
A2C67	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C68	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA

Component Number	Tektronix Part Number	Serial / Assembly Number Effective	Discontinued	Name & Description	Mfr. Code	Mfr. Part Number
A2C69	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C70	290-0891-00			CAP,FXD,ELCTLT:1UF,+75 -10%,50V	0H1N5	CEUSM1H010
A2C71	281-0819-00			CAP,FXD,CERAMIC:MLC;33 PF,5%,50V,0.100 X 0.170	04222	SA102A330JAA
A2C72	281-0819-00			CAP,FXD,CERAMIC:MLC;33 PF,5%,50V,0.100 X 0.170	04222	SA102A330JAA
A2C78	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C79	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C80	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C81	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C82	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C83	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C84	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C85	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C86	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C87	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C88	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C89	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C93	283-0359-00			CAP,FXD,CER DI:1000PF,10%,200V	04222	SR212A102KAA
A2C94	281-0765-00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A2C95	281-0765-00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A2C97	290-1313-00			CAP,FXD,ALUM:10UF,20%,50V,8 X 11MM;105 DEG,RDL,T&A	55680	UET1H100MPH1TA
A2C99	290-1313-00			CAP,FXD,ALUM:10UF,20%,50V,8 X 11MM;105 DEG,RDL,T&A	55680	UET1H100MPH1TA
A2C100	281-0765-00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A2C101	281-0765-00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A2C102	283-0642-00			CAP,FXD,MICA DI:33PF,2%,500V,0.370 X 0.340	TK0974	DM10E330G5
A2C103	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C105	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C106	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C108	290-0944-01			CAP,FXD,ELCTLT:220UF,20%,10V,LEADSPACING 0.2	0H1N5	CEBSM1C221M-T4
A2C109	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C110	290-1311-00			CAP,FXD,ALUM:10UF,20%,50V,ESR=1.4 OHM(100KHZ,20C),5X11MM,105C,5000HRS	55680	UPL1H100MDH1TD
A2C111	290-0782-00			CAP,FXD,AL:4.7UF,20%,35V,ESR=42.33 OHM (120HZ,20C)	55680	UVX1V4R7MAA
A2C112	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C113	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C114	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C115	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C116	281-0819-00			CAP,FXD,CERAMIC:MLC;33 PF,5%,50V,0.100 X 0.170	04222	SA102A330JAA
A2C117	281-0819-00			CAP,FXD,CERAMIC:MLC;33 PF,5%,50V,0.100 X 0.170	04222	SA102A330JAA
A2C118	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C119	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C120	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C121	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C124	283-0067-00			CAP,FXD,CER DI:0.001UF,10%,200V	18796	DD09B10 Y5F 102
A2C125	283-0067-00			CAP,FXD,CER DI:0.001UF,10%,200V	18796	DD09B10 Y5F 102
A2C137	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C140	281-0775-02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2C141	281-0765-00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A2C142	290-0973-00			CAP,FXD,ELCTLT:100UF,20%,25VDC	0H1N5	CEUSM1E101
A2C143	281-0765-00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A2J1	174-2353-00			CA ASSY,SP,ELEC:10,28 AWG,9.25 L	TK1547	174-2353-00
A2J2	131-0608-00			CONN,TERMINAL:PRESSFIT/PCB;MALE,STR,0.025SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/FERRULE (QUANTITY 3)	22526	48283-018
A2J7	131-0608-00			CONN,TERMINAL:PRESSFIT/PCB;MALE,STR,0.025SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/FERRULE (QUANTITY 3)	22526	48283-018
A2J8	131-0608-00			CONN,TERMINAL:PRESSFIT/PCB;MALE,STR,0.025SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/FERRULE (QUANTITY 50)	22526	48283-018

Component Number	Tektronix Part Number	Serial / Assembly Number Effective	Discontinued	Name & Description	Mfr. Code	Mfr. Part Number
A2J20	131-0608-00			CONN,TERMINAL:PRESSFIT/PCB;MALE,STR,0.025SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/FERRULE (QUANTITY 3)	22526	48283-018
A2J25	131-3520-00			CONN,HDR:PCB;MALE,STR,2 X 5,0.1 CTR,0.365H X 0.112 TAIL,SHRD/4 SIDES,MIL PLZ,30 GOLD	53387	2510-6002UB
A2J26	131-0608-00			CONN,TERMINAL:PRESSFIT/PCB;MALE,STR,0.025SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/FERRULE (QUANTITY 2)	22526	48283-018
A2J28	131-0608-00			CONN,TERMINAL:PRESSFIT/PCB;MALE,STR,0.025SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/FERRULE (QUANTITY 12)	22526	48283-018
A2J29	131-0608-00			CONN,TERMINAL:PRESSFIT/PCB;MALE,STR,0.025SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/FERRULE (QUANTITY 2)	22526	48283-018
A2J30	131-0608-00			CONN,TERMINAL:PRESSFIT/PCB;MALE,STR,0.025SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/FERRULE (QUANTITY 18)	22526	48283-018
A2J32	131-0608-00			CONN,TERMINAL:PRESSFIT/PCB;MALE,STR,0.025SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/FERRULE (QUANTITY 12)	22526	48283-018
A2J33	131-3360-00			CONN,HDR:PCB;MALE,STR,2 X 10,0.1 CTR,0.365D	53387	2520-6002UB
A2P2	131-0993-00			CONN,BOX:SHUNT;FEMALE,STR,1 X 2,0.1 CTR,0.385 H,30 GOLD,BLACK,JUMPER	22526	65474-006
A2Q18	151-0190-00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMPL	04713	2N3904
A2Q19	151-0190-00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMPL	04713	2N3904
A2Q20	151-1121-00			TRANSISTOR,PWR:MOS,N-CH;60V,0.5A,3.0 OHM	17856	VN0606L
A2R1	307-0445-00			RES,NTWK:THICK FILM;(9) 4.7K OHM,2%,0.2W EACH,TC=100 PPM	11236	750-101-R4.7 K
A2R2	307-0445-00			RES,NTWK:THICK FILM;(9) 4.7K OHM,2%,0.2W EA-CH,TC=100 PPM	11236	750-101-R4.7 K
A2R3	307-0445-00			RES,NTWK:THICK FILM;(9) 4.7K OHM,2%,0.2W EA-CH,TC=100 PPM	11236	750-101-R4.7 K
A2R5	322-3258-00			RES,FXD:METAL FILM;4.75K OHM,1%,0.2W,TC=100	56845	CCF50-2-G4751FT
A2R6	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R7	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R13	322-3318-00	671-2056-05	671-2056-07	RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R14	322-3450-00			RES,FXD,FILM:475K OHM,1%,0.2W,TC=T0MI,SMALL	91637	CCF50-2G47502F
A2R15	322-3450-00			RES,FXD,FILM:475K OHM,1%,0.2W,TC=T0MI,SMALL	91637	CCF50-2G47502F
A2R16	322-3414-00			RES,FXD:METAL FILM;200K OHM,1%,0.2W,TC=100PPM	91637	CCF501G20002F
A2R17	322-3414-00			RES,FXD:METAL FILM;200K OHM,1%,0.2W,TC=100PPM	91637	CCF501G20002F
A2R18	322-3318-00	671-2056-05	671-2056-07	RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R19	322-3222-07			RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9,SMALL BODY	91637	CCF501C20000B
A2R20	322-3222-07	671-1758-00	671-1758-08	RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9	80009	322-3222-07
A2R20	322-3176-00	671-1758-09		RES,FXD,FILM:665 OHM,0.1%,0.2W TC=T0MI	80009	322-3176-00
A2R21	322-3222-07			RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9	80009	322-3222-07
A2R22	322-3222-07	671-1758-00	671-1758-08	RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9	80009	322-3222-07
A2R22	322-3176-00	671-1758-09		RES,FXD,FILM:665 OHM,0.1%,0.2W TC=T0MI	80009	322-3176-00
A2R23	322-3001-00	671-1758-00	671-1758-08	RES,FXD,META FILM:10 OHM,0.1%,0.2W TC=100	80009	322-3001-00
A2R23	322-3201-00	671-1758-09		RES,FXD,META FILM:1.21K OHM,0.1%,0.2W TC=T9	80009	322-3201-00
A2R24	311-1895-00			RES,VAR,NONWW:TRMR2K OHM,10%,0.5,LIN	32997	3299W-1-202
A2R25	322-3001-00	671-1758-00	671-1758-08	RES,FXD,META FILM:10 OHM,0.1%,0.2W TC=100	80009	322-3001-00
A2R25	322-3201-00	671-1758-09		RES,FXD,META FILM:1.21K OHM,0.1%,0.2W TC=T9	80009	322-3201-00
A2R26	311-1895-00			RES,VAR,NONWW:TRMR,2K OHM,10%,0.5,LINEAR	32997	3299W-1-202
A2R27	311-2239-00			RES,VAR,TRMR:CERMET;100K OHM,20%,0.5W,0.197	TK2073	GF06UT2 104 M L
A2R28	311-2239-00			RES,VAR,TRMR:CERMET;100K OHM,20%,0.5W,0.197	TK2073	GF06UT2 104 M L
A2R29	322-3112-00			RES,FXD,FILM:143 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G143R0F
A2R30	321-1762-07			RES,FXD,FILM:6.695K OHM,0.1%,0.125W,TC=T9	57027	RC55-D-6K695-B-
A2R31	322-3509-07			RES,FXD,FILM:2.162K OHM,0.1%,0.2W,TC=T9,SMALL BODY	91637	2.162K OHM
A2R32	321-1611-07			RES,FXD,FILM:550 OHM,0.1%,0.125W,TC=T9MI	19701	5033RE550R0B
A2R33	321-1708-01			RES,FXD,FILM:133.3 OHM,0.5%,0.125W,TC=T0	07716	CEAD133.3OHM 0.
A2R34	322-3126-07			RES,FXD,FILM:200 OHM,0.1%,0.2W,TC=T9	91637	CCF50-2-C200ROB
A2R35	321-0021-00			RES,FXD,FILM:16.2 OHM,1%,0.125W,TC=TOMI	57668	RB14FXE 16E2
A2R36	321-0811-07			RES,FXD,FILM:56.3 OHM,0.1%,0.125W,TC=T9 MI	57668	RB14BZE 56E3
A2R66	322-3226-00			RES,FXD:METAL FILM;2.21K OHM,1%,0.2W,TC=100	91637	CCF501G22100F

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A2R68	322-3509-07			RES,FXD,FILM:2.162K OHM,0.1%,0.2W,TC=T9,SMALL BODY	91637	2.162K OHM
A2R69	322-3112-00			RES,FXD,FILM:143 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G143R0F
A2R70	321-1762-07			RES,FXD,FILM:6.695K OHM,0.1%,0.125W,TC=T9	57027	RC55-D-6K695-B-
A2R71	322-3509-07			RES,FXD,FILM:2.162K OHM,0.1%,0.2W,TC=T9,SMALL BODY	91637	2.162K OHM
A2R72	321-1611-07			RES,FXD,FILM:550 OHM,0.1%,0.125W,TC=T9MI	19701	5033RE550R0B
A2R73	321-1708-01			RES,FXD,FILM:133.3 OHM,0.5%,0.125W,TC=T0	07716	CEAD133.3OHM 0.
A2R74	322-3126-07			RES,FXD,FILM:200 OHM,0.1%,0.2W,TC=T9	91637	CCF50-2-C200ROB
A2R75	321-0021-00			RES,FXD,FILM:16.2 OHM,1%,0.125W,TC=T0MI	57668	RB14FXE 16E2
A2R76	321-0811-07			RES,FXD,FILM:56.3 OHM,0.1%,0.125W,TC=T9 MI	57668	RB14BZE 56E3
A2R108	322-3509-07			RES,FXD,FILM:2.162K OHM,0.1%,0.2W,TC=T9,SMALL BODY	91637	2.162K OHM
A2R109	322-3114-00			RES,FXD:METAL FILM;150 OHM,1%,0.2W,TC=100 PPM	91637	CCF50-2-G1500F
A2R110	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R111	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R112	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R113	322-3097-00			RES,FXD:METAL FILM;100 OHM,1%,0.2W,TC=100 PPM	91637	CCF501G100R0F
A2R114	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R115	322-3361-00			RES,FXD:METAL FILM;56.2K OHM,1%,0.2W,TC=100	91637	CCF50-2F56201F
A2R117	322-3385-00			RES,FXD:METAL FILM;100K OHM,1%,0.2W,TC=100PPM	91637	CCF501G10002F
A2R118	322-3114-00			RES,FXD:METAL FILM;150 OHM,1%,0.2W,TC=100 PPM	91637	CCF50-2-G1500F
A2R119	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R120	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R121	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R122	322-3097-00			RES,FXD:METAL FILM;100 OHM,1%,0.2W,TC=100 PPM	91637	CCF501G100R0F
A2R123	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R124	322-3361-00			RES,FXD:METAL FILM;56.2K OHM,1%,0.2W,TC=100	91637	CCF50-2F56201F
A2R126	322-3385-00			RES,FXD:METAL FILM;100K OHM,1%,0.2W,TC=100PPM	91637	CCF501G10002F
A2R127	322-3248-00			RES,FXD,FILM:3.74K OHM,1%,0.2W,TC=T0TAPED &	91637	CCF50G37400F
A2R128	322-3289-00			RES,FXD:METAL FILM;10K OHM,1%,0.2W,TC=100 PPM	91637	CCF50G10001F
A2R129	322-3289-00			RES,FXD:METAL FILM;10K OHM,1%,0.2W,TC=100 PPM	91637	CCF50G10001F
A2R130	322-3248-00			RES,FXD,FILM:3.74K OHM,1%,0.2W,TC=T0TAPED &	91637	CCF50G37400F
A2R132	322-3385-00			RES,FXD:METAL FILM;100K OHM,1%,0.2W,TC=100PPM	91637	CCF501G10002F
A2R133	322-3243-00			RES,FXD:METAL FILM;3.32K OHM,1%,0.2W,TC=100	91637	CCF50-1-G33200F
A2R134	322-3193-00			RES,FXD:METAL FILM;1K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G10000F
A2R135	322-3145-00			RES,FXD,FILM:316 OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF50G316R0F
A2R136	322-3226-00			RES,FXD:METAL FILM;2.21K OHM,1%,0.2W,TC=100	91637	CCF501G22100F
A2R137	322-3226-00			RES,FXD:METAL FILM;2.21K OHM,1%,0.2W,TC=100	91637	CCF501G22100F
A2R138	322-3289-00			RES,FXD:METAL FILM;10K OHM,1%,0.2W,TC=100 PPM	91637	CCF50G10001F
A2R140	321-0307-00			RES,FXD,FILM:15.4K OHM,1%,0.125W,TC=T0MI	TK1727	MR25-2322-151-1
A2R141	322-3193-00			RES,FXD:METAL FILM;1K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G10000F
A2R142	322-3285-00			RES,FXD,FILM:9.09K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G90900F
A2R143	322-3285-00			RES,FXD,FILM:9.09K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G90900F
A2R144	322-3289-00			RES,FXD:METAL FILM;10K OHM,1%,0.2W,TC=100 PPM	91637	CCF50G10001F
A2R145	322-3301-00			RES,FXD,FILM:13.3K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G13301F
A2R148	307-0446-00			RES NTWK,FXD,FI:10K OHM,20%,(9)RES	11236	750-101-R10K
A2R149	322-3481-00			RES,FXD,FILM:1M OHM.1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G10003F
A2R158	322-3193-00			RES,FXD:METAL FILM;1K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G10000F
A2R159	322-3258-00			RES,FXD:METAL FILM;4.75K OHM,1%,0.2W,TC=100	56845	CCF50-2-G4751FT
A2R160	322-3097-00			RES,FXD:METAL FILM;100 OHM,1%,0.2W,TC=100 PPM	91637	CCF501G100R0F
A2R161	322-3097-00			RES,FXD:METAL FILM;100 OHM,1%,0.2W,TC=100 PPM	91637	CCF501G100R0F
A2R162	322-3356-00			RES,FXD,FILM:49.9K OHM,1%,0.2W,TC=T0MI,SMALL BODY	91637	CCF501G49901F
A2R163	322-3385-00			RES,FXD:METAL FILM;100K OHM,1%,0.2W,TC=100PPM	91637	CCF501G10002F
A2R164	322-3361-00			RES,FXD:METAL FILM;56.2K OHM,1%,0.2W,TC=100	91637	CCF50-2F56201F
A2R165	322-3385-00			RES,FXD:METAL FILM;100K OHM,1%,0.2W,TC=100PPM	91637	CCF501G10002F
A2R166	322-3361-00			RES,FXD:METAL FILM;56.2K OHM,1%,0.2W,TC=100	91637	CCF50-2F56201F
A2R174	322-3193-00			RES,FXD:METAL FILM;1K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G10000F
A2R175	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R176	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R177	307-0542-00			RES NTWK,FXD,FI:(5)10K OHM,5%,0.125W	11236	750-61-R10K OR

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A2R178	307-0542-00			RES NTWK,FXD,FI:(5)10K OHM,5%,0.125W	11236	750-61-R10K OR
A2R179	322-3289-00			RES,FXD:METAL FILM;10K OHM,1%,0.2W,TC=100 PPM	91637	CCF50G10001F
A2R180	321-0793-07			RES,FXD,FILM:37.5 OHM 0.1%,0.125W TC=T9 MI	07716	CEA 37.5 OHM 0.
A2R181	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2R182	322-3126-07			RES,FXD,FILM:200 OHM,0.1%,0.2W,TC=T9	91637	CCF50-2-C200ROB
A2R183	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2R184	322-3126-07			RES,FXD,FILM:200 OHM,0.1%,0.2W,TC=T9	91637	CCF50-2-C200ROB
A2R185	321-0793-07			RES,FXD,FILM:37.5 OHM 0.1%,0.125W TC=T9 MI	07716	CEA 37.5 OHM 0.
A2R186	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R187	322-3318-00			RES,FXD:METAL FILM;20K OHM,1%,0.2W,TC=100 PPM	91637	CCF501G20001F
A2R188	322-3147-00			RES,FXD:METAL FILM;332 OHM,1%,0.2W,TC=100 PPM	91637	CCF501G332R0F
A2R189	322-3258-00			RES,FXD:METAL FILM;4.75K OHM,1%,0.2W,TC=100	56845	CCF50-2-G4751FT
A2R190	322-3114-00			RES,FXD:METAL FILM;150 OHM,1%,0.2W,TC=100 PPM	91637	CCF50-2-G1500F
A2R191	322-3289-00			RES,FXD:METAL FILM;10K OHM,1%,0.2W,TC=100 PPM	91637	CCF50G10001F
A2S1	260-2544-00			SWITCH,ROCKER:SPST,10 PIN,PIANO DIP	81073	76PSB10S
A2U1	156-6157-00	671-2056-00	671-2056-06	IC,PROCESSOR:CMOS,DSP;24-BITS,20MHZ,512X 24	04713	DSP56001FE20
A2U1	156-6157-01	671-2056-07		DSP56001 ON ADAPTER		
A2U2	160-7395-04			IC,DIGITAL:CMOS,EPROM;64K X 8,25NS	80009	160739504
				MOUNTING PARTS		
	136-0755-00			SOCKET,DIP:PCB;FEMALE,STR,2 X 14,28 POS,0.1 X 0.6 CTR,0.175 H X0.130 TAIL,BECU,TIN,ACCOM 0.008-0.0015 X 0.014-0.022	09922	DILB28P-108
				END MOUNTING PARTS		
A2U3	160-7396-04			IC,DIGITAL:CMOS,EPROM;64K X 8,25NS	80009	160739604
				MOUNTING PARTS		
	136-0755-00			SOCKET,DIP:PCB;FEMALE,STR,2 X 14,28 POS,0.1 X 0.6 CTR,0.175 H X0.130 TAIL,BECU,TIN,ACCOM 0.008-0.0015 X 0.014-0.022	09922	DILB28P-108
				END MOUNTING PARTS		
A2U4	160-7397-04			IC,DIGITAL:CMOS,EPROM;64K X 8,25NS	80009	160739704
				MOUNTING PARTS		
	136-0755-00			SOCKET,DIP:PCB;FEMALE,STR,2 X 14,28 POS,0.1 X 0.6 CTR,0.175 H X0.130 TAIL,BECU,TIN,ACCOM 0.008-0.0015 X 0.014-0.022	09922	DILB28P-108
				END MOUNTING PARTS		
A2U5	156-2760-00			IC,MISC:CMOS,PWR SUPPLY SUPERVISOR;NONVOLATILE CMOS RAM BATTERY BACKUP CONTROLLER	0B0A9	DS1210
A2U6	156-3850-00			IC,MEMORY:CMOS,SRAM;32K X 8,120NS,3UA,OE	TK1146	M5M5256BP-12LL
A2U7	156-0991-02			IC,LINEAR:BIPOLAR,VR;POSITIVE,5.0V,100MA,5%	01295	UA78L05ACLPM
A2U8	156-1150-01			IC,LINEAR:BIPOLAR,VR;NEGATIVE,-5.0V,100MA,4%	27014	LM79L05ACZ/T4
A2U9	156-4044-00			IC,MISC:CMOS,TELECOM;ULAW PCM CODEC AND FILTER	01295	TCM29C18N
A2U10	156-0865-02			IC,DIGITAL:LSTTL,FLIP FLOP	01295	SN74LS273N
A2U11	156-0865-02			IC,DIGITAL:LSTTL,FLIP FLOP	01295	SN74LS273N
A2U12	160-7393-00			MICROCKT,DGTL:STTL,PLD;10NS,180MA	80009	160739300
				MOUNTING PARTS		
	136-0925-00			SOCKET,DIP:PCB;24 POS,2 X 12,0.1 X 0.3 CTR,0.196 H X 0.130 TAIL,BECU,TIN,ACCOM 0.008-0.015THRU 0.014 X 0.022 LEADS	00779	2-641932-3
				END MOUNTING PARTS		
A2U13	156-1191-00			IC,LINEAR:BIFET,OP-AMP;DUAL	01295	TL072CP
A2U14	156-4040-00			IC,CONVERTER:BICMOS,D/A;18-BIT,176KHZ,VOLT/CUR OUT,SERIAL DATA IN,0.0024% MAX THD,AUDIO	24355	AD1860N-K
				MOUNTING PARTS		
	136-0729-00			SOCKET,DIP:PCB;FEMALE,STR,2 X 8,16 POS,0.1	09922	DILB16P-108T

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				END MOUNTING PARTS		
A2U15	156-4040-00			IC,CONVERTER:BICMOS,D/A;18-BIT,176KHZ,VOLT/CUR OUT,SERIAL DATA IN,0.0024% MAX THD,AUDIO	24355	AD1860N-K
				MOUNTING PARTS		
	136-0729-00			SOCKET,DIP:PCB;FEMALE,STR,2 X 8,16 POS,0.1	09922	DILB16P-108T
				END MOUNTING PARTS		
A2U16	156-0651-02			IC,DIGITAL:LSTTL,SHIFT REGISTER	01295	SN74LS164N
A2U17	156-0651-02			IC,DIGITAL:LSTTL,SHIFT REGISTER	01295	SN74LS164N
A2U18	156-0651-02			IC,DIGITAL:LSTTL,SHIFT REGISTER	01295	SN74LS164N
A2U19	156-0651-02			IC,DIGITAL:LSTTL,SHIFT REGISTER	01295	SN74LS164N
A2U20	156-4043-00			IC,LINEAR:BIPOLAR,OP-AMP;40MHZ,UNITYGAIN STABLE,LOW OFFSET	24355	AD841KN
A2U21	156-4043-00			IC,LINEAR:BIPOLAR,OP-AMP;40MHZ,UNITYGAIN STABLE,LOW OFFSET	24355	AD841KN
A2U22	156-1270-00			IC,MISC:BIFET,ANALOG MUX;8 CHANNEL, 850 OHM, 1.6US	24355	MUX08-063Q
A2U28	156-1270-00			IC,MISC:BIFET,ANALOG MUX;8 CHANNEL, 850 OHM, 1.6US	24355	MUX08-063Q
A2U33	156-3098-00			IC,MISC:BIPOL,MISC;DBX NOISE RDCN SYS V CONT AMP	4T165	UPC1252HA2
A2U35	156-1272-00			IC,LIN:BIPOLAR,OP-AMP;DUAL,HI OUT DRV,LOW NOISE	01295	NE5532P
A2U36	156-3098-00			IC,MISC:BIPOL,MISC;DBX NOISE RDCN SYS V CONT AMP	4T165	UPC1252HA2
A2U38	156-1272-00			IC,LIN:BIPOLAR,OP-AMP;DUAL,HI OUT DRV,LOW NOISE	01295	NE5532P
A2U39	156-1149-00			IC,LINEAR:BIFET,OP-AMP	27014	LF351N
A2U40	156-0645-02			IC,DIGITAL:LSTTL,GATES	01295	SN74LS14N
A2U41	156-3166-00			IC,MISC:CMOS,ANALOG SW;DUAL DPST,55 OHM,+/-15V	1ES66	DG405DJ/C30251
A2U42	156-1272-00			IC,LIN:BIPOLAR,OP-AMP;DUAL,HI OUT DRV,LOW NOISE	01295	NE5532P
A2U46	156-2815-00			IC,MISC:BIPOLAR,MISC;ANALOG COMPANDOR	1CH66	NE572N
A2U47	156-1065-00			IC,DIGITAL:LSTTL,LATCH;OCTAL D TRANSPARENT	01295	SN74LS373N
A2U48	156-4046-00			IC,PROCESSOR:CMOS,MICROCOMPUTER;8 BIT,16MHZ,256X8 RAM,ROMLESS,80C51 FAMILY	1CH66	P80C32EBPN
				MOUNTING PARTS		
	136-0757-00			SOCKET,DIP:PCB;FEMALE,STR,2 X 20,40 POS,0.1 X 0.6 CTR,0.175 H X0.130 TAIL,BECU,TIN,ACCOM 0.008-0.015 X 0.014-0.022 IC	09922	DILB40P-108
				END MOUNTING PARTS		
A2U49	160-7392-03	671-2056-05	671-2056-05	IC,DIGITAL:CMOS,PLD;EEPLD,22V10,25NS,33.3MHZ,90MA	80009	160739203
A2U49	160-7392-04	671-2056-06		IC,DIGITAL:CMOS,PLD;EEPLD,22V10,25NS,33.3MHZ,90MA	80009	160739204
				MOUNTING PARTS		
	136-0925-00			SOCKET,DIP:PCB;24 POS,2 X 12,0.1 X 0.3 CTR,0.196 H X 0.130 TAIL,BECU,TIN,ACCOM 0.008-0.015THRU 0.014 X 0.022 LEADS	00779	2-641932-3
				END MOUNTING PARTS		
A2U50	156-0865-02			IC,DIGITAL:LSTTL,FLIP FLOP	01295	SN74LS273N
A2U51	156-0956-02			IC,DIGITAL:LSTTL,BUFFER/DRIVER	01295	SN74LS244N
A2U52	156-0956-02			IC,DIGITAL:LSTTL,BUFFER/DRIVER	01295	SN74LS244N
A2U54	156-3547-00			IC,MISC:CMOS,PWR SUPPLY SUPERVISOR;MPU RESET GEN,WATCHDOG TIMER,BATTERY BACKUP,UV DETECT	1ES66	MAX690CPA
A2U62	156-2760-00			IC,MISC:CMOS,PWR SUPPLY SUPERVISOR;NONVOLATILE CMOS RAM BATTERY BACKUP CONTROLLER	0B0A9	DS1210
A2U63	160-7394-05			IC,DIGITAL:CMOS,EPROM;64K X 8,25NS	80009	160739405
				MOUNTING PARTS		
	136-0755-00			SOCKET,DIP:PCB;FEMALE,STR,2 X 14,28 POS,0.1 X 0.6 CTR,0.175 H X0.130 TAIL,BECU,TIN,ACCOM 0.008-0.0015 X 0.014-0.022	09922	DILB28P-108
				END MOUNTING PARTS		
A2U64	156-3850-00			IC,MEMORY:CMOS,SRAM;32K X 8,120NS,3UA,OE	TK1146	M5M5256BP-12LL
A2U66	156-0388-03			IC,DIGITAL:LSTTL,FLIP FLOP	01295	SN74LS74AN
A2U67	156-4048-00			IC,MISC:CMOS,INTERFACE;RS-232,3 DRIVERS,5 RECEIVERS,3-STATE,EXTERNAL CAPS REQUIRED	1ES66	MAX239CNG-C7014
				MOUNTING PARTS		

Component Number	Tektronix Part Number	Serial / Assembly Number Effective	Discontinued	Name & Description	Mfr. Code	Mfr. Part Number
	136–0925–00			SOCKET,DIP:PCB;24 POS,2 X 12,0.1 X 0.3 CTR,0.196 H X 0.130 TAIL,BECU,TIN,ACCOM 0.008–0.015THRU 0.014 X 0.022 LEADS	00779	2–641932–3
				END MOUNTING PARTS		
A2U68	156–2735–00			IC,LINEAR:BIPOLAR,VR;POSITIVE,12V,100MA,5%	27014	LM78L12ACZ
A2U69	156–2735–00			IC,LINEAR:BIPOLAR,VR;POSITIVE,12V,100MA,5%	27014	LM78L12ACZ
A2U70	156–2263–00			IC,LINEAR:BIPOLAR,VR;NEGATIVE,–12V,100MA,4%	27014	LM79L12ACZ
A2W1	131–0566–00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225L	24546	OMA0207
A2W123	131–0566–00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225L	24546	OMA0207
A2Y2	158–0393–00			XTAL UNIT,QTZ:11.0592 MHZ,+/– 0.005,SERIES,ESR MAX 30 OHMS,HC–49/U PKG	61429	FOX115
				ATTACHED PARTS		
	346–0032–00			STRAP,RETAINING:0.075 DIA X 4.0 L,MLD RBR	98159	2829–75–4
				END ATTACHED PARTS		
A2Y3	119–4072–00			OSC,XTAL,CLOCK:18.432MHZ,+/– 0.01%,HCMOS,0TO 70 DEG C,4 PIN 14 PIN DIP COMPATIBLE	21022	HC15R8–18.432MH
A2BT1	146–0049–00			BATTERY,STORAGE:3.5V,750MAH	81855	LTC–7P
A2DS1	150–1033–00			DIODE,OPTO:LED;AMBER,585NM,2MCD AT 10MA	50434	HLMP–1401
A2FL2	119–4080–00	671–2056–05	671–2056–07	FILTER,LOWPASS	80009	119–4080–00
A2FL2	671–4081–00	671–2056–08		FILTER,LOWPASS	80009	671–4081–00
A2FL3	119–4080–00	671–2056–05	671–2056–07	FILTER,LOWPASS	80009	119–4080–00
A2FL3	671–4081–00	671–2056–08		FILTER,LOWPASS	80009	671–4081–00
A2FL12	119–4225–00			FILTER,EMI:T CKT FILTER,0.47UH,180PF,CUT OFF FREQ 25MHZ,50VDC,0.5A,IMP 70 OHM PKG0.094X 0.295,0.315 H	TK2058	ZJSC–R47–181 TA
A2FL13	119–4225–00			FILTER,EMI:T CIRCUIT FILTER,0.47UH,180PF,CUT OFF FREQ 25MHZ,50VDC,0.5A,IMP 70 OHM PKG0.094X 0.295,0.315 HIGH	TK2058	ZJSC–R47–181 TA
A2TP2	214–4085–00			TERM,TEST POINT:0.070 ID,0.220 H,0.063 DIAPCB,0.015 X 0.032 BRASS,W/RED NYLON COLLAR	26364	104–01–02
A2TP3	214–4085–00			TERM,TEST POINT:0.070 ID,0.220 H,0.063 DIAPCB,0.015 X 0.032 BRASS,W/RED NYLON COLLAR	26364	104–01–02
A2TP4	214–4085–00			TERM,TEST POINT:0.070 ID,0.220 H,0.063 DIAPCB,0.015 X 0.032 BRASS,W/RED NYLON COLLAR	26364	104–01–02
A2TP5	214–4085–00			TERM,TEST POINT:0.070 ID,0.220 H,0.063 DIAPCB,0.015 X 0.032 BRASS,W/RED NYLON COLLAR	26364	104–01–02
A2TP6	214–4085–00			TERM,TEST POINT:0.070 ID,0.220 H,0.063 DIAPCB,0.015 X 0.032 BRASS,W/RED NYLON COLLAR	26364	104–01–02
A2TP7	214–4085–00			TERM,TEST POINT:0.070 ID,0.220 H,0.063 DIAPCB,0.015 X 0.032 BRASS,W/RED NYLON COLLAR	26364	104–01–02
A2TP8	214–4085–00			TERM,TEST POINT:0.070 ID,0.220 H,0.063 DIAPCB,0.015 X 0.032 BRASS,W/RED NYLON COLLAR	26364	104–01–02
A2VR3	152–0195–00			DIODE,ZENER:5.1V,5%,0.4W	14552	CD332125
A2VR4	152–0395–00			DIODE,ZENER:4.3V,5%,0.4W	04713	1N749ARL
A2VR5	152–0395–00			DIODE,ZENER:4.3V,5%,0.4W	04713	1N749ARL
A2XR167	136–0971–00			SKT,PL–IN ELEK:DIP,16 PIN,2 X 8,0.3 X 0.1SP,T/G,0.095 H X 0.1 TAILMINIMUM TEMP RATING100 DEG C,ACCOM 0.015–0.022	55322	ICO–316–NGT
A2A1	671–2005–01			CIRCUIT BD ASSY:FOUR BALANCED OUTPUTS	80009	671200501
A2A1C1	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2A1C2	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2A1C3	281–0765–00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A2A1C4	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2A1C5	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2A1C6	281–0765–00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A2A1C7	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2A1C8	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2A1C9	281–0765–00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA

Replaceable Electrical Parts

Component Number	Tektronix Part Number	Serial / Assembly Number Effective	Discontinued	Name & Description	Mfr. Code	Mfr. Part Number
A2A1C10	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2A1C11	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2A1C12	281–0765–00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A2A1C13	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2A1C14	290–0966–00			CAP,FXD,ALUM:220UF,20%,25V,ESR=1.06 OHM (120HZ,20C),8 X 16MM	55680	TVXIE221MAA
A2A1C15	281–0775–02			CAP,FXD,CERAMIC:MLC;0.1UF,20%,50V,X7R,0.265	04222	SA205C104MAA
A2A1C16	290–0966–00			CAP,FXD,ALUM:220UF,20%,25V,ESR=1.06 OHM (120HZ,20C),8 X 16MM	55680	TVXIE221MAA
A2A1C17	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C18	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C19	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C20	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C21	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C22	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C23	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C24	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C25	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C26	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C27	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C28	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C29	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C30	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C31	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1C32	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A2A1J1	131–3987–00			CONN,CIRC:PCB,AUDIO;MALE,RTANG,3 POS,1.22H X 1.024 W,CTR PLZ,LATCHING	0FMA6	NC3MD–H
				MOUNTING PARTS		
	213–0055–00			SCREW,TPG,TF:2–32 X 0.188,TYPE B,PNH,STL	TK0435	ORDER BY DESC
				END MOUNTING PARTS		
A2A1J2	131–3987–00			CONN,CIRC:PCB,AUDIO;MALE,RTANG,3 POS,1.22H X 1.024 W,CTR PLZ,LATCHING	0FMA6	NC3MD–H
				MOUNTING PARTS		
	213–0055–00			SCREW,TPG,TF:2–32 X 0.188,TYPE B,PNH,STL	TK0435	ORDER BY DESC
				END MOUNTING PARTS		
A2A1J3	131–3987–00			CONN,CIRC:PCB,AUDIO;MALE,RTANG,3 POS,1.22H X 1.024 W,CTR PLZ,LATCHING	0FMA6	NC3MD–H
				MOUNTING PARTS		
	213–0055–00			SCREW,TPG,TF:2–32 X 0.188,TYPE B,PNH,STL	TK0435	ORDER BY DESC
				END MOUNTING PARTS		
A2A1J4	131–3987–00			CONN,CIRC:PCB,AUDIO;MALE,RTANG,3 POS,1.22H X 1.024 W,CTR PLZ,LATCHING	0FMA6	NC3MD–H
A2A1J4	213–0055–00			SCREW,TPG,TF:2–32 X 0.188,TYPE B,PNH,STL	TK0435	ORDER BY DESC
A2A1Q1	151–0190–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMPL	04713	2N3904
A2A1Q2	151–0188–00			TRANSISTOR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMPL	04713	2N3906
A2A1Q3	151–0136–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,700MA,100MHZ,AMPL	04713	2N3053
A2A1Q4	151–0235–00			TRANSISTOR,SIG:BIPOLAR,PNP;80V,1.0A,150MHZ,AMPL	04713	2N4033
A2A1Q5	151–0190–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMPL	04713	2N3904
A2A1Q6	151–0188–00			TRANSISTOR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMPL	04713	2N3906
A2A1Q7	151–0136–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,700MA,100MHZ,AMPL	04713	2N3053
A2A1Q8	151–0235–00			TRANSISTOR,SIG:BIPOLAR,PNP;80V,1.0A,150MHZ,AMPL	04713	2N4033
A2A1Q9	151–0190–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMPL	04713	2N3904
A2A1Q10	151–0188–00			TRANSISTOR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMPL	04713	2N3906
A2A1Q11	151–0136–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,700MA,100MHZ,AMPL	04713	2N3053
A2A1Q12	151–0235–00			TRANSISTOR,SIG:BIPOLAR,PNP;80V,1.0A,150MHZ,AMPL	04713	2N4033
A2A1Q13	151–0190–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMPL	04713	2N3904
A2A1Q14	151–0188–00			TRANSISTOR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMPL	04713	2N3906
A2A1Q15	151–0136–00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,700MA,100MHZ,AMPL	04713	2N3053
A2A1Q16	151–0235–00			TRANSISTOR,SIG:BIPOLAR,PNP;80V,1.0A,150MHZ,AMPL	04713	2N4033

Component Number	Tektronix Part Number	Serial / Assembly Number Effective	Discontinued	Name & Description	Mfr. Code	Mfr. Part Number
A2A1Q17	151-0190-00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMPL	04713	2N3904
A2A1Q18	151-0188-00			TRANSISTOR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMPL	04713	2N3906
A2A1Q19	151-0136-00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,700MA,100MHZ,AMPL	04713	2N3053
A2A1Q20	151-0235-00			TRANSISTOR,SIG:BIPOLAR,PNP;80V,1.0A,150MHZ,AMPL	04713	2N4033
A2A1Q21	151-0190-00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMPL	04713	2N3904
A2A1Q22	151-0188-00			TRANSISTOR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMPL	04713	2N3906
A2A1Q23	151-0136-00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,700MA,100MHZ,AMPL	04713	2N3053
A2A1Q24	151-0235-00			TRANSISTOR,SIG:BIPOLAR,PNP;80V,1.0A,150MHZ,AMPL	04713	2N4033
A2A1Q25	151-0190-00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMPL	04713	2N3904
A2A1Q26	151-0188-00			TRANSISTOR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMPL	04713	2N3906
A2A1Q27	151-0136-00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,700MA,100MHZ,AMPL	04713	2N3053
A2A1Q28	151-0235-00			TRANSISTOR,SIG:BIPOLAR,PNP;80V,1.0A,150MHZ,AMPL	04713	2N4033
A2A1Q29	151-0190-00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMPL	04713	2N3904
A2A1Q30	151-0188-00			TRANSISTOR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMPL	04713	2N3906
A2A1Q31	151-0136-00			TRANSISTOR,SIG:BIPOLAR,NPN;40V,700MA,100MHZ,AMPL	04713	2N3053
A2A1Q32	151-0235-00			TRANSISTOR,SIG:BIPOLAR,PNP;80V,1.0A,150MHZ,AMPL	04713	2N4033
A2A1R1	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R2	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R3	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R4	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R5	322-3222-07			RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9 ,SMALL BODY	91637	CCF501C20000B
A2A1R6	322-3222-07			RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9 ,SMALL BODY	91637	CCF501C20000B
A2A1R7	322-3193-07			RES,FXD,FILM:1K OHM,0.1%,0.2W,TC=T9	91637	CCF501C10000B
A2A1R8	322-3509-07			RES,FXD,FILM:2.162K OHM,0.1%,0.2W,TC=T9,SMALL BODY	91637	2.162K OHM
A2A1R9	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R10	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R11	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R12	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R13	307-0106-00			RES,FXD,CMPSN:4.7 OHM,5%,0.25W	50139	CB47G5
A2A1R14	307-0106-00			RES,FXD,CMPSN:4.7 OHM,5%,0.25W	50139	CB47G5
A2A1R15	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R16	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R17	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R18	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R19	322-3222-07			RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9 ,SMALL BODY	91637	CCF501C20000B
A2A1R20	322-3222-07			RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9 ,SMALL BODY	91637	CCF501C20000B
A2A1R21	322-3193-07			RES,FXD,FILM:1K OHM,0.1%,0.2W,TC=T9	91637	CCF501C10000B
A2A1R22	322-3509-07			RES,FXD,FILM:2.162K OHM,0.1%,0.2W,TC=T9,SMALL BODY	91637	2.162K OHM
A2A1R23	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R24	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R25	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R26	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R27	307-0106-00			RES,FXD,CMPSN:4.7 OHM,5%,0.25W	50139	CB47G5
A2A1R28	307-0106-00			RES,FXD,CMPSN:4.7 OHM,5%,0.25W	50139	CB47G5
A2A1R29	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R30	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R31	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R32	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R33	322-3222-07			RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9 ,SMALL BODY	91637	CCF501C20000B
A2A1R34	322-3222-07			RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9 ,SMALL BODY	91637	CCF501C20000B
A2A1R35	322-3193-07			RES,FXD,FILM:1K OHM,0.1%,0.2W,TC=T9	91637	CCF501C10000B
A2A1R36	322-3509-07			RES,FXD,FILM:2.162K OHM,0.1%,0.2W,TC=T9,SMALL BODY	91637	2.162K OHM
A2A1R37	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R38	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R39	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R40	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R41	307-0106-00			RES,FXD,CMPSN:4.7 OHM,5%,0.25W	50139	CB47G5
A2A1R42	307-0106-00			RES,FXD,CMPSN:4.7 OHM,5%,0.25W	50139	CB47G5

Component Number	Tektronix Part Number	Serial / Assembly Number Effective	Discontinued	Name & Description	Mfr. Code	Mfr. Part Number
A2A1R43	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R44	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R45	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R46	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2A1R47	322-3222-07			RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9,SMALL BODY	91637	CCF501C20000B
A2A1R48	322-3222-07			RES,FXD,FILM:2K OHM,0.1%,0.2W TC=T9,SMALL BODY	91637	CCF501C20000B
A2A1R49	322-3193-07			RES,FXD,FILM:1K OHM,0.1%,0.2W,TC=T9	91637	CCF501C10000B
A2A1R50	322-3509-07			RES,FXD,FILM:2.162K OHM,0.1%,0.2W,TC=T9,SMALL BODY	91637	2.162K OHM
A2A1R51	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R52	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R53	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R54	322-3009-00			RES,FXD:METAL FILM;12.1 OHM,1%,0.2W,TC=100PPM	57668	CRB20FXE12E1
A2A1R55	307-0106-00			RES,FXD,CMPSN:4.7 OHM,5%,0.25W	50139	CB47G5
A2A1R56	307-0106-00			RES,FXD,CMPSN:4.7 OHM,5%,0.25W	50139	CB47G5
A2A1R57	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R58	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R59	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R60	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R61	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R62	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R63	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R64	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R65	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R66	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R67	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R68	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R69	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R70	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R71	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R72	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R73	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R74	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R75	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R76	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R77	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R78	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R79	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R80	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R81	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R82	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R83	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R84	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R85	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R86	322-3322-00			RES,FXD:METAL FILM;22.1K OHM,1%,0.2W,TC=100	91637	CCF501G22101F
A2A1R87	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1R88	322-3165-00			RES,FXD,FILM:511 OHM,1%,0.2W,TC=T0MI,SM BODY	91637	CCF501G511R0F
A2A1U1	156-1272-00			IC,LIN:BIPOLAR,OP-AMP;DUAL,HI OUT DRV,LOW NOISE	01295	NE5532P
A2A1U2	156-1211-00			IC,MISC:BIFET,ANALOG SWITCH;QUAD	24355	SW-06
A2A1U3	156-1272-00			IC,LIN:BIPOLAR,OP-AMP;DUAL,HI OUT DRV,LOW NOISE	01295	NE5532P
A2A1U4	156-1272-00			IC,LIN:BIPOLAR,OP-AMP;DUAL,HI OUT DRV,LOW NOISE	01295	NE5532P
A2A1U5	156-1211-00			IC,MISC:BIFET,ANALOG SWITCH;QUAD	24355	SW-06
A2A1U6	156-1272-00			IC,LIN:BIPOLAR,OP-AMP;DUAL,HI OUT DRV,LOW NOISE	01295	NE5532P
A2A1W1	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225L	24546	OMA0207
A2A1W2	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225L	24546	OMA0207
A2A1W33	174-2416-00			CA ASSY,SP,ELEC:20,28 AWG,2.4 L,RIBBON (CONNECTED TO A2J33)	TK1547	174-2416-00
A2A1CR1	152-0141-02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR2	152-0141-02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427

Component Number	Tektronix Part Number	Serial / Assembly Number Effective	Discontinued	Name & Description	Mfr. Code	Mfr. Part Number
A2A1CR3	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR4	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR5	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR6	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR7	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR8	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR9	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR10	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR11	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR12	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR13	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR14	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR15	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1CR16	152–0141–02			DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	27014	FDH9427
A2A1TP1	214–4085–00			TERM,TEST POINT:0.070 ID,0.220 H,0.063 DIAPCB,0.015 X 0.032 BRASS,W/RED NYLON COLLAR	26364	104–01–02
A3	119–4112–00			POWER SUPPLY:SWITCHING,AUTO IN 85–264VAC, 47–440HZ,OUT 5VDC 5A,+15V2A, –15V 0.5A	TK1955	NFS40–7610
A4	671–2106–00			CIRCUIT BD ASSY:SERIAL FILTER	80009	671210600
A4C1	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C2	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C3	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C4	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C5	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C6	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C7	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C8	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C9	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C10	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C11	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C12	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C13	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C14	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C15	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C16	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C17	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4C18	283–0197–00			CAP,FXD,CER DI:470PF,5%,50V	04222	SR205A471JAA
A4J1	174–2353–00			CA ASSY,SP,ELEC:10,28 AWG,9.25 L (CONNECTED TO A1J25)	TK1547	174–2353–00
A4J2	131–3926–00			CONN,DSUB:PCB;MALE,RTANG,9 POS,0.112 CTR,0.318 MLG X 0.125 TAIL,4–40 THD INSERT,BD RETENTION	TK0AY	JEY–9P–1A3F–14
A4FL1	119–3580–00			FILTER,EMI:T CIRCUIT FILTER,1000PF,ATTEN 15.094X.335,.315 HIGH,ZJSR5101–102	80009	119358000
A4FL2	119–3580–00			FILTER,EMI:T CIRCUIT FILTER,1000PF,ATTEN 15.094X.335,.315 HIGH,ZJSR5101–102	80009	119358000
A4FL3	119–3580–00			FILTER,EMI:T CIRCUIT FILTER,1000PF,ATTEN 15.094X.335,.315 HIGH,ZJSR5101–102	80009	119358000
A4FL4	119–3580–00			FILTER,EMI:T CIRCUIT FILTER,1000PF,ATTEN 15.094X.335,.315 HIGH,ZJSR5101–102	80009	119358000
A4FL5	119–3580–00			FILTER,EMI:T CIRCUIT FILTER,1000PF,ATTEN 15.094X.335,.315 HIGH,ZJSR5101–102	80009	119358000
A4FL6	119–3580–00			FILTER,EMI:T CIRCUIT FILTER,1000PF,ATTEN 15.094X.335,.315 HIGH,ZJSR5101–102	80009	119358000
A4FL7	119–3580–00			FILTER,EMI:T CIRCUIT FILTER,1000PF,ATTEN 15.094X.335,.315 HIGH,ZJSR5101–102	80009	119358000
A4FL8	119–3580–00			FILTER,EMI:T CIRCUIT FILTER,1000PF,ATTEN 15.094X.335,.315 HIGH,ZJSR5101–102	80009	119358000

Replaceable Electrical Parts

Component Number	Tektronix Part Number	Serial / Assembly Number Effective	Discontinued	Name & Description	Mfr. Code	Mfr. Part Number
A4FL9	119–3580–00			FILTER,EMI:T CIRCUIT FILTER,1000PF,ATTEN 15.094X.335,.315 HIGH,ZJSR5101–102	80009	119358000
C135	283–0067–00			CAP,FXD,CER DI:0.001UF,10%,200V	18796	DD09B10 Y5F 102
C136	283–0067–00			CAP,FXD,CER DI:0.001UF,10%,200V	18796	DD09B10 Y5F 102
C200	283–0067–00			CAP,FXD,CER D1:0.001UF,10%,200V	51046	283–0067–00
J200	131–5233–00			CONN,JACK,PHONE:PNL/SLDR LUG;0.25 ID FEMALE,STR,3 CONTACT,1.369 L,W/0.276 L 0.375–32THD INSUL MTG,FOR 0.25 STEREO PLUG	82389	N113B
J200	210–0201–00			TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL	TK1741	2004–4 PHOSPHOR
J230	174–2338–00			CA ASSY,SP,ELEC:DESCRETE,JUMPER PWR;6,18AWG,2.2 L,1X6,0.156 CTR TIN,W/O FRICTION LOCKBOTH ENDS (CONNECTED FROM A1J23 TO A3J2)	TK1547	174–2338–00
S100	260–2553–00			SWITCH,ROCKER:DPDT,6A,125VAC,POWER,W/QUICKCONNECT TERMINALS	7W718	1852.1102
W1	174–2497–00			CA ASSY,SP,ELEC:2,18 AWG,3.25 L (CONNECTED FROM A3J1 TO S100)	TK1547	174–2497–00
W7	174–2451–00			CA ASSY,RF:COAXIAL;RFD,50 OHM,0.083 DIA,11.0 L,1X3,0.1 CTR,RCPTBOTH ENDS (CONNECTED FROM A1J7 TO A2J2)	TK1547	174–2451–00
W200	174–2552–00			CA ASSY,SP,ELEC:3,26 AWG,3.1 L,RIBBON (CONNECTED FROM J200 TO A2J20)	80009	174255200
FL100	119–1536–00			FILTER,RFI:3A,250VAC,50/60HZ	TK2058	ZUB2203–00

DIAGRAMS/CIRCUIT BOARD ILLUSTRATIONS

Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

Both overline and parenthesis indicate a low asserting state.

Example: $\overline{\text{ID CONTROL}}$ or (ID CONTROL)

Abbreviations are based on ANSI Y1.1-1972.

Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

Y14.15, 1966 — Drafting Practices.
Y14.2, 1973 — Line Conventions and Lettering.
Y10.5, 1968 — Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

American National Standard Institute
1430 Broadway, New York, New York 10018

Component Values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

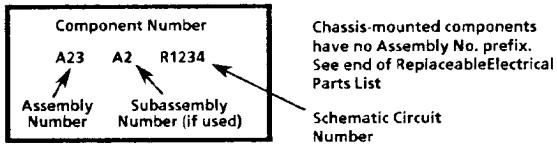
Capacitors:
Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

The following information and special symbols may appear in this manual.

Assembly Numbers

Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the diagram (in circuit board outline), circuit board illustration title, and lookup table for the schematic diagram.

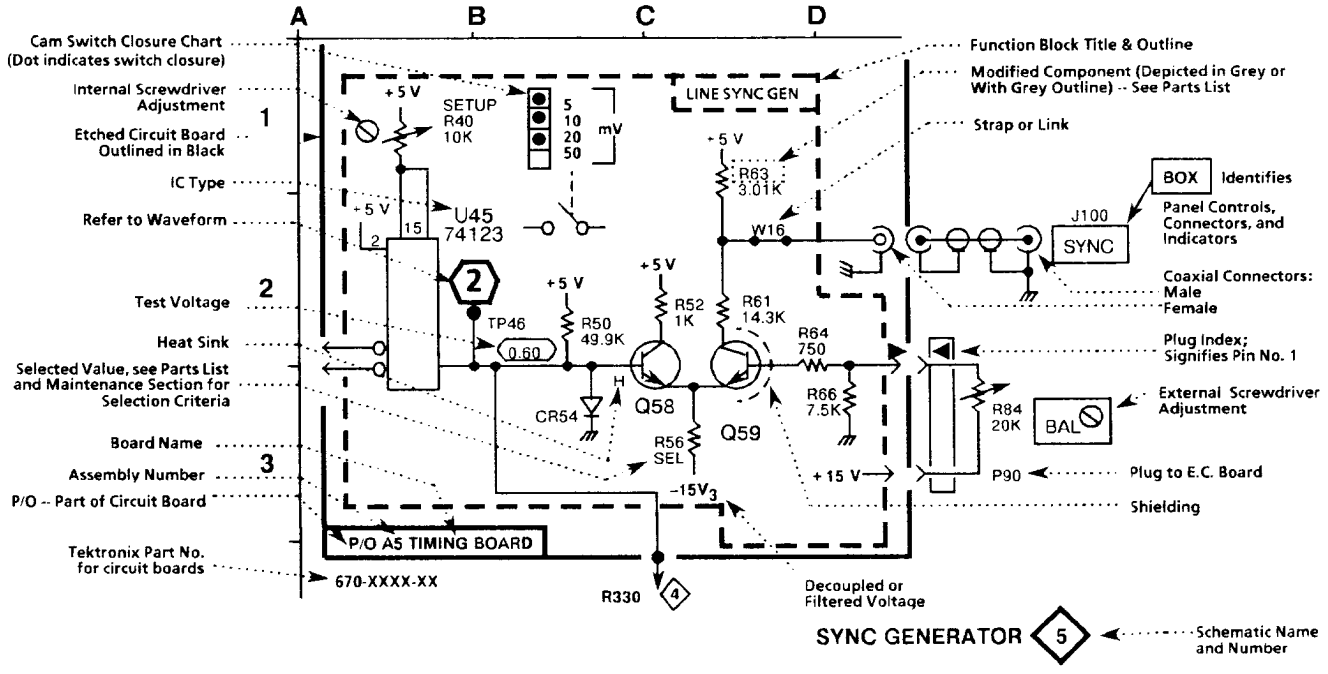
The Replaceable Electrical Parts List is arranged by assembly number in numerical sequence; the components are listed by component number. Example:



Grid Coordinates

The schematic diagram and circuit board component location illustration have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table

When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram; the lookup table will list the diagram number of other diagrams that the other circuitry appears on.



Section 9
Replaceable Mechanical Parts

This section contains a list of the components that are replaceable for the ASG 140. Use this list to identify and order replacement parts. There is a separate Replaceable Mechanical Parts list for each instrument.

Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc., Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benifit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order.

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc., Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

Using the Replaceable Mechanical Parts List

The tabular information in the Replaceable Mechanical Parts list is arranged for quick retrieval. Understanding the structure and features of the list will help you find all of the information you need for ordering replaceable parts.

Cross Index–Mfr. Code Number to Manufacturer

The Mfg. Code Number to Manufacturer Cross Index for the mechanical parts list is located immediately after this page. The cross index provides codes, names, and addresses of manufacturers of components listed in the mechanical-parts list.

Abbreviations

Abbreviations confrorm to American National Standards Institute (ANSI) standard Y1.1.

Chassis Parts

Chassis–mounted parts and cable assemblies are located at the end of the Replaceable Electrical Parts list.

Column Descriptions

Figure & Index No. (Column 1)

Items in this section are referenced by figure and index numbers to the illustrations.

Tektronix Part No. (Column 2)

Indicates part number to be used when ordering replacement part from Tektronix.

Serial No. (Column 3 and 4)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

Qty (Column 5)

This indicates the quantity of mechanical parts used.

Name and Description (Column 6)

An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.

Following is an example of the indentation system used to indicate relationship.

```
1  2  3  4  5        Name & Description
Assembly and/or Component
Mounting parts for Assembly and/or Component
*MOUNTING PARTS*/*END MOUNTING PARTS*
    Detail Part of Assembly and/or Component
    Mounting parts for Detail Part
    *MOUNTING PARTS*/*END MOUNTING PARTS*
        Parts of Detail Part
        Mounting parts for Parts of Detail Part
        *MOUNTING PARTS*/*END MOUNTING PARTS*
```

Mounting Parts always appear in the same indentation as the Item it mounts, while the detail parts are indented to the right. Indented items are part of and included with, the next higher indentation. **Mounting parts must be purchased separately, unless otherwise specified.**

Mfr. Code (Column 7)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

Mfr. Part Number (Column 8)

Indicates actual manufacturer's part number.

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code.	Manufacturer	Address	City, State, Zip Code
07416	NELSON NAME PLATE CO	3191 CASITAS	LOS ANGELES CA 90039–2410
52152	MINNESOTA MINING AND MFG CO INDUSTRIAL SPECIALTIES DIV	3M CENTER	ST PAUL MN 55144–0001
54583	TDK ELECTRONICS CORP	12 HARBOR PARK DR	PORT WASHINGTON NY 11550
71468	ITT CANNON DIV OF ITT CORP	666 E DYER RD	SANTA ANA CA 92702
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077–0001
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108–5181
TK0858	STAUFFER SUPPLY CO (DIST)		
TK1373	PATELEC–CEM (ITALY)	10156 TORINO	VAICENTALLO 62/45S ITALY

Fig. & Index No.	Tektronix Part No.	Serial Number Effective	Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
1–1	200–3870–00			1		COVER,TOP:ALUMINUM,ASG100	80009	200–3870–00
						MOUNTING PARTS		
–2	211–0119–00			8		SCREW,MACHINE:4–40 X 0.25,FLH,100 DEG,STL	93907	ORDER BY DESCR
						END MOUNTING PARTS		
–3	426–2420–00			1		FRAME,FRONT:ALUMINUM,ASG100	80009	426–2420–00
						MOUNTING PARTS		
–4	211–0119–00			2		SCREW,MACHINE:4–40 X 0.25,FLH,100 DEG,STL	93907	ORDER BY DESCR
						END MOUNTING PARTS		
–5	366–2167–00			1		KNOB:GRAY,0.125 ID X 0.392 OD X	80009	366–2167–00
–6	—— ——			1		CIRCUIT BD ASSY:FRONT PANEL		
						(SEE A1 REPL)		
						MOUNTING PARTS		
–7	211–0244–00			3		SCR,ASSEM WSHR:4–40 X 0.312,PNH STL	TK0858	211–0244–00
	211–0012–00			1		SCREW,MACHINE:4–40 X 0.375,PNH,STL	93907	ORDER BY DESCR
						END MOUNTING PARTS		
–8	333–3945–00			1		PANEL,FRONT:ASG140	80009	333–3945–00
–9	337–3749–00			1		PROTECTOR,SW:TV GRAY,POLYCARBONATE	80009	337–3749–00
–10	—— ——			1		CIRCUIT BD ASSY:FOUR BALANCED OUTPUTS		
						(SEE A2A1 REPL)		
						MOUNTING PARTS		
–11	211–0101–00			8		SCREW,MACHINE:4–40 X 0.25,FLH,100 DEG,STL	93907	ORDER BY DESCR
						END MOUNTING PARTS		
–12	—— ——			1		CIRCUIT BD ASSY:MAIN		
						(SEE A2 REPL)		
						MOUNTING PARTS		
–13	211–0244–00			8		SCR,ASSEM WSHR:4–40 X 0.312,PNH STL	TK0858	211–0244–00
						END MOUNTING PARTS		
–14	—— ——			1		POWER SUPPLY:SWITCHING,AUTO IN 85–264VAC,47–440HZ,OUT 5VDC 5A,+15V 2A, –15V 0.5A		
						(SEE A3 REPL)		
						MOUNTING PARTS		
–15	211–0244–00			3		SCR,ASSEM WSHR:4–40 X 0.312,PNH STL	TK0858	211–0244–00
						END MOUNTING PARTS		
–16	220–0187–00			1		NUT,HEX:4–40,NYLON	80009	220–0187–00
–17	211–0119–00			1		SCREW,MACHINE:4–40 X 0.25,FLH,100 DEG,STL	93907	ORDER BY DESCR
–18	337–3738–00			1		SHIELD,ELEC:POWER SUPPLY	80009	337–3738–00
–19	—— ——			1		FILTER,RFI:3A,250VAC,50/60HZ		
						(SEE FL100 REPL)		
						MOUNTING PARTS		
–20	211–0012–00			2		SCREW,MACHINE:4–40 X 0.375,PNH,STL	93907	ORDER BY DESCR
–21	210–0586–00			2		NUT,PL,ASSEM WA:4–40 X 0.25,STL CD PL	78189	211–041800–00
						END MOUNTING PARTS		
–22	174–2495–00			1		CA ASSY,SP,ELEC:18 AWG,3.3 L,8–0	80009	174–2495–00
–23	174–2496–00			1		CA ASSY,SP,ELEC:18 AWG,3.3 L,8–9	80009	174–2496–00
–24	196–1213–00			1		LEAD,ELECTRICAL:18 AWG,2.5 L,5–4	80009	196–1213–00
						MOUNTING PARTS		
–25	211–0244–00	B010100	B010391	1		SCR,ASSEM WSHR:4–40 X 0.312,PNH STL	TK0858	211–0244–00
–25	211–0722–00	B010392		1		SCREW,MACHINE,6–32 X 0.250,PNH,STL,CDPL		
						END MOUNTING PARTS		
–26	334–3379–00			1		MARKER,IDENT:MARKED GROUND SYMBOL	07416	ORDER BY DESCR
–27	—— ——			1		CIRCUIT BD ASSY:SERIAL FILTER		
						(SEE A4 REPL)		
						MOUNTING PARTS		
–28	214–3903–01			2		SCR,JACK:4–40 X 0.312 EXT THD,4–40 INT THD, 0.188 HEX,STEEL,CAD PLATE	80009	214–3903–01
						END MOUNTING PARTS		
–29	334–8082–00			1		LABEL:ASG100	80009	334–8082–00

Fig. & Index No.	Tektronix Part No.	Serial Number Effective	Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
-30	348-0844-00			5		PAD,CUSHIONING:0.05 SQ X 0.23 H,POLYURETHANE W/ PRESSURE SENS ADHESIVE	52152	SJ-5018-GRAY
-31	200-3869-00	B010100	B010276	1		COVER,BOTTOM:ALUMINUM,ASG100	80009	200-3869-00
-31	200-3869-01	B010277	B010391	1		COVER,BOTTOM:ALUMINUM,ASG100	80009	200-3869-01
-31	200-3869-02	B010392		1		COVER,BOTTOM:ALUMINUM,ASG100	80009	200-3869-02
						STANDARD ACCESSORIES		
-32	161-0066-00			1		CABLE ASSY,PWR:3,18AWG,98 L,SVT,GREY/BLK,60 DEG C,IEC BME X STR,IEC RCPT,10A/125V	80009	161-0066-00
	070-8667-XX			1		MANUAL,TECH:INSTR,ASG140	80009	070-8667-XX
						OPTIONAL ACCESSORIES		
-33	161-0066-09			1		CABLE ASSY,PWR:3,0.75MM SQ,220V,99.0 L (EUROPEAN OPTION A1 ONLY)	80009	161-0066-09
-34	161-0066-10			1		CABLE ASSY,PWR: (UNITED KINGDOM OPTION A2 ONLY)	TK1373	24230
-35	161-0066-11			1		CABLE ASSY,PWR:3,0.75MM,240V,96.0 L (AUSTRALIAN OPTION A3 ONLY)	80009	161-0066-11

Appendix A
REMOTE OPERATION

REMOTE CONTROL FROM A TERMINAL

You can control the ASG 140 from a terminal, a computer running terminal emulation software, or a VM700A Video Measurement Set via the RS-232C serial interface. Remote control via a modem is also possible using the RS-232C serial port of the ASG 140. These operations are:

- AUTO test selection and level setting
- LINE UP test tone
- MANUAL test tone in left, right, or both channels plus level and frequency setting
- MANUAL polarity test tone in left, right, or both channels plus level setting
- MANUAL multitone test in left, right, or both channels plus level setting
- SILENCE function
- VOICE playback
- VOICE plus LINE UP test tone, alternating
- ID setting and queries
- Queries of test signal settings
- OFFLINE (turns the signal off and applies SILENCE to the output connectors)

LIMITED LOCAL REMOTE CONTROL

Limited remote control of the ASG 140 is possible using contact closures on the remote connector. One closure activates the auto sequence, and the other enables front panel editing of a setting when editing is internally disabled. Remote connections for these functions are explained in the following text.

INSTALLATION FOR REMOTE CONTROL

Connect a Properly Configured Communications Cable

On the back panel of the ASG 140, to the right of the power switch, is a 9-pin male connector labeled "REMOTE." This DB-9 connector is used to access two types of remote control. It may be used to connect switching contacts that are used to start the AUTO test or to override the editing locked feature so new setups may be saved without removing the ASG 140 from a rack installation to reset the internal DIP switches. Its second, and most versatile, purpose is to provide an RS-232C interface for remote control of the instrument's signal generation functions.

When used for RS-232C serial data transfer, the remote port is configured as a 9-pin (DB-9) DTE (data terminal equipment) connector. You can set up remote control by connecting this serial port to the serial port of a terminal (or terminal-emulating computer) through a properly configured communications cable.

The functions of the pins on the remote connector are shown in Table A-1. On the ASG 140 end, the DTE cable you use must be connected to a 9-pin female connector conforming to this configuration.

Table A-1
Pin Connections for Remote Connector

Pin Number	Signal Name	Signal Description
1	DCD	Data Carrier Detect (not connected)
2	RXD	Received Data (connected)
3	TXD	Transmitted Data (connected)
4	DTR	Contact closure with pin 6 enables editing of function settings. Contact closure with pin 9 starts AUTO test. Do not connect this pin with the remote terminal via the RS-232C interconnection cable.
5	GND	Signal Ground/Common Return (connected)
6	DSR	Contact closure with pin 4 enables editing of function settings. Do not connect this pin to the remote terminal via the RS-232C interconnection cable.
7	RTS	Request to Send (not used in the ASG 140)
8	CTS	Clear to Send (not used in the ASG 140)
9	RI	Contact closure with pin 4 starts AUTO test. Do not connect this pin to the remote terminal via the RS-232C interconnection cable.

On the remote terminal end, the configuration of the cable connector should match that of the terminal's serial port. The cable configurations for communication between the ASG 140 and IBM PCs and compatibles operating as data terminal equipment are shown in Figure A-1 and Figure A-2.

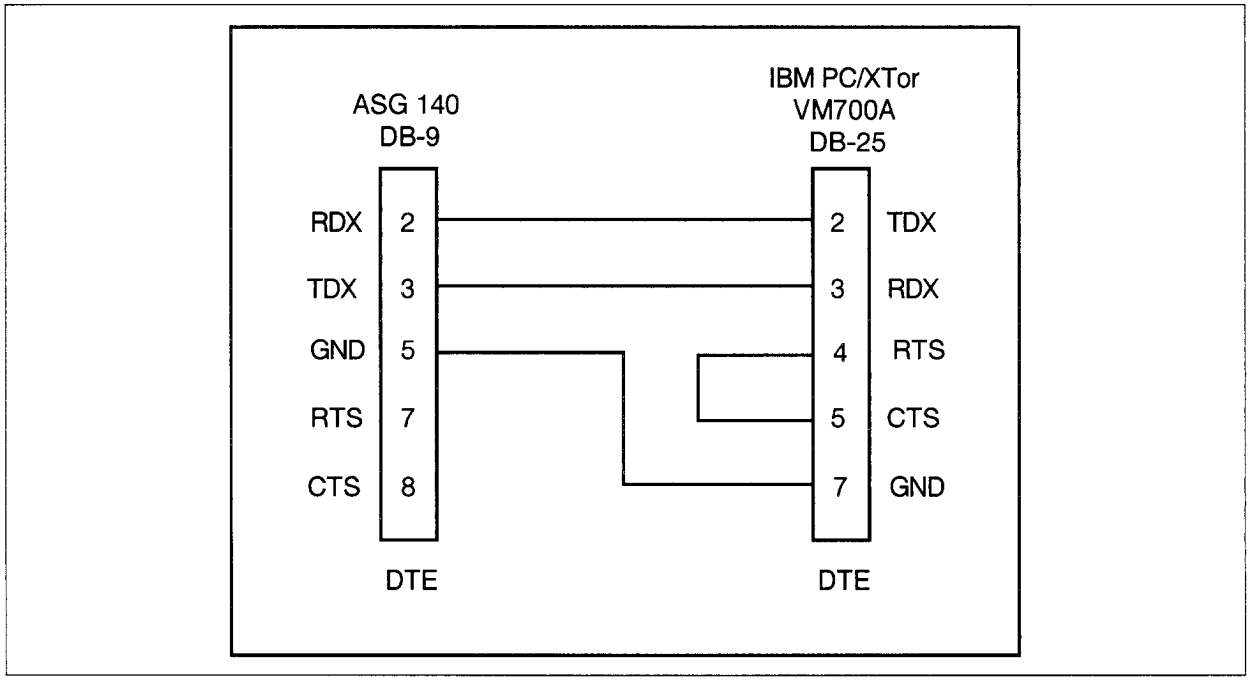


Figure A-1. Cabling to IBM PC/XT or compatibles or the VM700A.

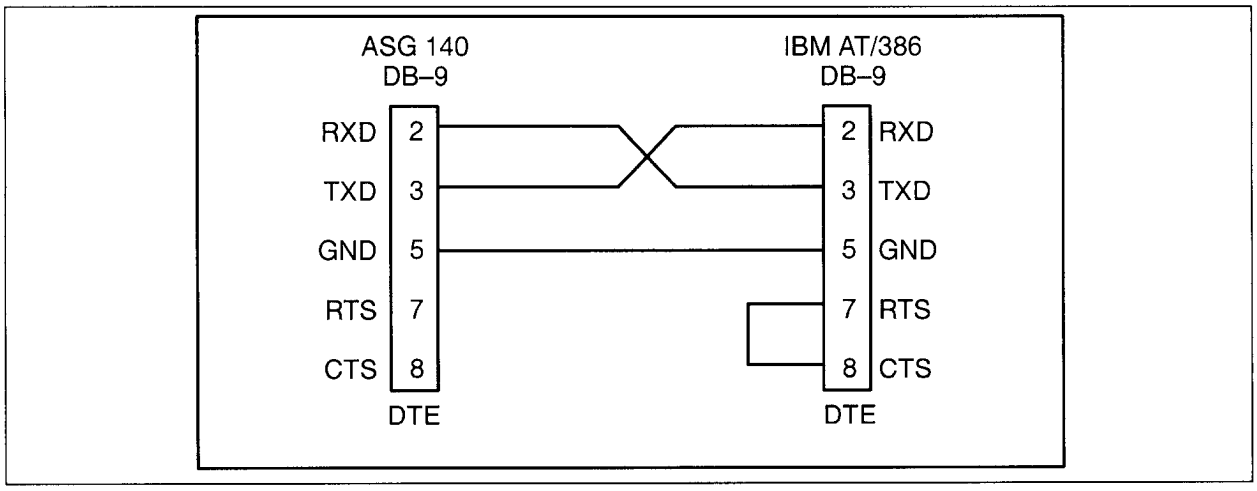


Figure A-2. Cabling to IBM AT/386 and compatibles.

NOTE

In all configurations pins 4, 6 and 9 on the ASG 140 serial port must not be connected to the serial port on the remote terminal or computer; they are reserved for remotely enabling function editing and initiating the AUTO test. Typically, if you establish remote control through a terminal or computer, you will perform these operations through remote commands, rather than through shorting these pins.

Set DIP Switch to Enable Remote Control

As explained in Section 2, *Operation and Setup*, certain functions are enabled and disabled by the positions of the switches on the 10-switch DIP labeled "S1" on the circuit board. You access this switch through the cover on the left panel of the ASG 140. As with all servicing, refer the internal adjustments to a qualified service person.

Remote operation of the ASG 140 through its remote port is enabled when switch S1, position 8 (labeled "PROG7" on the circuit board) is in the up position.

Set Serial Communication Parameters on the Terminal

Using the commands appropriate for your terminal or terminal emulator, set the communication parameters to the values shown below in Table A-2.

Table A-2
Serial Communication Parameters

Parameter	Value
Baud Rate	9600[a]
Data Bits	8
Parity	None
Stop Bits	1

[a]Baud rate for the ASG 140 is selectable for 1200, 2400, 4800, or 9600 baud. The factory setting is 9600 baud.

Setting Baud Rate of the ASG 140

The baud rate of the ASG 140 is user settable from the front panel so that lower baud rate modems not capable of the factory default of 9600 baud may be used for remote control. Four choices are available: 1200, 2400, 4800, and 9600 baud. The data bits, parity, and stop bits parameters for the ASG 140 are fixed.

NOTE

If you need to operate the ASG 140 on a baud rate setting other than 9600, PROG0 of S1 must be set to the user defaults position (down) to make the needed baud rate setting. Leave the switch set to user defaults to prevent the baud rate (and the other user-selectable front panel settings as well) from being changed to factory defaults in the event of a loss of power to the ASG 140. The factory default baud rate setting of 9600 is restored at power on if PROG0 of S1 is set to the factory default (up) position

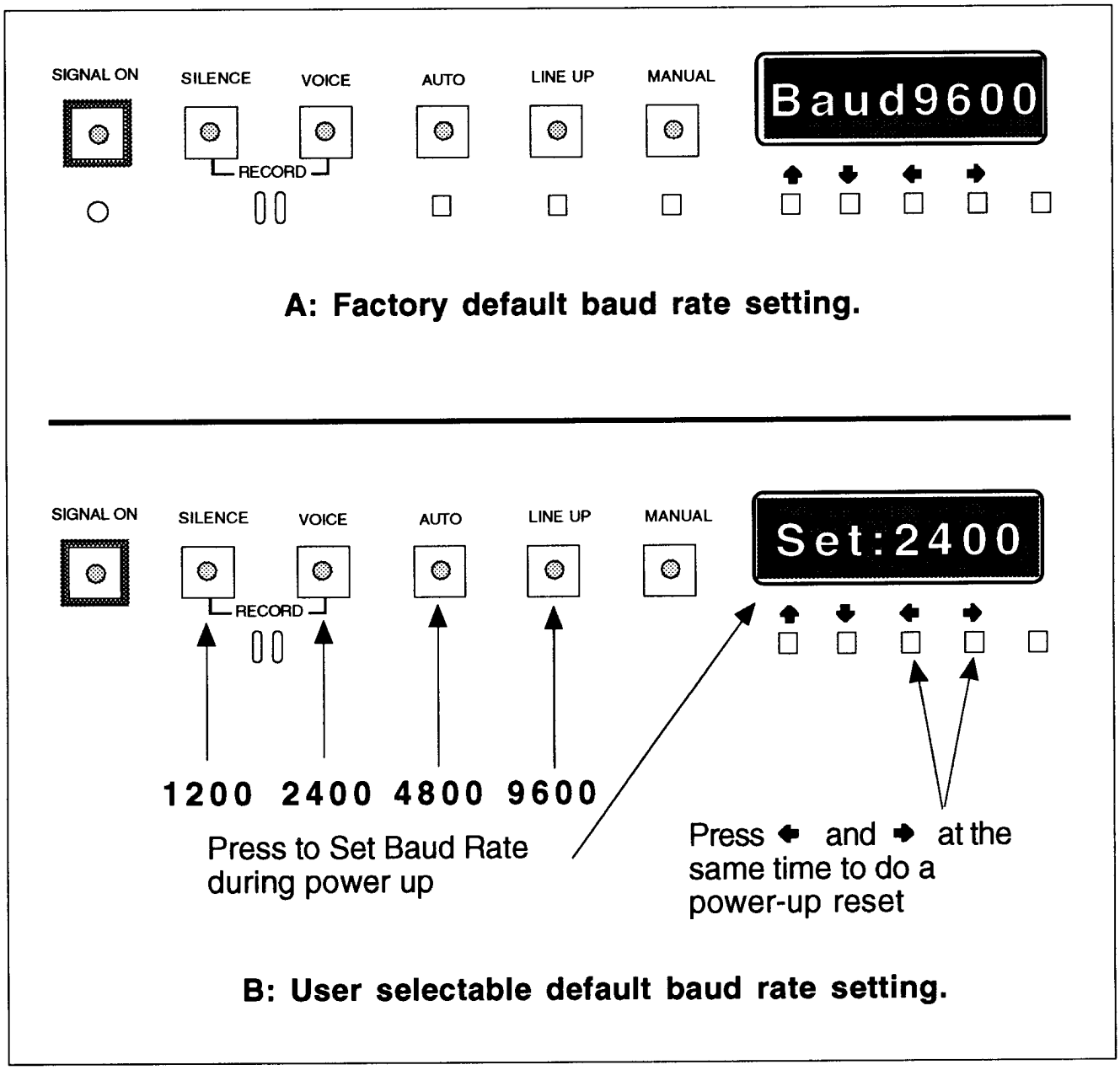


Figure A-3. Setting baud rate during power on.

The baud rate may be set during power up only if PROG0 of S1, the default settings switch (factory defaults up and user defaults down) is set to the user default position (down). At power up, the current baud rate setting (for example, Baud9600) appears in the display window for about 3 seconds. A front panel button that selects baud rate must be pressed to change the setting (see Figure A-3, A) before that message is removed from the display. Setting a new baud rate automatically saves it as the user-selectable power-on setting.

When a baud rate selection button is pressed, the message "Set:nnnn" (where nnnn is the new baud rate) will be displayed. Holding a button in keeps the setting associated with that button displayed until it is released. When released, the new baud rate is displayed. If that is not the required setting, immediately pressing another baud rate choice selects the baud rate associated with that front panel button (see Figure A-3, B).

If another baud rate selection button is not pressed within the 3-second time period after a baud rate setting has been made, the ASG 140 continues with the power-on routine and initialization of the front panel settings.

It is not necessary to turn off the ASG 140 at the rear panel ON/OFF switch to get a power up restart for resetting the baud rate. Pressing the left and right arrow buttons at the same time resets the ASG 140 and restores the enabled defaults (factory or user). This is the same action that occurs when a control C is sent to the ASG 140 via the RS-232C serial port.

Once the ASG 140 baud rate has been set to a different choice, the device communicating with the ASG 140 must also be set to that same baud rate (or be able to auto baud) to communicate with the ASG 140. If the baud rate selected matches the baud rate expected by the device that the ASG 140 is sending to, the remote display will print out the DSP Firmware version number, the DSP diagnostics version number, and the FP Controller version number. If nothing is seen, either the serial communication path is not connected, or the baud rate is incorrect. If only garbled ASCII characters are seen, try another baud rate.

REMOTE OPERATION

Once installation is complete, when you power on the ASG 140 the screen of the remote terminal transcripts the self-test that the ASG 140 performs, then displays the following prompt:

```
ASG100\fp>
```

When this prompt is displayed, you can enter the remote commands. Any command that is not understood will cause the error line "Unrecognized command" to appear. Other error messages appear when arguments to the command are not within limits or errors in the syntax of the arguments are found.

The RS-232C interface of the ASG 140 permits only one command per line, and a command line is terminated by a carriage return. If the command sent requires a reply from the ASG 140 or starts an AUTO test sequence (for example, Sweep which needs about 32 seconds to finish), an appropriate time delay must be permitted before another command is sent. Attempting to batch load a set of commands to the ASG 140 may cause command data to be lost while the ASG 140 is sending its reply. Also, *any* command sent to the ASG 140 while an AUTO test is being executed will terminate the AUTO test.

Remote Commands

There are commands that take arguments to permit the parameters of the command to be altered. The commands also have associated queries to determine the parameters of a test signal. Several of the commands are queries only. There are also three control characters that the ASG 140 recognizes to assist in remote operation of the instrument. A concise list of the commands, arguments, queries, and special control characters is given in Tables A-3, A-4, and A-5 for quick reference. The text following the tables explains the commands in more detail.

Table A-3
List of ASG 140 Commands, Arguments, and Queries

Commands	Argument	Argument	Queries	Responses
auto	l:[*level*]	[*test name*]	auto? auto help	Auto with no arguments starts the selected auto test at the current level setting. The level argument sets a new TEST Lev for the O.33 and Tek tests from –6 dBu to +14 dBu. The test name argument selects the test sequence. If the test signal for auto is a Sweep signal, the level argument sets a new SweepLev from –90 dBu to +24 dBu. When help is on, the ASG 140 sends a reply of ""Auto sequence done." when the auto sequence has completed. auto? returns the selected test sequence, the current ID, and the level settings for Test Level and Sweep Level. auto help returns a list of valid arguments for the auto command.
help			help? ?	This command return a list of ASG 140 commands.
helpoff				Turns off the help replies, error messages, and prompts. Test signal queries are answered.
helpon				Turns the help replies, error messages, and prompts back on.
id "*****"			id?	Sets a new 4-character ID. All printable ASCII characters are valid and all four characters must be used. Spaces are valid. The query returns the 4-character ID.

Table A-3 (cont)

Commands	Argument	Argument	Queries	Responses
lineup			lineup?	Sends the line up signal to all four outputs. The frequency and level cannot be changed remotely. If a variable tone signal is needed for a special line up, use the tone test signal. The query returns the present level and frequency for the line up signal.
lmtone<1|2|3|4>	l:[*level*]		lmtone[n]?	Sends the selected multitone (1, 2, 3, or 4) to the two left channel outputs at the current level. The level argument sets the new signal level from –90 dBu to +24 dBu. The query returns the present level for the multitone test signals.
lpolr	l:[*level*]		lpolr?	Sends the polarity signal to the two left channel outputs. The level argument sets the new signal level from –90 dBu to +24 dBu. The query returns the present level for the polarity test signals.
ltone	l:[*level*]	f:[*frequency*]	ltone?	Sends the tone signal to the two left channel outputs. The level argument sets the new signal level from –90 dBu to +24 dBu. The frequency argument sets a new frequency from 10 Hz to 20 kHz. The query returns the present level for the tone test signals.
mtone<1|2|3|4>	l:[*level*]		mtone[n]?	Sends the selected multitone (1, 2, 3, or 4) to all four outputs. The level argument sets the new signal level from –90 dBu to +24 dBu. The query returns the present level for the multitone test signals.
offline			offline?	Turns off the ASG 140 signal and applies SILENCE to the connected signal lines. The query replies that there are no variables for offline.

Table A-3 (cont)

Commands	Argument	Argument	Queries	Responses
rmtone<1|2|3|4>	l:[*level*]		rmtone[n]?	Sends the selected multitone signal (1, 2, 3, or 4) to the two right channel outputs. The level argument sets the new signal level from –90 dBu to +24 dBu. The query returns the present level for the multitone test signals.
rpolr	l:[*level*]		rpolr?	Sends the polarity signal to the two right channel outputs. The level argument sets the new signal level from –90 dBu to +24 dBu. The query returns the present level for the polarity test signals.
rtone	l:[*level*]	f:[*frequency*]	rtone?	Sends the tone signal to the two right channel outputs. The level argument sets the new signal level from –90 dBu to +24 dBu. The frequency argument sets a new frequency from 10 Hz to 20 kHz. The query returns the present level for the tone test signals.
silence			silence?	Sends silence on all the output signal lines. The query replies that there are no variables for the silence command.
tone	l:[*level*]	f:[*frequency*]	tone?	Sends the tone signal to all outputs. The level argument sets the new signal level from –90 dBu to +24 dBu. The frequency argument sets a new frequency from 10 Hz to 20 kHz. The query returns the present level for the tone test signals.
voi+lu			voi+lu?	Sends the recorded voice id alternately with the line up signal. The query returns the present line up level which is also the voice level.
voice			voice?	Sends the recorded voice id. The query returns the line up level which is also the voice level.

Table A-4
Special Queries

Query	Response
display?	Returns the present display text.
leds?	Returns the LED or LEDs that are on. NOTE: If an auto sequence is on, it is aborted.
version?	Returns the front panel controller firmware version number and date the version was created.

Table A-5
Control Signals

Control Signal	Response
control C	Restarts the ASG 140 and restores the default front panel settings (either factory or user selected as determined by the setting PROG 0 of DIP switch S1).
control S	Halts communication from the ASG 140 serial port.
control Q	Restarts communications from the ASG 140 serial port after being halted by a control S.

Command Description

Help Commands

To display a list of the remote test signal commands on the terminal screen, enter:

help[cr] or **?**

Figure A-4 shows the resulting menu.

Sending help with the auto command in the following form:

auto help

returns a list of the legal arguments that may be used with the auto command (see Table A-3 for test names).

Help mode can be disabled to eliminate the output of the help menu and the normal prompts. The command to disable the help menu is:

helpoff[cr]

All error messages and prompts are disabled. The ASG 140 still responds to the direct queries for information on frequency or levels when given as shown below, but it will not respond to help, ?, or auto help and does not return error messages on incorrect commands with help turned off.

Help is turned on again using the command:

helpon[cr]

```
                    ASG 100 REMOTE COMMAND MENU

offline ..........................Takes  unit  offline.
silence ..........................Sends  silence.
voice ............................Sends  the  stored  voice  sequence.
auto  [l:level]  [test_name] .....Starts  auto  sequence.
id  "*****" ......................Assigns  identification  code.
lineup ...........................Sends the preset line up tone.
voi+lu ...........................Alternately sends voice and line up.
[r  |  l]tone  [f:freq]  [l:level] .....Sends  a  tone  to  respective  channel(s).
[r  |  l]polr  [l:level] ..............Sends  polarity  to  respective  channel(s).
[r  |  l]mtone<1|2|3|4>  [l:level] ....Sends  multi-tone  to  respective  channel(s).
Where:
test_name   is  an  auto  sequence  argument.  Type  "auto  help"  for  list.
            Example:       "auto  tek:91"     will  generate  the  tek:91  sequence.
freq        is  the  frequency  in  Hz.
            Example:       "tone  f:440"  sends  a  tone  at  440Hz,  default  level.
level       is  the  level  in  dBu.  The  level  must  be  entered  to  the  nearest  tenth
            of  a  dBu.
            Example:    "lmtone  l:+2.3"  sends  left  channel  multi-tone  at  +2.3dBu.
*           is  any  ASCII  character  from  "  "  to  "~".
```

Figure A-4. Help screen of remote commands.

Queries

There are several remote queries available. They are associated with the test signal commands. The form of the query is:

```
tone?
```

and the return is the present setting for the MANUAL tone frequency and the MANUAL tone level. Similar information is returned when the question mark is used to make a query of one of the other test signal commands. The query associated with the commands of voice, voi+lu, and lineup that have no arguments return the current line up signal level and frequency.

A query of **Auto?** returns the currently selected test sequence, the 4-character ID of the ASG 140 queried, and the Test Level and Sweep Level settings associated with the auto test sequences.

Unit Identification

There is an id command and an id query. The id command sends a four-character identification code to the ASG 140. That identification code will be used in the preamble of the auto tests that make use of the unit identifier. The form of the command is:

```
id  "*****"
```

Any 4-character combination of ASCII figures, letters, or punctuation is permitted. All four characters are needed, but they may be spaces. Note: if you use a space for all four characters, the the display will be blank. An error message is generated when an argument syntax error is found if help is on.

The query **id?** returns the 4-character identification code of the ASG 140.

Special Queries

There are two queries that let the remote operator determine the display state of the ASG 140. They are :

`display?` and `leds?`

The `display?` query returns the present display seen on the front panel, and the `leds?` query returns all the front panel indicators that are on.

NOTE

The power-on LED is not firmware controlled, so it is not reported in the return.

Either of these commands may prove useful for determining the state of the ASG 140 without sending a command to cause the state to change. Coupled with the queries regarding the present signal parameters (tone?, lineup?, etc.), it is possible to determine the state of the ASG 140 front panel and the signal parameters without sending a command that will turn the signal on.

NOTE

If an auto sequence is in progress, the auto sequence is aborted if any communication is received during the test sequence. This includes asking the ASG 140 what its present state is.

A third special query, `version?`, returns the front panel controller firmware version and the date it was generated. This query is provided because any version related firmware questions that arise may be more easily addressed when the installed version is known.

Restoring Defaults

The remote commands with arguments change the setup from the power-on setup. To restore the power-on state, either the factory defaults or the user-selected settings, whichever is enabled, type control C. This restarts the ASG 140 and restores the power-on control settings.

Flow Control

The ASG 140 responds to X ON/X OFF software flow control. When a control S is received for X OFF, the ASG 140 stops sending on its serial port. When a control Q is received for X ON, serial communications is re-enabled. If there is a message pending from the ASG 140, it is sent. The number of messages that are sent after a control Q is received is limited by the memory space available to hold the unsent messages. During the time communication is off, incoming commands are processed, but not echoed.

REMOTE COMMAND SYNTAX

The commands **offline, silence, voice, lineup,** and **voi+lu** take no arguments and perform the requested operation just as from the front panel.

The remote **auto** and remote **tone, polarity,** and **mtone** commands allow you to specify optional arguments, as indicated by the bracketed text in Figure A-4 (shown previously). The following text describes the syntax for these remote commands. Type in the commands exactly, one

command to a line; do not add extra spaces or other punctuation in front of a command. After the command, use one space before an argument and as a separator when two arguments are used, as in the case of setting both amplitude and frequency for tone. For example:

```
tone  f:1000  l:-2.5
```

The order of the arguments does not matter, and the arguments are not case sensitive. The command may be all upper case, all lower case, or mixed. The command line terminator is the carriage return [cr]. The special control characters, control C, control S, and control Q, are received immediately without waiting for a carriage return.

auto [l:*level*][*test_name*]

Level is an optional argument. The test level reference for the auto test sequence is specified. If the argument is not used, the auto test level reference remains at the last selected value. The valid arguments are +14 dBu to –6 dBu in whole integer values. For example, `l:5, l:0, l:-3,` etc.). Error messages are generated if a limit violation is detected in the argument if help is on.

Test_name is also an optional argument. The argument is a text string specifying which automatic test sequence you want to send. If you do not specify a test name, the auto command initiates the test last selected. The level and test name arguments for auto are not order sensitive, and either may be used first.

The text strings to use for the test sequences supplied by Tektronix are listed in Table A-6. Enter the arguments with punctuation exactly as shown. The command to send the TEK:90 test at 0.0 dBu will look like this: `auto tek:90 l:0` or `AUTO TEK:90 L:0.` A help query of the auto command in the form of `auto help` returns a list of the legal arguments available with the auto command. An error in the test name argument also results in a display of the legal arguments if help is on.

When the sequence is done, the ASG 140 sends the below message followed by the ASCII bell character:

```
*Auto  sequence  done.
```

A programmer may choose to watch for the * so that all other commands are held off until the test sequence is done. Another option is to put in a wait state long enough for the test sequence to finish. A wait state would be required if the helpoff command is in effect as the ASG 140 will not return any messages or prompts in this state.

Aborting an Auto Sequence

An auto test sequence is aborted if ANY communication is received after the command is given until the auto test sequence is done. The message "`Aborting time sequence, executing new command`" is generated. Sending a carriage return only halts the AUTO sequence, and the ASG 140 waits for a second carriage return or a new command to execute before returning the prompt.

Aborting the auto test sequence is a precaution, because the processor of the ASG 140 is also sending the commands needed to generate the test signals in the proper time sequence. Any interruption to handle communications may corrupt the timing of the test sequence.

Table A-6
Test Name Arguments to Remote "AUTO" Command

0.33:00 Test Type	Argument	Tek Test Type	Argument
Mono	`0.33:00`	Mono	`Tek:90`
Mono with Voice ID	`0.33:00V`	Mono with Voice ID	`Tek:90V`
Stereo	`0.33:01`	Stereo	`Tek:91`
Stereo with Voice ID	`0.33:01V`	Stereo with Voice ID	`Tek:91V`
Medium Band Sound Program	`0.33:02`	Microphone	`Tek:92`
Medium Band Sound Program with Voice ID	`0.33:02V`	Microphone with Voice ID	`Tek:92V`
Narrow Band	`0.33:03`	Line Level	`Tek:93`
Narrow Band with Voice ID	`0.33:03V`	Line Level with Voice ID	`Tek:93V`
Narrow Band Sound Program with Compandor	`0.33:04`	Transmitter	`Tek:94`
Narrow Band Sound Program with Compandor with Voice ID	`0.33:04V`	Transmitter with Voice ID	`Tek:94V`
3-Level Alignment Signal for International Sound Program without Station Identifier	`0.33:05`	Stereo with Crosstalk	`Tek:95`
		Stereo with Crosstalk and Voice ID	`Tek:95V`

		Sweep	`Sweep`
			`Sweepr`
			`Sweepl`

[rll][tone [f:*frequency*] [l:*level*]

The **tone** remote command with no arguments makes the ASG 140 send the currently selected MANUAL test tone through the right and left channels at the same time. The **rtone** and **ltone** versions of this command send the MANUAL test tone through the right and left channels, respectively. A query of any of the tone commands in the form of `tone?` returns the current frequency and level setting of the manual tone signals.

The frequency argument specifies a desired frequency for the manual test tone. Enter the initial characters of this argument, **f:**, literally, as shown. Specify *frequency* as an positive integer number representing the desired frequency in Hertz. An error in the frequency argument, such as a number outside the legal range or bad syntax, will result in an error message being generated if help is on.

The level argument specifies a desired amplitude for the MANUAL test tone. Enter the initial characters of this argument, **l:**, literally, as shown. Specify *level* as a number representing the amplitude in dBu. You can specify values to tenths of a decibel, for example **5.3**. Do not add extra numbers after the tenths. An error in the argument, such as specifying a number outside the legal range or bad syntax, will result in an error message being generated if help is on.

If you want to specify a negative amplitude, you must prefix the value with a – (minus sign), for example, **–4**. Otherwise the value is assumed to be positive. You can also explicitly specify a positive amplitude with a + (plus sign) prefix, for example, **+6**. A change in the level applies to all the tone signals.

[rll]polr [l:*level*]

The **polr** remote command with no argument makes the ASG 140 send the polarity tone at the currently selected level through both channels. The **rpolr** and **lpolr** versions of this command send the polarity tone through the right and left channels, respectively. A query of any of the polarity commands in the form of `polr?` returns the fixed frequency of 440 Hz and the current level setting of the manual polarity signals.

The level argument specifies a desired amplitude for the polarity test tone. Enter the initial characters of this argument, **l:**, literally, as shown. Specify *level* as a number representing the amplitude in dBu. You can specify values to tenths of a decibel, for example **5.3**. Do not add extra numbers after the tenths. An error in the level argument, such as specifying a level outside the legal range or bad syntax, will result in an error message being generated if help is on.

If you want to specify a negative amplitude, you must prefix the value with a – (minus sign), for example, **–4**. Otherwise the value is assumed to be positive. You can also explicitly specify a positive amplitude with a + (plus sign) prefix, for example, **+6**. A change in the level applies to all the polarity signals.

There is no frequency argument for polarity. The polarity testing signal is composed of two equal-amplitude sine waves of 440 Hz and 880 Hz, and frequency changes are not permitted. Attempting to send a frequency argument to polarity will result in an error message being generated if help is on.

[rll]mtone<1|2|3|4> [l:*level*]

The **mtone<1|2|3|4>** remote commands makes the ASG 140 send the selected multitone signal at the currently selected amplitude through both channels. The **rmtone <1..4>** and **lmtone <1..4>** versions of this command send the selected test multitone through the right and left channels, respectively. The multitone signal wanted must be designated. Sending mtone alone does not cause a default multitone to be sent. A query of any of the multitone commands in the form of `mtone1?` returns the current level setting of the manual multitone signals.

The level argument specifies a desired amplitude for the multitone test signal. Enter the initial characters of this argument, **l:**, literally, as shown. Specify *level* as a number representing the amplitude in dBu. A change in the level applies to all the multitone signals. An error in the level argument, such as specifying a level outside the legal range or bad syntax, will result in an error message being generated if help is on.

If you want to specify a negative amplitude, you must prefix the value with a – (minus sign), for example, **–4**. Otherwise the value is assumed to be positive. You can also explicitly specify a positive amplitude with a + (plus sign) prefix, for example, **+6**.

There is no frequency argument for multitone. The test signals are composed of sets of equal-amplitude sine waves at predetermined frequencies, and there is no specific frequency associated with multitones. Attempting to send a frequency argument to multitone will result in an error message being generated if help is on.

Appendix B
STANDARD TEST SEQUENCES

CCITT O.33 TEST SEQUENCES

The following text is a brief description of the requirement of the test signals and levels and the measurement equipment for a CCITT O.33 automatic test. Tables B1 through B6 give the test sequences for the CCITT O.33 auto test available with the ASG 140 Audio Signal Generator.

Monophonic Testing

Insertion Gain. For insertion gain, a 1020 Hz signal is sent at the TEST level. The measurement equipment checks the received level of the signal and expresses the result in dB with respect to the transmitted TEST level.

Frequency Response. Frequency response of the audio circuit is checked by sending a set of discrete frequencies from 40 Hz to 15 kHz at a level –12 dB below the TEST level. The measured levels of the received signals are displayed in dB with respect to the received 1020 Hz signal level which is also sent at –12 dB below the TEST level.

Harmonic Distortion. Distortion is checked at two signal frequencies (60 Hz and 1020 Hz) that are sent +9 dB above the TEST level. The test equipment provides an rms indication of the second and third harmonic content of the received test signals expressed in dB with respect to the fundamental level of the test signal. The duration of the +9 dB signal is limited to a single time interval of 1 second each. A 1-second pause between the two test signals used for the harmonic distortion test provides circuit settling time.

Signal-to-Noise Ratio. Signal-to-noise ratio is checked when the sending unit properly terminates the line at the sending end and sends silence. The noise on the terminated line is checked for a period of 8 seconds, and the result is displayed in dB with respect to the received level of the 1020 Hz test signal.

Compandor Linearity. Compandor linearity is checked at a single test frequency that is sent at +6 dB, –6 dB, and +6 dB with respect to the TEST level during three consecutive time intervals. The actual level of the received signal during those test intervals is displayed.

Expanded Noise. Expanded noise testing uses the same time interval and test signal as sent for the 60 Hz distortion test. The measuring equipment filters the signal to remove second and third order harmonics of the 60 Hz frequency, and the remaining noise is measured.

Stereo Testing

The previous testing for monophonic circuitry applies to stereophonic sound channels as well. The added test for stereo check the channel-to-channel matching and crosstalk between the two channels.

Interchannel Gain and Phase. Testing stereo channels for interchannel gain and phase difference must determine the difference in phase and amplitude between the left/right channel signals. These measurements are made at all the frequencies used for the monophonic frequency and distortion tests. The measuring equipment indicates the results of the measurement expressed in dB and phase angle, using channel A as the reference signal channel. This measurement must be done on the channels simultaneously or the results must be verified as equivalent to measuring simultaneously.

Interchannel Crosstalk and Transposition. Interchannel crosstalk and circuit transposition testing uses a signal at 2040 Hz that is –12 dB from the TEST level. Alternate channels are

terminated without a signal being applied. The terminated channel is checked for the level of unwanted signal. The result is expressed in dB with respect to the active channel.

Table B-1
O.33:00/O.33:00V Monophonic Test Sequence

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 00
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	1650/1850	–12	1650/1850	–12	Start / Source / Program ID
1	1020	0	1020	0	Received Level
1	1020	–12	1020	–12	Frequency Response, Interchannel Gain, and Phase
1	40	–12	40	–12	
1	80	–12	80	–12	
1	200	–12	200	–12	
1	500	–12	500	–12	
1	820	–12	820	–12	
1	1900	–12	1900	–12	
1	3000	–12	3000	–12	
1	5000	–12	5000	–12	
1	6300	–12	6300	–12	
1	9500	–12	9500	–12	
1	11500	–12	11500	–12	
1	13500	–12	13500	–12	
1	15000	–12	15000	–12	
1	1020	+9	1020	+9	Total Harmonic Distortion (Waiting Interval)
1	–	–	–	–	
1	60	+9	60	+9	
1	820	+6	820	+6	Compandor Test
1	820	–6	820	–6	
1	820	+6	820	+6	
8	–	–	–	–	Signal-to-Noise Ratio

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-2
O.33:01/O.33:01V Stereo Test Sequence

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 01
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	1650/1850	–12	1650/1850	–12	Start / Source / Program ID
1	1020	0	1020	0	Received Level
1	1020	–12	1020	–12	Frequency Response,
1	40	–12	40	–12	Interchannel Gain,
1	80	–12	80	–12	and Phase
1	200	–12	200	–12	
1	500	–12	500	–12	
1	820	–12	820	–12	
1	1900	–12	1900	–12	
1	3000	–12	3000	–12	
1	5000	–12	5000	–12	
1	6300	–12	6300	–12	
1	9500	–12	9500	–12	
1	11500	–12	11500	–12	
1	13500	–12	13500	–12	
1	15000	–12	15000	–12	
1	1020	+9	1020	+9	Total Harmonic Distortion
1	–	–	–	–	(Waiting Interval)
1	60	+9	60	+9	
1	2040	–12	–	–	Crosstalk and Circuit
1	–	–	2040	–12	Transposition
1	820	+6	820	+6	
1	820	–6	820	–6	Compandor Test
1	820	+6	820	+6	
8	–	–	–	–	Signal-to-Noise Ratio

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-3
O.33:02/O.33:02V Medium Band Sound Program Test Sequence

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 02
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	1650/1850	–12	1650/1850	–12	Start / Source / Program ID
1	1020	0	1020	0	Received Level
1	1020	–12	1020	–12	Frequency Response
1	40	–12	40	–12	
1	80	–12	80	–12	
1	200	–12	200	–12	
1	300	–12	300	–12	
1	500	–12	500	–12	
1	820	–12	820	–12	
1	1400	–12	1400	–12	
1	3000	–12	3000	–12	
1	5000	–12	5000	–12	
1	6300	–12	6300	–12	
1	7400	–12	7400	–12	
1	8020	–12	8020	–12	
1	10000	–12	10000	–12	
1	1020	+9	1020	+9	Total Harmonic Distortion
1	–	–	–	–	(Waiting Interval)
1	60	+9	60	+9	
1	820	+6	820	+6	Compandor Test
1	820	–6	820	–6	
1	820	+6	820	+6	
8	–	–	–	–	Signal-to-Noise Ratio

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-4
O.33:03/O.33:03V Narrow Band Test Sequence

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 03
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	1650/1850	–12	1650/1850	–12	Start / Source / Program ID
1	1020	0	1020	0	Received Level
1	1020	–10	1020	–10	Frequency Response
1	200	–10	200	–10	
1	300	–10	300	–10	
1	400	–10	400	–10	
1	600	–10	600	–10	
1	820	–10	820	–10	
1	1400	–10	1400	–10	
1	1900	–10	1900	–10	
1	2400	–10	2400	–10	
1	2700	–10	2700	–10	
1	2900	–10	2900	–10	
1	3000	–10	3000	–10	
1	3100	–10	3100	–10	
1	3400	–10	3400	–10	
1	1020	+9	1020	+9	Total Harmonic Distortion
8	–	–	–	–	Signal-to-Noise Ratio

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-5
O.33:04/O.33:04V Narrow Band Sound Program With Compandor Test Sequence

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 04
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	1650/1850	–12	1650/1850	–12	Start / Source / Program ID
1	1020	0	1020	0	Received Level
1	1020	–10	1020	–10	Frequency Response
1	200	–10	200	–10	
1	300	–10	300	–10	
1	400	–10	400	–10	
1	600	–10	600	–10	
1	820	–10	820	–10	
1	1400	–10	1400	–10	
1	1900	–10	1900	–10	
1	2400	–10	2400	–10	
1	2700	–10	2700	–10	
1	2900	–10	2900	–10	
1	3000	–10	3000	–10	
1	3100	–10	3100	–10	
1	3400	–10	3400	–10	
1	1020	+9	1020	+9	Total Harmonic Distortion
1	820	+6	820	+6	Compandor Test
1	820	–6	820	–6	
1	820	+6	820	+6	
8	–	–	–	–	Signal-to-Noise Ratio

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-6
O.33:05 3-Level Alignment Signal for International Sound Program Test Sequence

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 05
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	1650/1850	–12	–	–	Star t/ Source / Program ID
1	–	–	–	–	Pause
2	1020	–12	1020	–12	Measurement Level (ML)
8	1020	0	1020	0	Alignment Level (AL)
2	1020	0			Permitted Maximum Level (PML)
3	–	–	–	–	Pause
2			1020	0	Permitted Maximum Level (PML)

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

The "O.33" test sequences comply with the CCITT O.33 recommendation.

CCITT O.33 REQUIREMENTS FOR THE PREAMBLE (START / SOURCE / PROGRAM IDENTIFICATION)

The preamble must contain data that performs the following functions:

- Instructs the receiving unit to start the measurement sequence.
- Identifies the source of the test signals.
- Indicates which of the stored measurement programs is to be used.

The preamble signal must consist of 7 data bits, one even parity bit, and two stop bits. It must be sent by frequency-shift keying with a mark frequency of 1650 Hz and a space frequency of 1850 Hz, at a transmission rate of 110 baud.

The required structure of the preamble signal is shown below in Table B-7.

Table B-7
O.33 Preamble Structure

Char. No.	Character Significance	ISO-7 Character
1	Start of Heading	"SOH" (01 Hexadecimal)
2 - 5	Source ID	Any four alphanumeric characters
6	Special Signaling; Meaning is discretionary.	Any single character
7	Start of Transmission	"STX" (02 Hexadecimal)
8 - 9	Measurement Program ID	ISO-7 characters for a two-digit number, 00 to 99
10	End of Transmission	"ETX" (03 Hexadecimal)

The mark frequency must be transmitted for at least 18 milliseconds (two bits) before the mark bit starting the "SOH" character.

The end of the second stop bit of the "ETX" character defines the start of the measurement sequence.

The preamble signal must be set at 12 dB below whatever the TEST level is defined to be in the ASG 140. You can display the current TEST level (TESTLev) setting by pushing the AMPLITUDE function button while in AUTO mode. If editing is enabled, you can also edit the TEST level. The CCITT O.33 Standard requires the TEST level to be 9 dB below the maximum level permitted at the point where the measurement is made.

TEK TEST SEQUENCES

The TEK Test Sequences allows testing to various standards for audio line measurements not defined in the CCITT O.33 recommendations.

TEK:90 and TEK:91 Test Sequences

TEK:90 and TEK:91 test sequences meet the ANSI TI.502-1988 recommended levels when the test level of the ASG 140 is set to +8 dBu with the ASG 140 output impedance of 10 Ω.

TEK:92 Test Sequence

TEK:92 test sequence is a low-amplitude test used for studio proof microphone level testing. It is used to test for audio circuit response over a frequency range of 50 to 10,000 Hz. When used with the VM700A Option 40 or Option 41, the user must provide a +70 dB preamplifier to raise the ASG 140 signal level to the correct measurement level for the monitoring equipment.

TEK:93 Test Sequence

TEK:93 is a special test sequence used for a studio proof line level test. It tests audio circuit response over a frequency range of 50 to 15,000 Hz.

TEK:94 Test Sequence

TEK:94 is another special test sequence used for transmitter proof testing over a frequency range of 50 to 12,500 Hz.

TEK:95 Test Sequence

TEK:95 Stereo test sequence is similar to TEK:90 Monophonic test sequence, but with a Left and Right Channel Crosstalk test signal added.

Test Sequence Output Level

You can display the current TEST level by pressing the AMPLITUDE button with the AUTO test selected (but not on line); and, if editing of function values is enabled, change the test level using the front panel arrow buttons. For complete information, refer to AUTO TESTLev in Section 2, *Operation and Setup.*

Tables B-8 through B-13 specify the steps of the TEK Mono, Stereo, Mic Level, Line Level, and Transmitter automatic test sequences.

Table B-8
TEK:90/TEK:90V Monophonic Test Sequence

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 90
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	1650/1850	–12	1650/1850	–12	O.33 Start / Source / Program ID
1	400	0	400	0	Insertion Gain
1	400	–8 dB on a peak prog. meter	400	–8 dB on a peak prog. meter	Polarity Tone: Polarity, Crosstalk plus Noise
250 msec	15000	–8	15000	–8	Sweep: Frequency Response, Interchannel Gain and Phase
250 msec	13999	–8	13999	–8	
250 msec	12503	–8	12503	–8	
250 msec	11243	–8	11243	–8	
250 msec	9001	–8	9001	–8	
250 msec	7500	–8	7500	–8	
250 msec	6203	–8	6203	–8	
250 msec	3499	–8	3499	–8	
250 msec	953	–8	953	–8	
250 msec	400	–8	400	–8	
500 msec	101	–8	101	–8	
1000 msec	50	–8	50	–8	
1	400	+10	400	+10	Total Harmonic Distortion plus Noise
2	–	–	–	–	Noise Floor (Silence)

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-9
TEK:91/TEK:91V Stereo Test Sequence

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 91
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	1650/1850	–12	1650/1850	–12	O.33 Start / Source / Program ID
1	400	0	400	0	Insertion Gain
1	400	–8 dB on a peak prog. meter	–	–	Left Polarity Tone: Polarity, Crosstalk plus Noise, Transposition
1	–	–	400	–8 dB on a peak prog. meter	Right Polarity Tone: Polarity, Crosstalk plus Noise, Transposition
250 msec	15000	–8	15000	–8	Sweep: Frequency Response, Interchannel Gain and Phase
250 msec	13999	–8	13999	–8	
250 msec	12503	–8	12503	–8	
250 msec	11243	–8	11243	–8	
250 msec	9001	–8	9001	–8	
250 msec	7500	–8	7500	–8	
250 msec	6203	–8	6203	–8	
250 msec	3499	–8	3499	–8	
250 msec	953	–8	953	–8	
250 msec	400	–8	400	–8	
500 msec	101	–8	101	–8	
1000 msec	50	–8	50	–8	
1	400	+10	400	+10	Total Harmonic Distortion plus Noise
2	–	–	–	–	Noise Floor (Silence)

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-10
TEK:92/TEK:92V Microphone Level Test Sequence

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 92
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	FSK	–70	FSK	–70	Start / Source / Program Ident
1	1000	–70	1000	–70	Insertion Gain
0.5	Polarity	–70	–	–	Polarity/Channel Transposition
0.5	–	–	Polarity	–70	
1	55	–70	55	–70	Level/Phase/THD+N
0.5	100	–70	100	–70	
0.5	200	–70	200	–70	
0.5	1,000	–70	1,000	–70	
0.5	7,500	–70	7,500	–70	
0.5	10,000	–70	10,000	–70	
1	55	–70	–	–	Crosstalk
0.5	100	–70	–	–	
0.5	200	–70	–	–	
0.5	1,000	–70	–	–	
0.5	7,500	–70	–	–	
0.5	10,000	–70	–	–	
1	–	–	55	–70	
0.5	–	–	100	–70	
0.5	–	–	200	–70	
0.5	–	–	1,000	–70	
0.5	–	–	7,500	–70	
0.5	–	–	10,000	–70	
1	55	–60	55	–60	THD+N
1	1,000	–60	1,000	–60	
1	7,500	–60	7,500	–60	
1	55	–55	55	–55	
1	1,000	–55	1,000	–55	
1	7,500	–55	7,500	–55	
3	–	–	–	–	Signal-to-Noise Ratio

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-11
TEK:93/TEK:93V Line Level Test Sequence

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 93
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	FSK	–12	FSK	–12	Start / Source / Program Ident
1	1000	0	1000	0	Insertion Gain
0.5	Polarity	0	–	–	Polarity / Channel Transposition
0.5	–	–	Polarity	0	
1	55	0	55	0	Level / Phase / THD+N
0.5	100	0	100	0	
0.5	200	0	200	0	
0.5	400	0	400	0	
0.5	1,000	0	1,000	0	
0.5	3,000	0	3,000	0	
0.5	5,000	0	5,000	0	
0.5	7,500	0	7,500	0	
0.5	10,000	0	10,000	0	
0.5	15,000	0	15,000	0	
1	55	0	–	–	Crosstalk
0.5	100	0	–	–	
0.5	200	0	–	–	
0.5	400	0	–	–	
0.5	1,000	0	–	–	
0.5	3,000	0	–	–	
0.5	5,000	0	–	–	
0.5	7,500	0	–	–	
0.5	10,000	0	–	–	
0.5	15,000	0	–	–	
1	–	–	55	0	
0.5	–	–	100	0	
0.5	–	–	200	0	
0.5	–	–	400	0	
0.5	–	–	1,000	0	
0.5	–	–	3,000	0	

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-11 (cont)

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 93
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
0.5	–	–	5,000	0	Crosstalk (cont)
0.5	–	–	7,500	0	
0.5	–	–	10,000	0	
0.5	–	–	15,000	0	
1	55	+10	55	+10	THD+N
1	1,000	+10	1,000	+10	
1	7,500	+10	7,500	+10	
1	55	+15	55	+15	
1	1,000	+15	1,000	+15	
1	7,500	+15	7,500	+15	
3	–	–	–	–	Signal-to-Noise Ratio

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-12
TEK:94/TEK:94V Transmitter Test Sequence

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 94
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	FSK	–12	FSK	–12	Start / Source / Program Ident
1	1000	0	1000	0	Insertion Gain
0.5	Polarity	0	–	–	Polarity / Channel Transposition
0.5	–	–	Polarity	0	
1	50	0	50	0	Level / Phase / THD+N
0.5	100	0	100	0	
0.5	400	0	400	0	
0.5	1,000	0	1,000	0	
0.5	2,000	0	2,000	0	
0.5	3,000	0	3,000	0	
0.5	5,000	0	5,000	0	

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-12 (cont)

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 94
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
0.5	7,500	0	7,500	0	Level / Phase / THD+N (cont)
0.5	10,000	0	10,000	0	
0.5	12,500	0	12,500	0	
1	50	0	–	–	Crosstalk
0.5	100	0	–	–	
0.5	400	0	–	–	
0.5	1,000	0	–	–	
0.5	2,000	0	–	–	
0.5	3,000	0	–	–	
0.5	5,000	0	–	–	
0.5	7,500	0	–	–	
0.5	10,000	0	–	–	
0.5	12,500	0	–	–	
1	–	–	50	0	
0.5	–	–	100	0	
0.5	–	–	400	0	
0.5	–	–	1,000	0	
0.5	–	–	2,000	0	
0.5	–	–	3,000	0	
0.5	–	–	5,000	0	
0.5	–	–	7,500	0	
0.5	–	–	10,000	0	
0.5	–	–	12,500	0	
3	–	–	–	–	Signal-to-Noise Ratio

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

Table B-13
TEK:95/TEK:95V Stereo Test Sequence with Crosstalk

Time Interval	Channel A (left) Sending Unit		Channel B (right) Sending Unit		Program Number: 95
Seconds	Frequency (Hz)	Level[a] (dBm0)	Frequency (Hz)	Level[a] (dBm0)	Measuring Function
1	1650/1850	–12	1650/1850	–12	O.33 Start / Source / Program ID
1	400	0	400	0	Insertion Gain
1	400	–8 dB on a peak prog. meter	400	–8 dB on a peak prog. meter	Polarity Tone: Polarity
250 msec	15000	–8	15000	–8	Sweep: Frequency Response, Interchannel Gain and Phase
250 msec	13999	–8	13999	–8	
250 msec	12503	–8	12503	–8	
250 msec	11243	–8	11243	–8	
250 msec	9001	–8	9001	–8	
250 msec	7500	–8	7500	–8	
250 msec	6203	–8	6203	–8	
250 msec	3499	–8	3499	–8	
250 msec	953	–8	953	–8	
250 msec	400	–8	400	–8	
500 msec	101	–8	101	–8	
1	50	–8	50	–8	
1	400	+10			Left Crosstalk
1			400	+10	Right Crosstalk
1	400	+10	400	+10	Total Harmonic Distortion plus Noise
2	–	–	–	–	Noise Floor (Silence)

[a]Relative to ASG 140 TEST level which can be set from –6 to +14 dBu.

TEK TEST SEQUENCE DESCRIPTION

TEK Preamble

The TEK preamble conforms to the CCITT O.33 preamble format, described previously in *CCITT O.33 Requirements for the Preamble (Start / Source / Program Identification).* A special signaling character of "0" is used to indicate the 0 dBm reference level, and a special signaling character of "1" is used to indicate the +8 dBm reference level.

Insertion Gain

This 400 Hz tone at the 0 dBm0 level in TEK:90, TEK:91, and TEK:95 is to be used to check for insertion gain. The tone is 1000 Hz at –70 dBm0 for TEK:92 to be used to check for insertion gain at microphone levels. For the TEK:93 and TEK:94 test, the tone is 1000 Hz, but the level is again 0 dBm0 for use at Line and Transmitter levels.

Polarity Tone

You can use this tone to check simultaneously for reversed polarity on the indicated channel, and for transposition and crosstalk into the other channel. You can measure it at the desired point in the audio path with an oscilloscope, or with analog or digital automatic measurement equipment.

The Polarity signal is the sum of two equal-amplitude sine waves. One has a fundamental frequency of 440 Hz (the displayed frequency for Polarity) and the other is the second harmonic of that frequency, 880 Hz. An example of the waveform generated by this function is shown in Figure B-1.

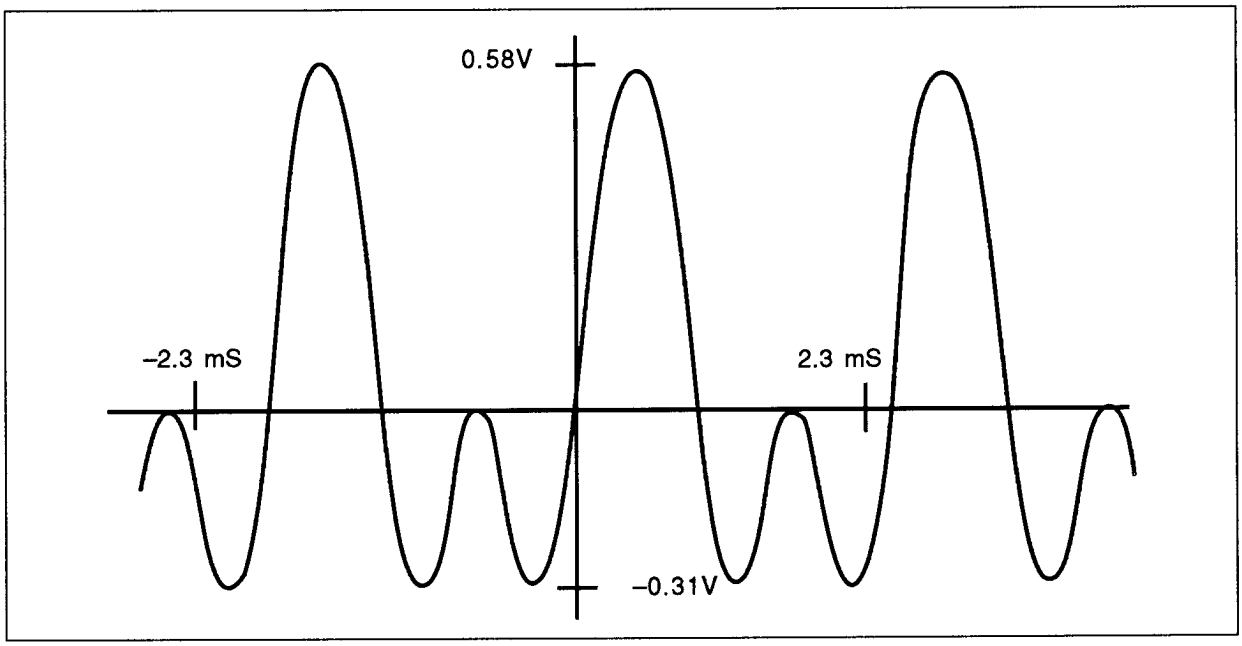


Figure B-1. TEK polarity signal waveform.

Crosstalk

These test levels are sent first on one channel, then the other. The undriven channel is checked to determine the amount of crosstalk between the channels.

Total Harmonic Distortion plus Noise (THD + N)

The test signals are sent at high levels to determine the signal path's harmonic distortion (non-linearity).

Noise Floor (Silence)

Silence is sent for a period of time to be used for checking the noise floor for a signal-to-noise ratio measurement.

Sweep

The frequencies of the sweep signals in the TEK tests satisfy the following conditions:

- Roughly logarithmic above 1 kHz.
- Prime number values.
- Non-multiples of 32 kHz, 44.1 kHz, and 48 kHz sampling rates.

The duration of the sweep signals were chosen to include either enough cycles to allow time for measurement, or to be 150 msec after a 140 msec settling period (conforming to CBC recommendations).

The level of the sweep signal is –8 dBm from the TEST Lev setting.

TEK SWEEP TEST

The TEK Sweep Test frequencies and times are shown in Table B-14.

The amplitude (SweepLev) for the three sweep tests (Sweep, R Sweep, and L Sweep) is separately selectable from the TEST Lev of the other AUTO test sequences. The Sweep level may be set to the same limits as the tone signal, from –90 to +24 dBu. With one of the Sweep Tests selected, pressing the AMPLITUDE button displays SweepLev; when the button is released, the current level setting is shown. That is the amplitude at which the sweep signals will be sent. If editing is enabled, the value can be changed using the front panel arrow keys in the same way as the TEST Lev for the other AUTO tests. The value may also be changed remotely using arguments with the AUTO command (see *Remote Operation* in Appendix A of this manual).

Table B-14
Sweep Test Sequence

Time Interval	Channel A (left) Sending Unit	Channel B (right) Sending Unit	Program Name: Sweep
Seconds	Frequency (Hz)	Frequency (Hz)	Measuring Function
1	25	25	Sweep: Frequency Response
1	31	31	
1	40	40	
1	50	50	
1	63	63	
1	80	80	
1	100	100	
1	125	125	
1	160	160	
1	200	200	
1	250	250	
1	315	315	
1	400	400	
1	500	500	
500 msec	630	630	
500 msec	800	800	
500 msec	1000	1000	
500 msec	1250	1250	
500 msec	1600	1600	
500 msec	2000	2000	

Table B-14 (cont)

Time Interval	Channel A (left) Sending Unit	Channel B (right) Sending Unit	Program Name: Sweep
Seconds	Frequency (Hz)	Frequency (Hz)	Measuring Function
500 msec	2500	2500	Sweep: Frequency Response (cont)
500 msec	3150	3150	
500 msec	4000	4000	
500 msec	5000	5000	
500 msec	6300	6300	
500 msec	8000	8000	
500 msec	10000	10000	
500 msec	12500	12500	
500 msec	16000	16000	
500 msec	20000	20000	

Appendix C
AUDIO/VIDEO TIMING

The Audio/Video Timing feature of the ASG 100/ASG 140 is part of a system that measures the timing difference between audio and video portions of a program that arrive from different transmission paths. Use this feature in conjunction with the VITS 200 NTSC and VITS 201 PAL insertion generators and VM 700A Video Measurement Set. Current production of the ASG 100 and ASG 140 Audio Signal Generators have the circuitry needed to support the Audio/Video timing measurement. Previously manufactured ASG 100 generators can be modified to support the measurement. See your local Tektronix representative for information on ordering any modification kits.

VM700A AUDIO/VIDEO MEASUREMENT OPERATING INSTRUCTIONS

The Audio/Video Timing measurement feature on the generators permits synchronization of the video and audio test signals at the sending end of the program. The VM 700A, equipped with Option 40 and the Audio Video Timing measurement, receives both at the receiving end and measures the timing difference to aid in retiming the signals. Figure C-1 shows the VM 700A display for the Audio Video Timing measurement. With no signals applied an error message line above the graph provides information regarding the state of the triggers needed to make a timing measurement. The line may say that it is waiting for either or both triggers (audio and video) to arrive, or that one or the other has arrived and it is waiting for the other. Upon receiving both triggers, the VM 700A makes the measurement and provides a delay time numerical readout and a graphical display.

VM 700A Signal Hookup

The measurement requires both video and audio test signal connections. Use one, two, or all three video input channels. The selected channel on the VM 700A is the source for the video part of the measurement, but audio signal selection is not automatic. You must externally switch the correct audio signal when switching between video channels (A, B, or C). The audio part of the timing measurement can come in on either the Left or the Right channel input; the measurement looks at both channels. The first arriving audio signal provides the audio trigger. The video channel providing the video signal for measurement follows the front panel channel selection.

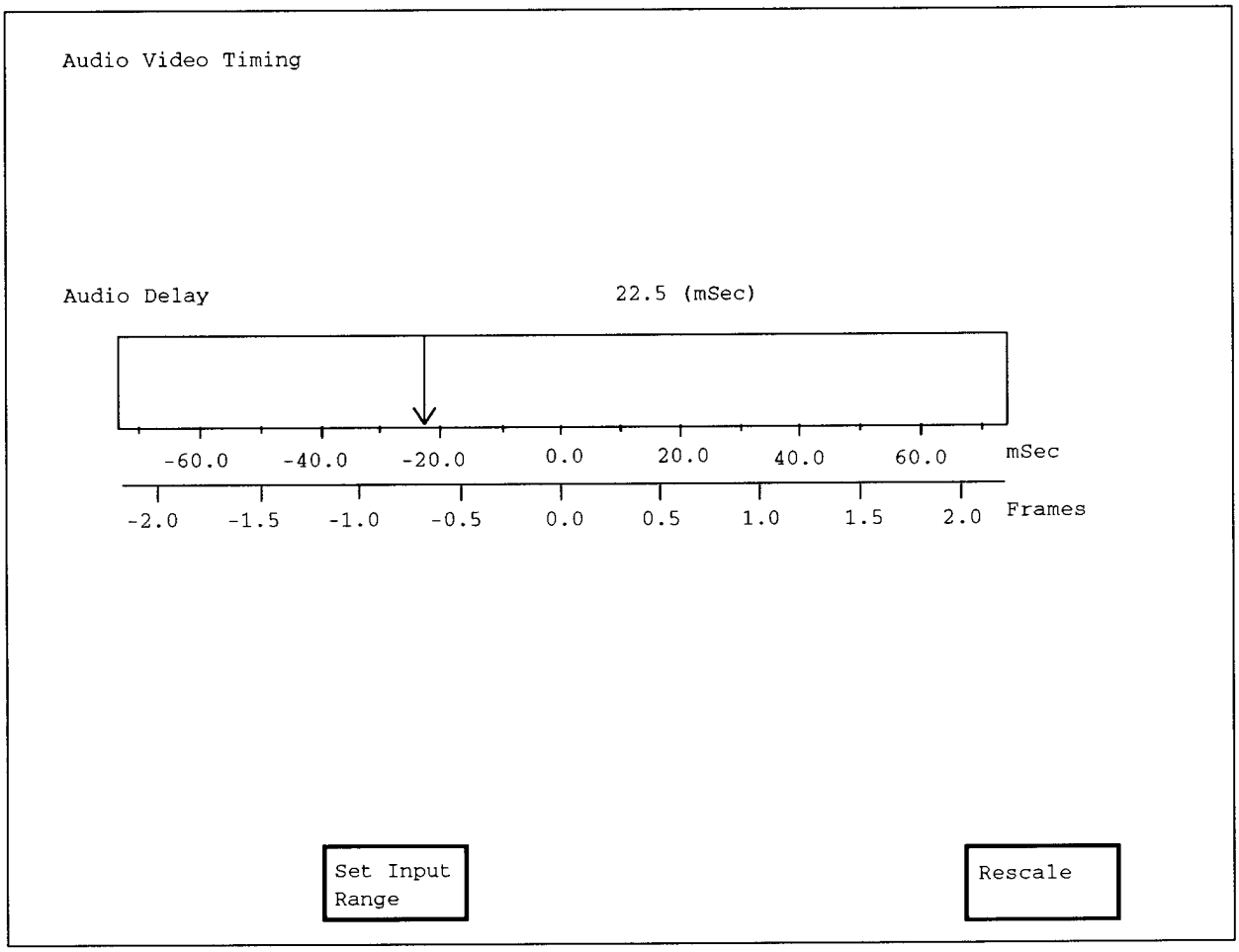


Figure C-1. Audio Video Timing display.

Audio Video Timing Menu

Set Input Range

Set Input Range enables you to select the range window that most closely matches the amplitude range of the input signal.

The VM700A will digitize audio in a 92 dB window within a total input range of 132 dB. The input ranges of the left and right channels may be configured independently with the **Left Range:** or **Right Range:** softkeys.

There are five input range windows:

range A: -62 to +30 dBu
range B: -72 to +20 dBu
range C: -82 to +10 dBu
range D: -92 to 0 dBu
range E: -102 to -10 dBu

Rescale

Rescale returns the display scaling to its default values.

VITS 200/ASG 100 AND ASG 140 AUDIO/VIDEO MEASUREMENT OPERATING INSTRUCTIONS

The Video/Audio Synchronization feature turns the vertical interval text of the VITS 200 generator and the audio output of the ASG 100/ASG 140 on and off at the same instant in time.

ASG100/ASG140 Instructions

1 Select manual mode.

2 Select 10 kHz frequency.

3 Select –10 dB output level.

4 Select "ON LINE" or "SIGNAL ON" as appropriate (red LED comes on).

Checkout

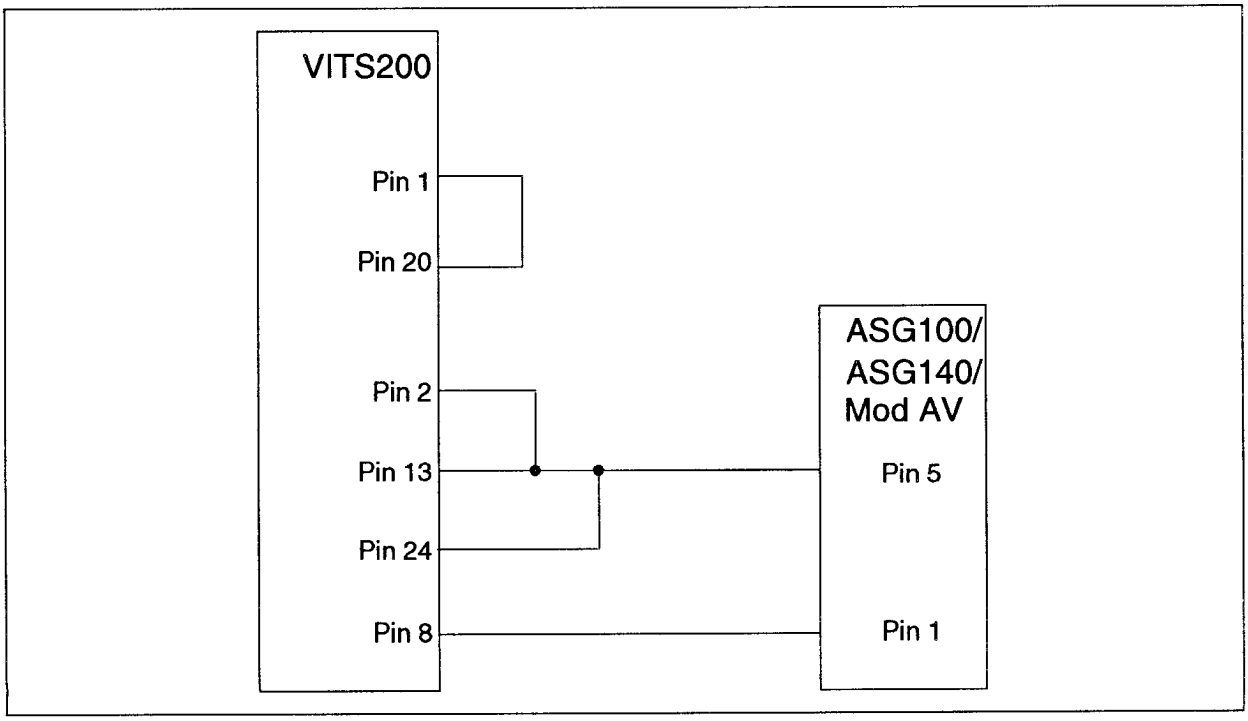
Grounding remote connector pin 1 turns off the audio output.

VITS 200 Instructions

1. Connect a NTSC video source so that the VITS 200 is genlocked.
2. From the front panel, select:

   Vertical Characters

   VERT CHAR 2 ENABLE
3. Input the message you intend to use.
4. Connect a special cable between the VITS 200 remote connector and the ASG 100/ASG 140 remote connector as shown in Figure C-2.



Checkout

When the VITS 200 is genlocked, the signal at the remote connector pin 14 of the VITS 200 will be a TTL HIGH voltage for 4.5 seconds then LOW for 0.5 seconds. The signal transitions from high to low at line 262 field 3. The signal at remote pin 15 is inverted from pin 14. The ASG 100/ASG 140 audio output is turned ON at this time, but the VITS 200 VITS text does not appear until field 1 line 11. This means that the ASG 100/ASG 140 Audio leads the video change by 17.334 ms. The VM 700A Audio Video Timing measurement removes the 17.334 ms before presenting the measured time difference.

NOTE

You can select any of the 15 possible messages by changing the selection lines that are grounded (pins 2,3,4,5). The wiring diagram above uses message #2 by grounding pin #2.

VITS 201/ASG100 AND ASG 140 AUDIO/VIDEO TIMING MEASUREMENT OPERATING INSTRUCTIONS

Video/Audio Synchronization

The Audio/Video feature turns the vertical interval text of the VITS 201 generator and the audio output of the ASG100/ASG 140 on and off at the same instant in time.

ASG100/ASG 140 Instructions

1. Select manual mode.
2. Select 10 kHz frequency.
3. Select –10 dB output level.
4. Select "ON LINE" or "SIGNAL ON" as appropriate (red LED comes on).

Checkout

Put the ASG 100 or ASG 140 on line with a manual test tone. Use a set of stereo headphones to listen to the outgoing signal. Check that grounding pin 1 of the rear panel remote connector turns off the audio output.

VITS 201 Instructions

1. Connect a PAL video source so that the VITS 201 is genlocked.
2. Open S11 switch 4 and switch 0.
3. Press function button 6 times until a C appears. Enter some text in the vertical interval like "Electronic Clapboard".

NOTE

Only one character is required.

NOTE

The output signal is HIGH during this function.

4. Close switch 0.
5. Connect a special cable between the VITS 201 remote connector and the ASG100 remote connector as shown in Figure C-3.

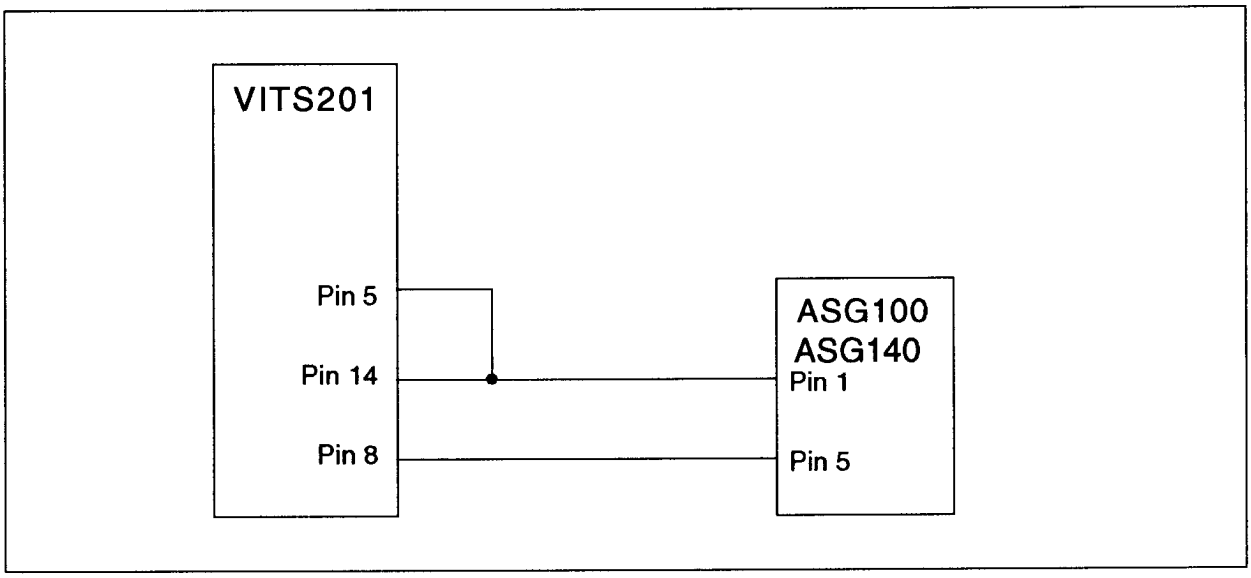


Figure C-3. Cabling between the VITS 201 and the ASG 100/ASG 140

Checkout

When the VITS 201 is in the power-up Line Selection mode and is genlocked, the signal at pin 14 of the remote connector will be a TTL low voltage for 4.5 seconds then high for 0.5 seconds. The signal transitions from low to high at line 1 field 1. When the TTL signal is high, the ASG 100/ASG 140 audio output is ON but the VITS 201 video text does not become visible until line 10 field 1. This time:

(9 lines * 64 µs = 576 µs)

is subtracted out of the VM700A measurement.

VITS 200, VITS 201 and ASG100 AUDIO/VIDEO TIMING MEASUREMENT CIRCUITRY MODIFICATIONS

Current production instruments have the Audio/Video circuitry incorporated. Make the following changes to existing equipment for the AV Timing Measurement modification. The ASG 140 supports the Audio/Video Timing measurement without modification.

WARNING

Only a qualified service person should attempt any modification to electronic circuitry.

VITS 200 Modification Description

This modification, required on early VITS 200 instruments only, calls for replacing U32 on the inserter board and U35 on the controller board with new programmed parts. Some rewiring of the control signals routing is also required. Future VITS 200 instruments will not require modification. If you require the AV Timing measurement, refer to your VITS 200 Operator's Manual or check with your Tektronix representative about the need to modify your existing equipment.

Board Modifications to Early VITS 200 Circuit Boards

The MONOCHR line (inserter board U38 pin 9, diagram 4) is an input to the Controller, U32, on pin 67. That signal is wire strapped to pin 4 of PAL U59 that provides two outputs: a buffered output from pin 18 and an inverted output from pin 17. These signals are wire strapped out of the VITS 200 on lines REM13 and REM14 on J12 to switch the ASG 100/ASG 140 signal generator on and off in synchronization with the VITS output video signal. Do the wire strapping to make the modification on the bottom side of the circuit board.

Add the following wires:

From	To
U23 pin 67	U59 pin 4
U59 pin 17	J12 pin 15
U59 pin 18	J12 pin 14
U35 pin 14	U35 pin 2

Remove the following components:

C148 0.1 μF and C147 0.1 μF.

Lift the pin 4 leg of U35 out of the socket (it remains unconnected).

VITS 201 Modification Description

This modification requires replacing U20 on the A1 assembly and adding a wire to route a control signal to the remote connector.

Remove A1U20 160-6539-00 and replace it with the Video Clapboard kernel EPROM **CMP-0028-00** checksum = **3484**.

Add a wire from A1U7 pin 6 (74LS273) to J35 pin 12. The signal will appear on the remote connector at pin 14.

Checkout

When the VITS 201 is in the power-up Line Selection mode and it is genlocked, the signal at the remote connector pin 14 will be a TTL low voltage for 4.5 seconds then high for 0.5 seconds. In all other cases, the signal will remain high. The signal transitions from low to high at line 1 field 1.

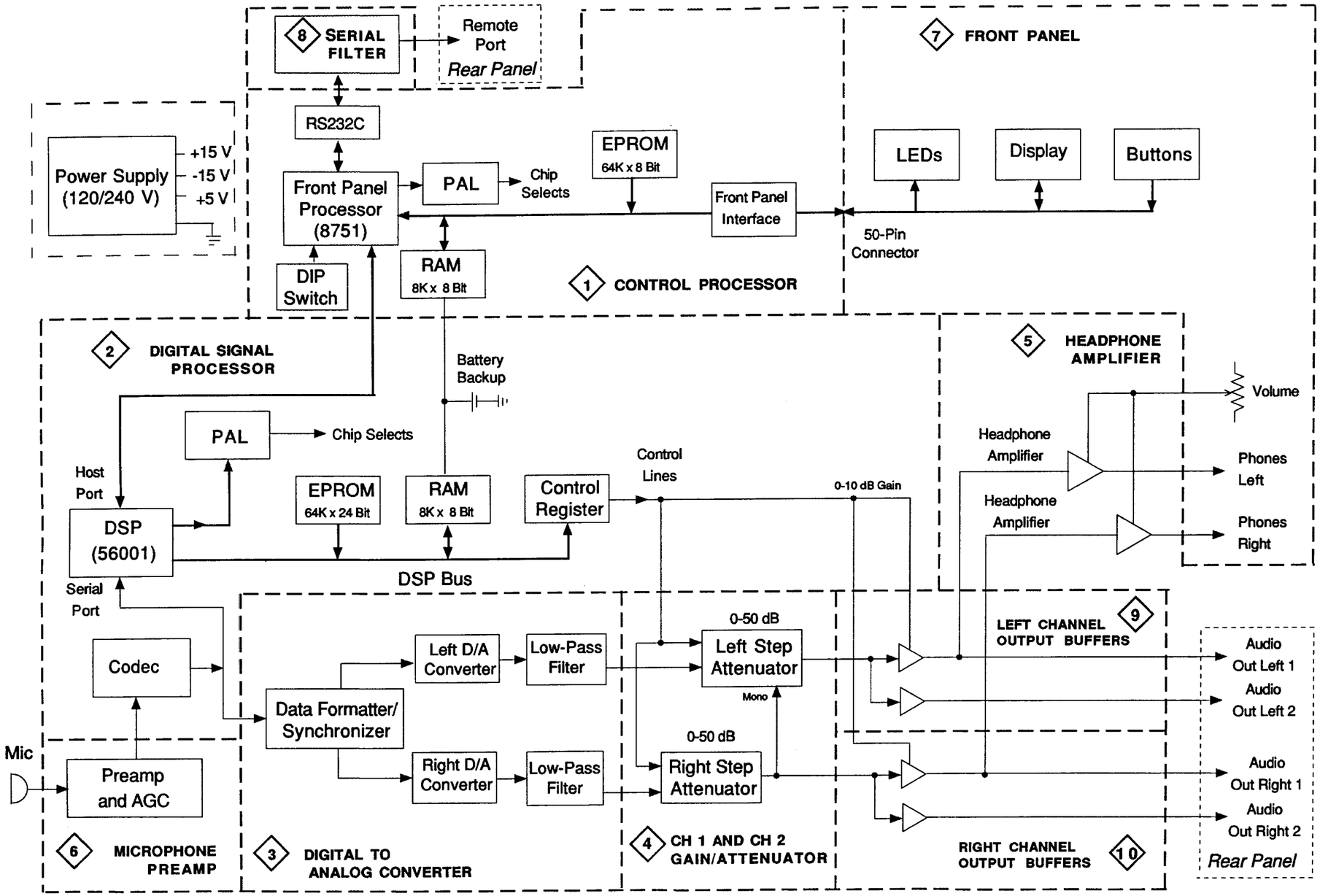
ASG100 Modification Description

This modification to the ASG100 requires some rewiring to route a control signal into the ASG100 from the remote connector and adding a pull-up resistor to the controlled signal line.

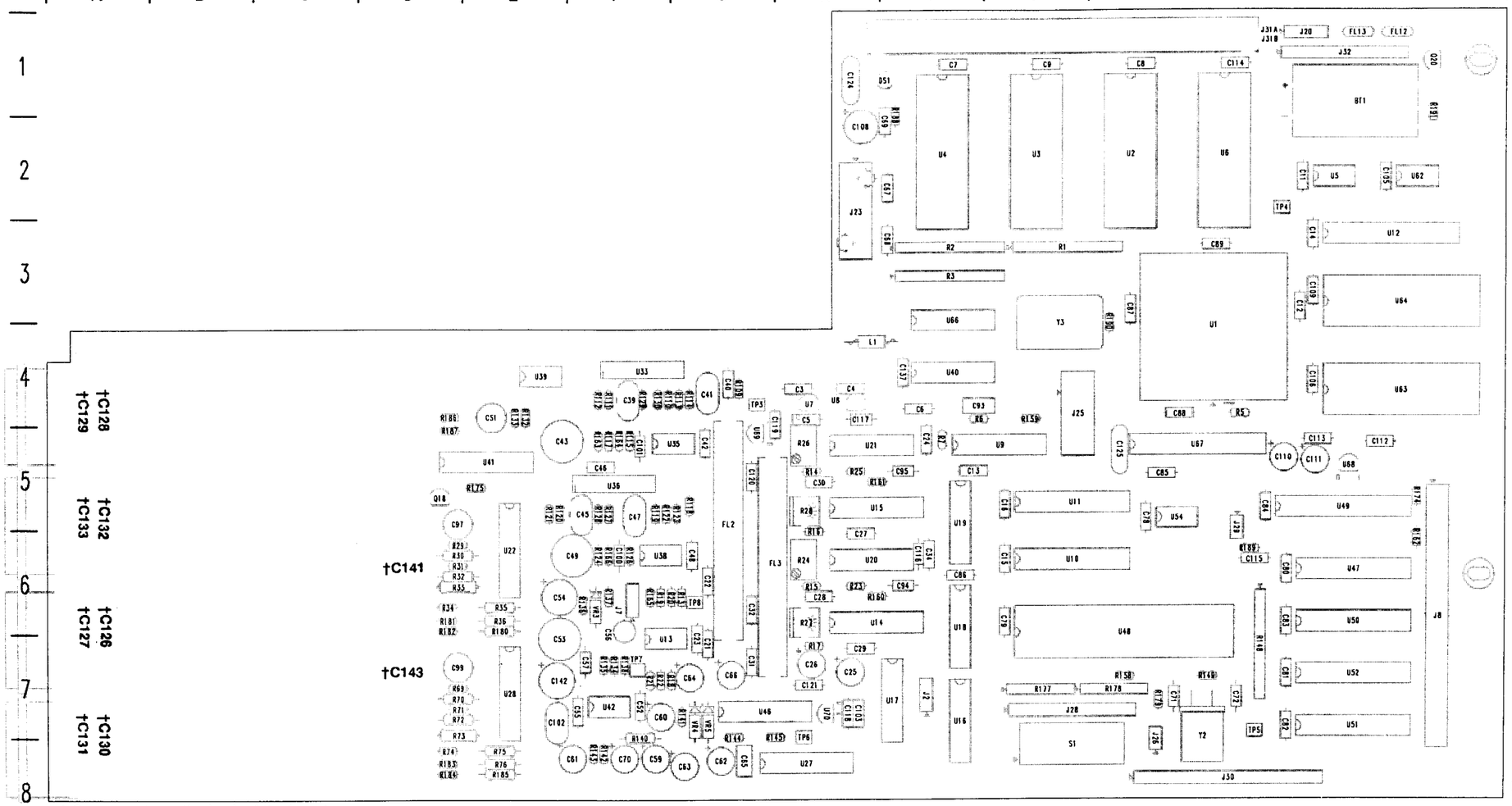
Cut pin 1 of A2U66 (74LS74). Solder a 2.2K resistor (313-1222-00) from pin 1 to pin 4. Connect a wire from A2U66 pin 1 to A2U67 (MAX239) pin 2.

Checkout

Put the ASG 100 on line with a manual test tone. Use a set of stereo headphones to listen to the outgoing signal. Check that grounding pin 1 of the rear panel remote connector turns off the audio output.



ASG 140 Block Diagram



671-2056-04

† Components on the back of the board

Static Sensitive Devices
See Maintenance Section

A2 MAIN Board

Schematic Diagram 1
MAIN Board

The schematic diagram has an alpha-numeric grid to assist in locating parts within that diagram. The etched circuit boards follow a numbering sequence starting with the lowest number at the upper left corner, as pictured in this manual.

ASSEMBLY A2 *Partial A2 also shown on diagrams 2, 3, 4, 5, and 6.*

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C71	B3	K7	R148	C1	L6	U40F	D3	G4
C72	B3	L7	R149	B3	L7	U47	D2	L6
C77	B4	L6	R153	B4	L5	U48	B2	J7
C78	B4	K5	R154	B4	L5	U49	E2	L6
C103	G2	N5	R158	A2	K7	U50	G3	L7
C109	F4	M3	R162	G2	N6	U51	G5	L8
C110	B5	L5	R174	H1	N5	U52	G4	L7
C111	B5	M5	R177	B1	J7	U54	C4	K6
C115	B3	L6	R178	B1	J7	U55	B4	K6
			R179	A3	K7	U62	E4	M2
CR14	B4	K6	R189	B3	L6	U63	F4	M5
						U64	F3	M4
J8	H1	N5	S1	A1	J8	U67	B5	K5
J25	C5	J4						
J26	A3	K7	U40B	D3	G4	Y2	B2	K8
J28	A1	J7	U40C	B3	G4			
J29	B3	L5	U40E	D3	G4			

FRONT PANEL PROCESSOR

DIP SWITCH

FOR TEST ONLY

J28

S1

R177 10K

R178 10K

MODA → U1-123

MODB → U1-121

R148 10K

U48 80C32T2-1

Y2 11.059MHZ

C71 33pF

R149 1M

C72 33pF

RESET

U40C 74LS04

R158 1.00K

(INT0) → U1-10

J26 INTERNAL EPROM

R179 10.0K

DATA [0..7] → U1

ADDR [0..2] → U1

U47 74LS373

ADDR [8..15]

U49 PAL22V10-25

(DSPEN) → U1-8

(DSPRST) → U1-124

(DSPWR) → U1-9

FRONT PANEL INTERFACE

J1 FRONT PANEL BOARD

AUD_J LEVEL → R132

C103 0.1uF

R162 49.9K

R174 1.00K

J8

RAM

u64 43256-12LL

u50 74LS273

u52 74LS244

u51 74LS244

BATTERY BACKUP

U62 DS1210

BATT → U5-2

C109 0.1uF

(NVRCE)

U63 27C512

EPROM

U54 MAX690

C78 0.1uF

(SWOEN)

(RESETA)

EXT. RESET → J29

R189 4.75K

C115 0.1uF

(EXTRST) → U31A-31

U40B 74LS04

U40E 74LS04

U40F 74LS04

RS232 PORT

U67 MAX239

C111 4.7uF

C110 10uF

U66-1 → DCD

J25

J1 SERIAL FILTER BOARD

= ANALOG GROUND

= DIGITAL GROUND

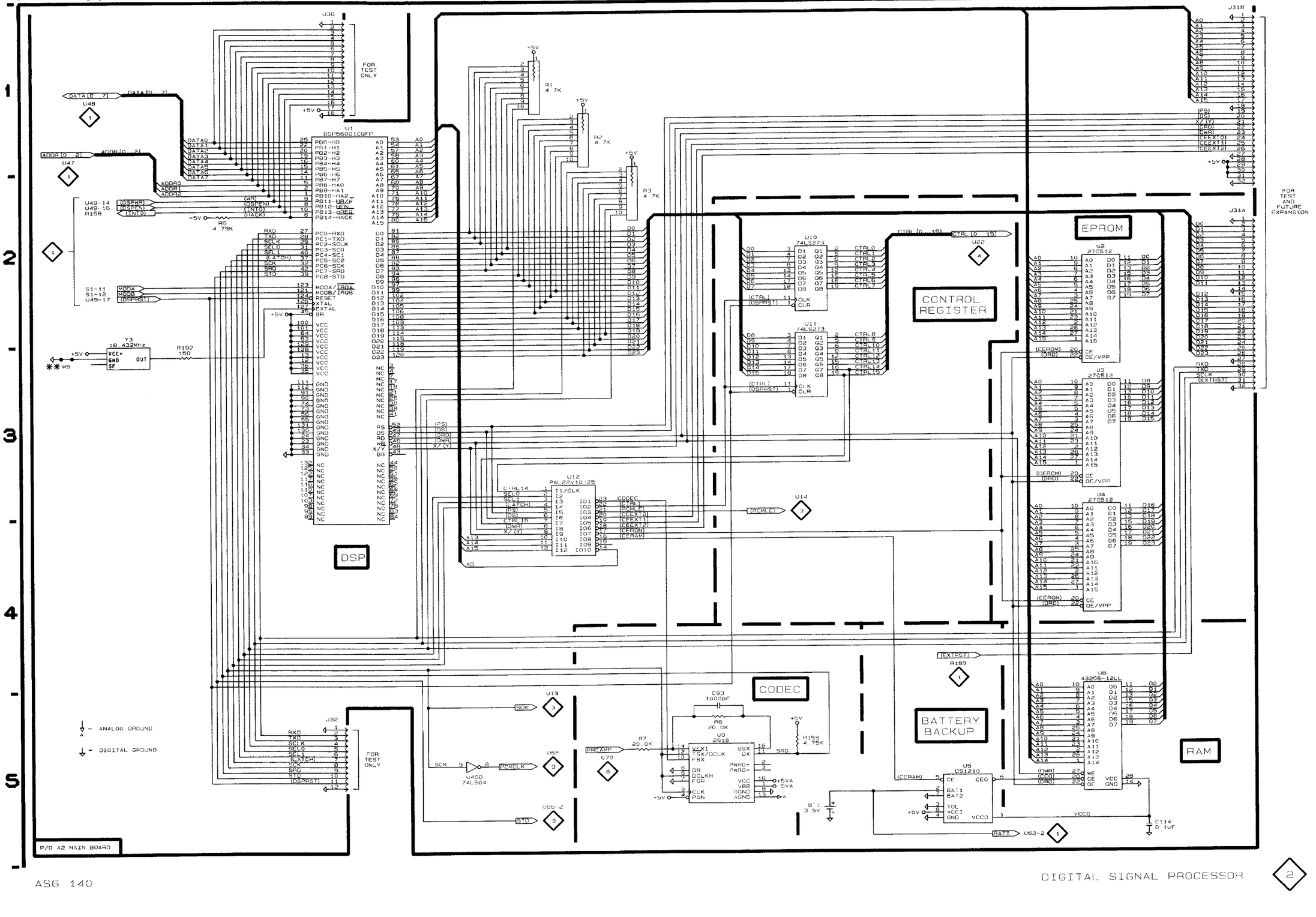
P/O A2 MAIN BOARD

Schematic Diagram 2
MAIN Board

The schematic diagram has an alpha-numeric grid to assist in locating parts within that diagram.

ASSEMBLY A2 *Partial A2 also shown on diagrams 1, 3, 4, 5, and 6*

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
BT1	E5	L2
C93	E5	I4
C114	G5	L1
CR15	F5	M1
J30	B1	K8
J31A	H2	L1
J31B	H1	L1
J32	B5	L1
R1	D1	J3
R2	D1	J3
R3	D1	J3
R5	B2	L4
R6	E5	I4
R7	D5	I5
R159	E5	J4
R190	A3	M1
U1	B1	L4
U2	G2	K1
U3	G3	J1
U4	G3	I1
U5	F5	M2
U6	G5	L1
U9	E5	I5
U10	E2	J6
U11	E2	J6
U12	D3	M3
U40D	C5	G4
W5	A3	I4
Y3	A3	I3

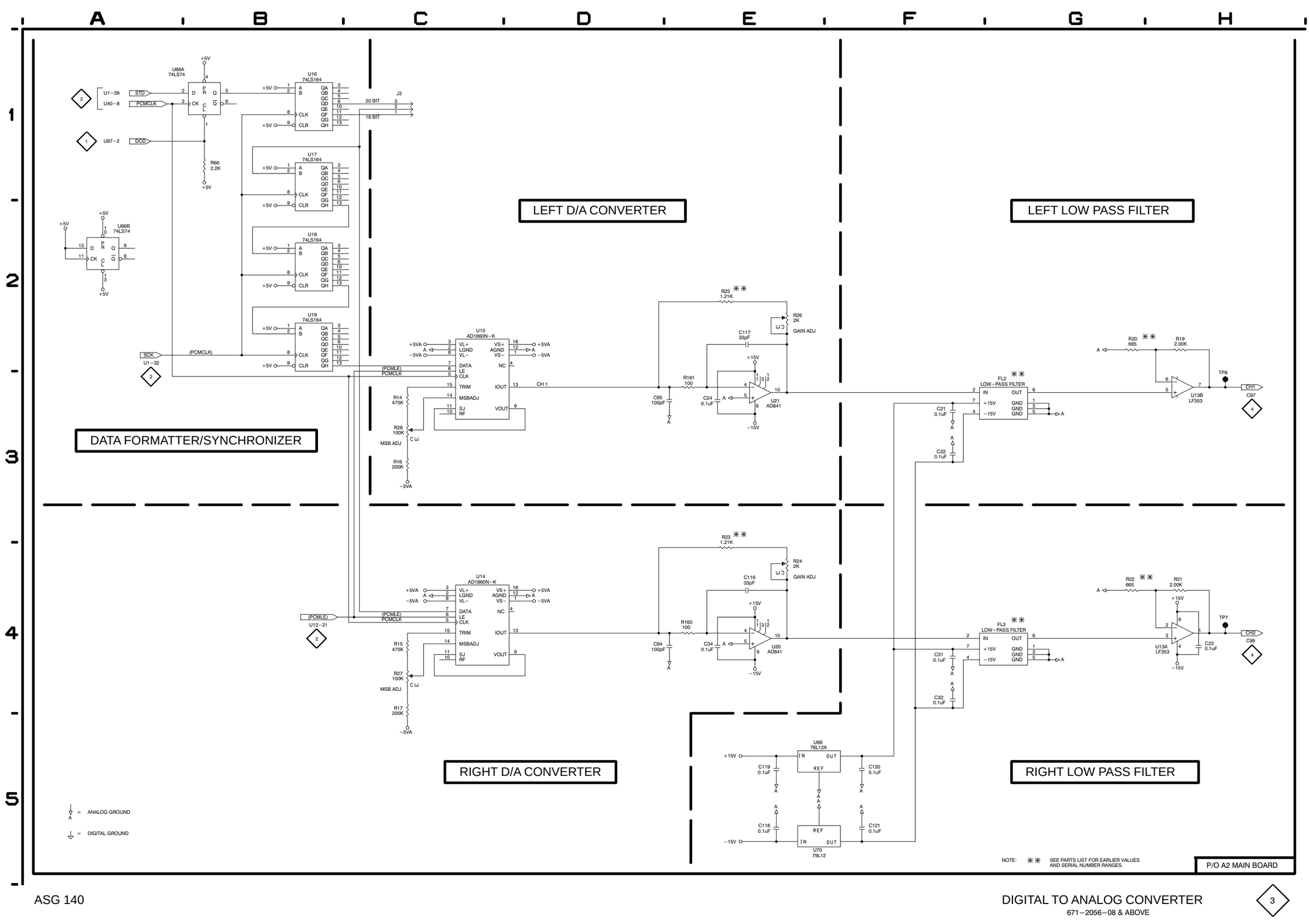

DSP
CODEC
EPROM
CONTROL REGISTER
BATTERY BACKUP
RAM
FOR TEST ONLY
FOR TEST AND FUTURE EXPANSION
P/O A2 MAIN BOARD
= ANALOG GROUND
= DIGITAL GROUND
U1 DSP56001CGFP
U10 74LS273
U11 74LS273
U12 PAL22V10-25
U2 27C512
U3 27C512
U4 27C512
U5 DS1210
U6 43256-12LL
U9 2916
U22
U400 74LS04
Y3 18.432MHz
R1 4.7K
R2 4.7K
R3 4.7K
R5 4.75K
R6 20.0K
R7 20.0K
R159 4.75K
R189
R192 150
C70
C93 1000pF
C114 0.1uF
BT1 3.5V
DATA[0..7]
ADDR[0..2]
CTRL[0..15]
STR[0..15]
(PCMCLK)
(PCMLE)
(EXTRST)
(CERAM)
BATT
VCCO
ASG 140
DIGITAL SIGNAL PROCESSOR
2

Schematic Diagram 3
MAIN Board

The schematic diagram has an alpha-numeric grid to assist in locating parts within that diagram.

ASSEMBLY A2 *Partial A2 also shown on diagrams 1, 2, 4, 5, and 6.*

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C21	F3	G7
C22	F3	G6
C23	H4	G6
C24	E3	I5
C31	F4	G7
C32	F4	G6
C34	E4	I6
C94	E4	I6
C95	E3	I5
C116	E4	I6
C117	E2	H4
C118	E5	H7
C119	E5	G4
C120	F5	G5
C121	F5	H7
FL2	F3	G5
FL3	F4	G5
J2	C1	I7
R14	C3	H5
R15	C4	H6
R16	C3	H6
R17	C4	H7
R19	H2	F6
R20	G2	F6
R21	H4	F7
R22	G4	F7
R23	E3	H6
R24	E4	H6
R25	E2	H5
R26	E2	H5
R27	C4	H6
R28	C3	H5
R160	E4	H6
R161	E3	H5
TP7	H4	F7
TP8	H3	G6
U13A	H4	F7
U13B	H3	F7
U14	C4	I6
U15	C2	I5
U16	B1	I7
U17	B1	H7
U18	B2	I6
U19	B2	I5
U20	E4	I6
U21	E3	I4
U66A	B1	I4
U66B	A1	I4
U69	E5	G5


DATA FORMATTER/SYNCHRONIZER
LEFT D/A CONVERTER
LEFT LOW PASS FILTER
RIGHT D/A CONVERTER
RIGHT LOW PASS FILTER
U66A 74LS74
U66B 74LS74
U16 74LS164
U17 74LS164
U18 74LS164
U19 74LS164
U15 AD1860N-K
U14 AD1860N-K
U21 AD841
U20 AD841
U13B LF353
U13A LF353
U69 78L12A
U70 79L12
FL2 LOW-PASS FILTER
FL3 LOW-PASS FILTER
STD
PCMCLK
DCD
SCK
(PCMCLK)
(PCMLE)
20 BIT
18 BIT
J2
GAIN ADJ
MSB ADJ
CH1
CH2
TP8
TP7
ANALOG GROUND
DIGITAL GROUND
NOTE: ** SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES.
P/O A2 MAIN BOARD

Schematic Diagram 3a
MAIN Board

The schematic diagram has an alpha-numeric grid to assist in locating parts within that diagram.

ASSEMBLY A2 *Partial A2 also shown on diagrams 1, 2, 4, 5, and 6.*

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C21	F3	G7
C22	F3	G6
C23	H4	G6
C24	E3	I5
C31	F4	G7
C32	F4	G6
C34	E4	I6
C94	E4	I6
C95	E3	I5
C116	E4	I6
C117	E2	H4
C118	E5	H7
C119	E5	G4
C120	F5	G5
C121	F5	H7
FL2	F3	G5
FL3	F4	G5
J2	C1	I7
R13	G3	G6
R14	C3	H5
R15	C4	H6
R16	C3	H6
R17	C4	H7
R18	G4	F7
R19	H2	F6
R20	G2	F6
R21	H4	F7
R22	G4	F7
R23	E3	H6
R24	E4	H6
R25	E2	H5
R26	E2	H5
R27	C4	H6
R28	C3	H5
R160	E4	H6
R161	E3	H5
TP7	H4	F7
TP8	H3	G6
U13A	H4	F7
U13B	H3	F7
U14	C4	I6
U15	C2	I5
U16	B1	I7
U17	B1	H7
U18	B2	I6
U19	B2	I5
U20	E4	I6
U21	E3	I4
U66A	B1	I4
U66B	A1	I4
U69	E5	G5

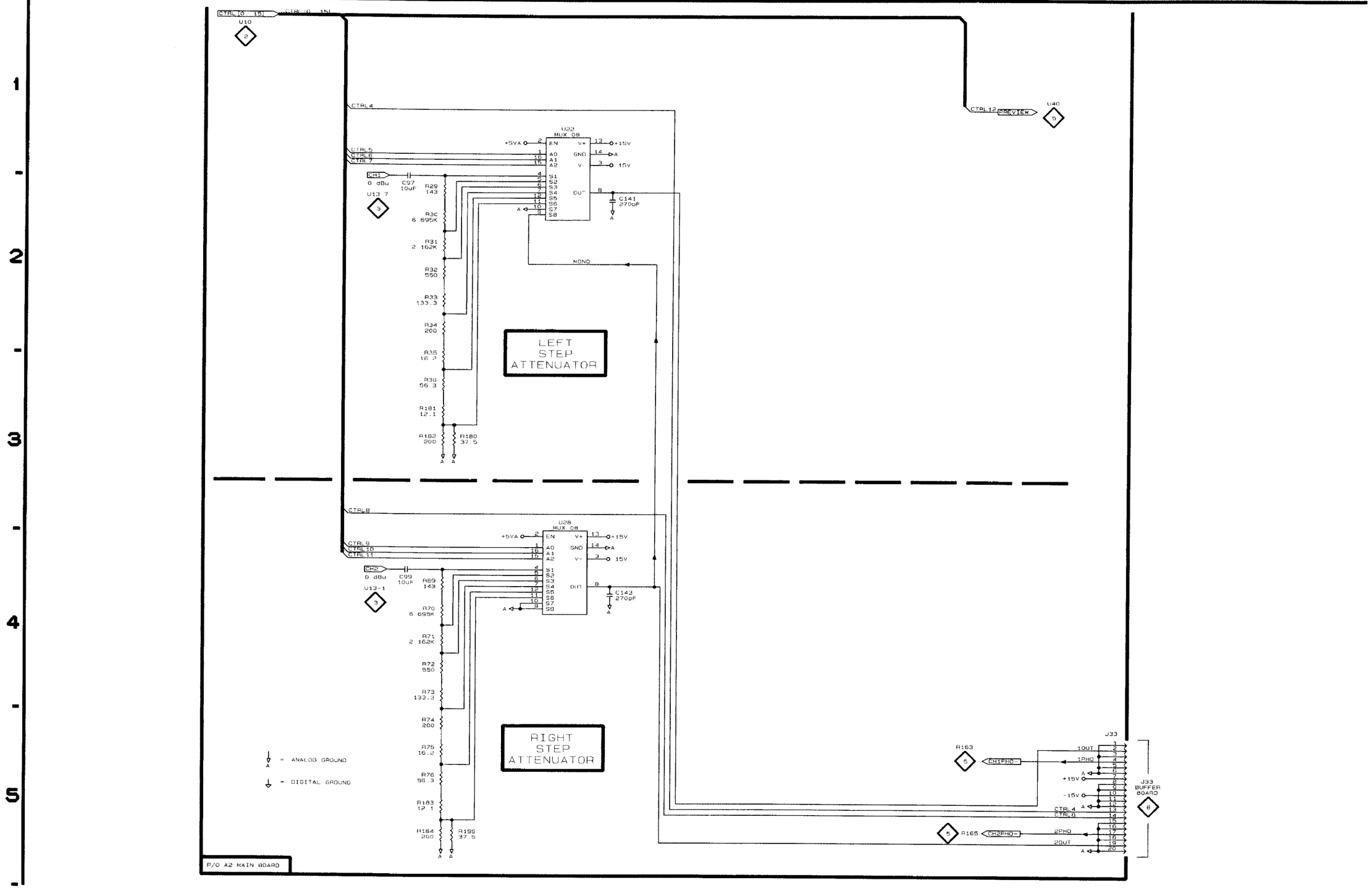
DATA FORMATTER/SYNCHRONIZER
LEFT D/A CONVERTER
LEFT LOW PASS FILTER
RIGHT D/A CONVERTER
RIGHT LOW PASS FILTER
U66A 74LS74
U66B 74LS74
U16 74LS164
U17 74LS164
U18 74LS164
U19 74LS164
U15 AD1860N-K
U14 AD1860N-K
U21 AD841
U20 AD841
U13B LF353
U13A LF353
U69 78L12A
U70 79L12
FL2 LOW-PASS FILTER
FL3 LOW-PASS FILTER
STD
PCMCLK
DCD
SCK
(PCMCLK)
(PCMLE)
20 BIT
18 BIT
GAIN ADJ
MSB ADJ
CH1
CH2
P/O A2 MAIN BOARD
= ANALOG GROUND
= DIGITAL GROUND

Schematic Diagram 4
MAIN Board

The schematic diagram has an alpha-numeric grid to assist in locating parts within that diagram.

ASSEMBLY A12 *Partial A2 also shown on diagrams 1, 2, 3, 5, and 6.*

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C35	D1	D5	R36	C3	E6
C36	D2	D5	R69	C4	D7
C37	D4	D7	R70	C4	D7
C38	D4	D8	R71	C4	D7
C96	D1	D5	R72	C4	D7
C97	C1	D6	R73	C4	D8
C99	C4	D7	R74	C5	D8
C141	D2	5D	R75	C5	E8
C143	D4	6D	R76	C5	E8
			R180	C3	E7
J33	G5	D5	R181	C3	D6
			R182	C3	D7
R29	C2	D6	R183	C5	D8
R30	C2	D6	R184	C5	D8
R31	C2	D6	R185	C5	E8
R32	C2	D6			
R33	C2	D6	U22	D1	E5
R34	C2	D6	U28	D4	E7
R35	C2	E6			


CTRL 0..15
U10
2
CTRL 4
CTRL 12 PREVIEW
U40
5
U22
MUX 08
+5VA
EN
V+
+15V
CTRL 5
CTRL 6
CTRL 7
A0
A1
A2
GND
A
V-
15V
CH1
0 dBu
C97
10uF
R29
143
U13-7
3
R30
6.695K
R31
2.162K
R32
550
R33
133.3
R34
200
R35
16.2
R36
56.3
R181
12.1
R182
200
R180
37.5
S1
S2
S3
S4
S5
S6
S7
S8
OUT
C141
270pF
MONO
LEFT
STEP
ATTENUATOR
CTRL 8
U28
MUX 08
CTRL 9
CTRL 10
CTRL 11
CH2
0 dBu
C99
10uF
R69
143
U13-1
R70
6.695K
R71
2.162K
R72
550
R73
133.3
R74
200
R75
16.2
R76
56.3
R183
12.1
R184
200
R195
37.5
C143
270pF
RIGHT
STEP
ATTENUATOR
= ANALOG GROUND
= DIGITAL GROUND
P/O A2 MAIN BOARD
J33
R163
5
CH1PHO-
1OUT
1PHO
+15V
-15V
CTRL 4
CTRL 0
J33
BUFFER
BOARD
6
5
R165
CH2PHO-
2PHO
2OUT

Schematic Diagram 5
MAIN Board

The schematic diagram has an alpha-numeric grid to assist in locating parts within that diagram.

ASSEMBLY A2 *Partial A2 also shown on diagrams 1, 2, 3, 4, and 6.*

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C39	D3	F4
C40	E3	G4
C41	F3	G4
C42	C1	G5
C43	C1	E4
C45	D4	F5
C46	E4	F5
C47	F4	F5
C48	C2	G6
C49	C2	E6
C51	C5	E4
C100	B2	F6
C101	B1	F5
FL12	G3	M1
FL13	G4	M1
J20	H3	L1
Q18	C3	D5
Q19	C3	C4
Q20	G3	N1
R109	G3	G4
R110	F3	F4
R111	D3	F4
R112	C1	F4
R113	F3	G4
R114	F3	G4
R115	B1	F5
R118	G4	G5
R119	F4	F5
R120	D4	E5
R121	C2	E5
R122	F4	F5
R123	F4	G5
R124	B2	F6
R127	E4	F5
R128	E4	F5
R129	E3	F4
R130	E3	F4
R132	B5	E4
R133	B5	E4
R163	B1	F5
R164	B1	F5
R165	B2	F6
R166	B2	F6
R175	B3	E5
R176	B3	D5
R186	C3	D4
R187	C3	D5
R191	G3	N1
U33	E3	F4
U35A	B1	F5
U35B	F3	F5
U36	E4	E5
U38A	B2	F6
U38B	F4	F6
U39	C5	E4
U40A	B3	G4
U41	D3	D5
CHASSIS		
E200	H3	---
C200	H3	---
C135	H2	---
C136	H2	---

HEADPHONE AMPLIFIER

J33–4 → CH1PHO– → R163 100.0K → U35A 5532 (C101 100pF, R115 56.2K, R164 56.2K, C42 0.1uF, C43 47uF, R112 20.0K; +15V, –15V, A)

J33–17 → CH2PHO– → R165 100.0K → U38A 5532 (C100 100pF, R124 56.2K, R166 56.2K, C48 0.1uF, C49 47uF, R121 20.0K; +15V, –15V, A)

U27 PREVIEW → U40A 74LS04 → Norm

R45 PREV1 / R85 PREV2 → R176 20.0K / R175 20.0K → Prev

Q19, R186 20.0K; Q18, R187 20.0K

U41 DG405 (+15V, –15V, +5VA)

U33 DBX 2151 (C40 0.1uF, R111 20.0K, C39 98pF, R129 10.0K, R130 3.74K, –15V)

U36 DBX 2151 (C46 0.1uF, R120 20.0K, C45 98pF, R128 10.0K, R127 3.74K, –15V)

J8–6 → AUD LEVEL → R132 100K, R133 3.32K, C51 10uF → U39 LF351

U35B 5532 (C41 33pF, R110 20.0K, R113 100, R114 20.0K, R109 150, FL12 180pF)

U38B 5532 (C47 33pF, R119 20.0K, R122 100, R123 20.0K, R118 150, FL13 180pF)

(RESET) → R191 10.0K → Q20 VNO105

LPHO / RPHO → J20

NOTE: PIN 3 OF J20 NOT INSERTED ON ECB.

EFF B010584 & BELOW

HEADPHONES JACK MOUNTED ON FRONT CASTING

J200, E200 **, C200 0.001 **, CH

J200, C135 .001, C136 .001, C200 0.001 **, CH

HEADPHONES JACK MOUNTED ON FRONT CASTING

= ANALOG GROUND

= DIGITAL GROUND

NOTE: ** SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES.

P/O A2 MAIN BOARD

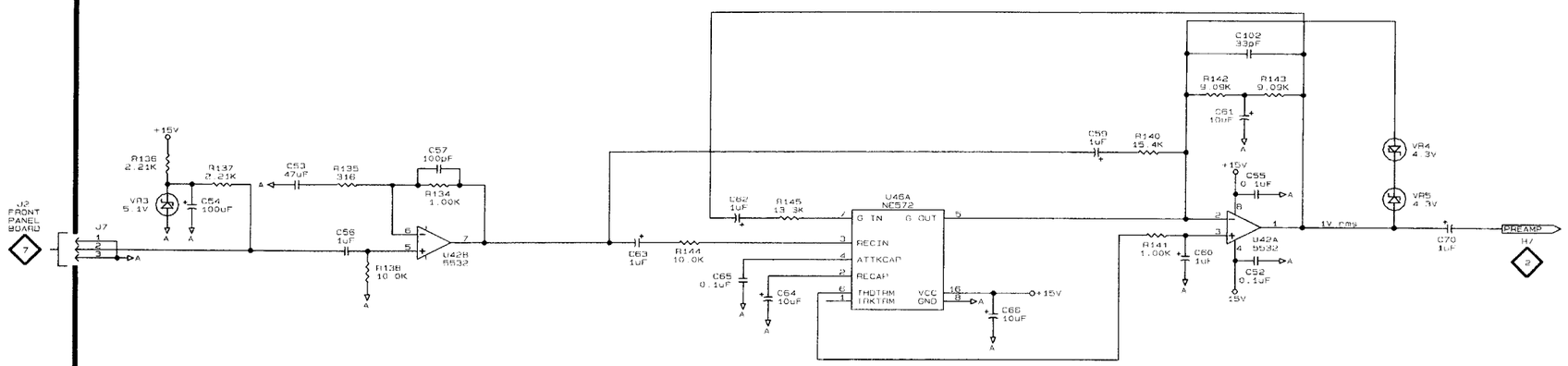
Schematic Diagram 6
MAIN Board

The schematic diagram has an alpha-numeric grid to assist in locating parts within that diagram.

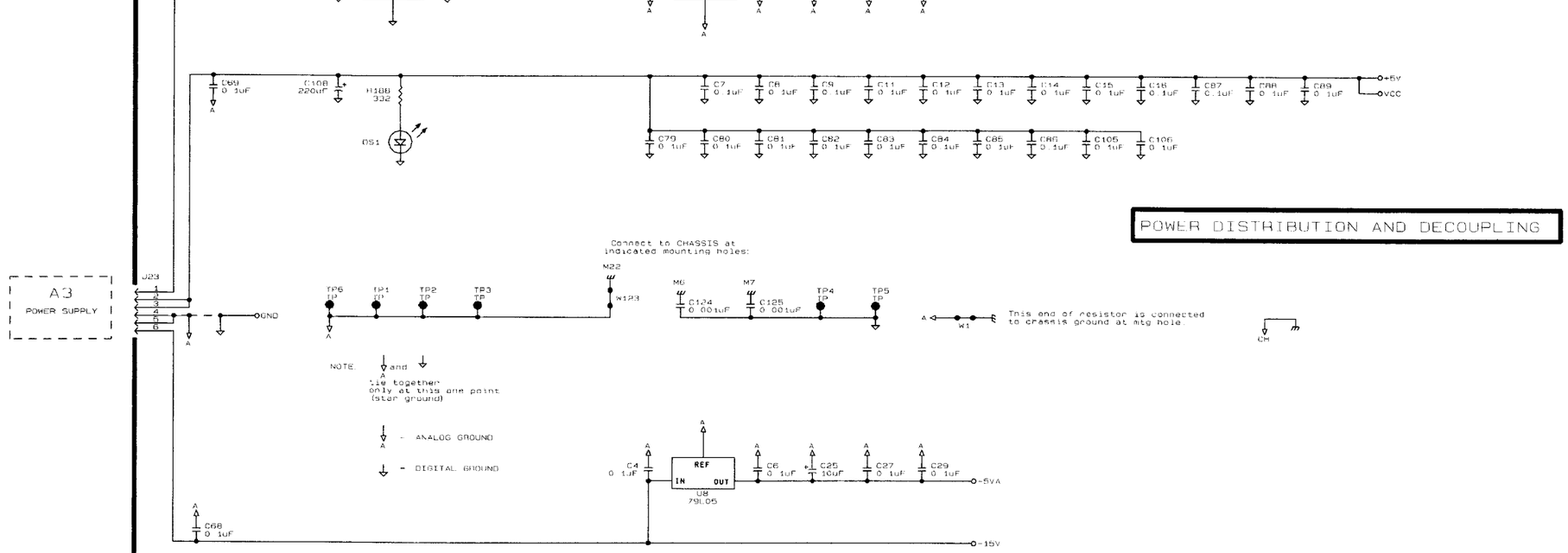
ASSEMBLY A2 *Partial A2 also shown on diagrams 1, 2, 3, 4, and 5.*

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3	D3	H4	C105	F4	M2
C4	D5	I4	C106	F4	M4
C5	D3	H4	C108	C3	H1
C6	D5	I4	C112	C3	M5
C7	D3	I1	C113	C3	M5
C8	D3	K1	C124	D4	H1
C9	E3	J1	C125	D4	K5
C11	E3	M2	C134	D4	8N
C12	E3	L3	C137	F4	4H
C13	E3	I5	C142	C3	E7
C14	F3	M3			
C15	F3	J6	DS1	C4	H1
C16	F3	J5			
C25	E5	H7	J7	B2	F6
C26	E3	H7	J23	B4	H2
C27	E5	H6			
C28	E3	H6	R134	C2	F7
C29	E5	H7	R135	C2	F7
C30	E3	H5	R136	B2	F6
C52	G2	F7	R137	B2	F6
C53	C2	E7	R138	C2	F7
C54	B2	E6	R140	F1	F8
C55	G2	F7	R141	F2	G7
C56	C2	F7	R142	F1	F8
C57	C2	F7	R143	G1	F8
C59	F1	F8	R144	D2	G8
C60	F2	G7	R145	E2	G8
C61	F1	E8	R188	C3	I1
C62	D2	G8			
C63	D2	G8	TP1	C4	B6
C64	E2	G7	TP2	C4	E7
C65	D2	G8	TP3	C4	G4
C66	E2	G7	TP4	E4	L2
C67	B3	I2	TP5	E4	L8
C68	B5	I3	TP6	C4	H7
C69	B3	I2			
C70	G2	F8	U7	D3	H4
C79	D4	J6	U8	D5	H4
C80	D4	L6	U42A	F2	F7
C81	D4	L7	U42B	C2	F7
C82	E4	L7	U46A	E2	G7
C83	E4	L6	U68	C3	M5
C84	E4	L5			
C85	E4	K5	VR3	B2	F6
C86	F4	I6	VR4	G1	G7
C87	F3	K3	VR5	G2	G7
C88	G3	K4			
C89	G3	L3	W1	E4	B8
C102	G1	E7	W123	D4	A4

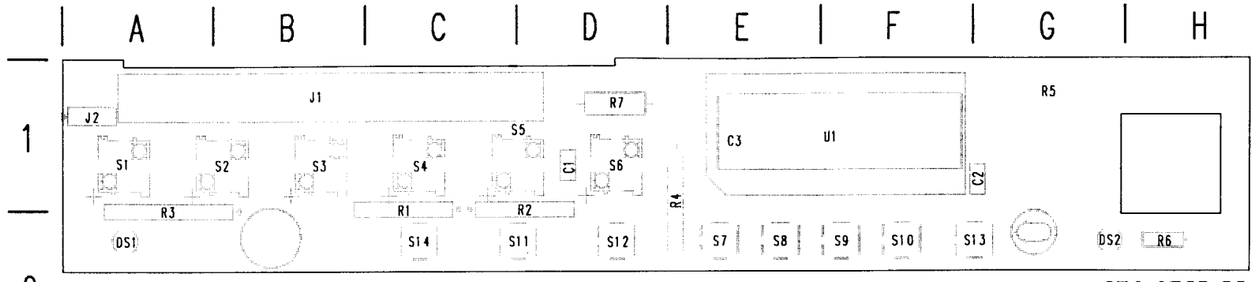
MIC PREAMP AND AGC



POWER DISTRIBUTION AND DECOUPLING



P/O A2 MAIN BOARD



671-1763-00

A1 FRONT PANEL Board

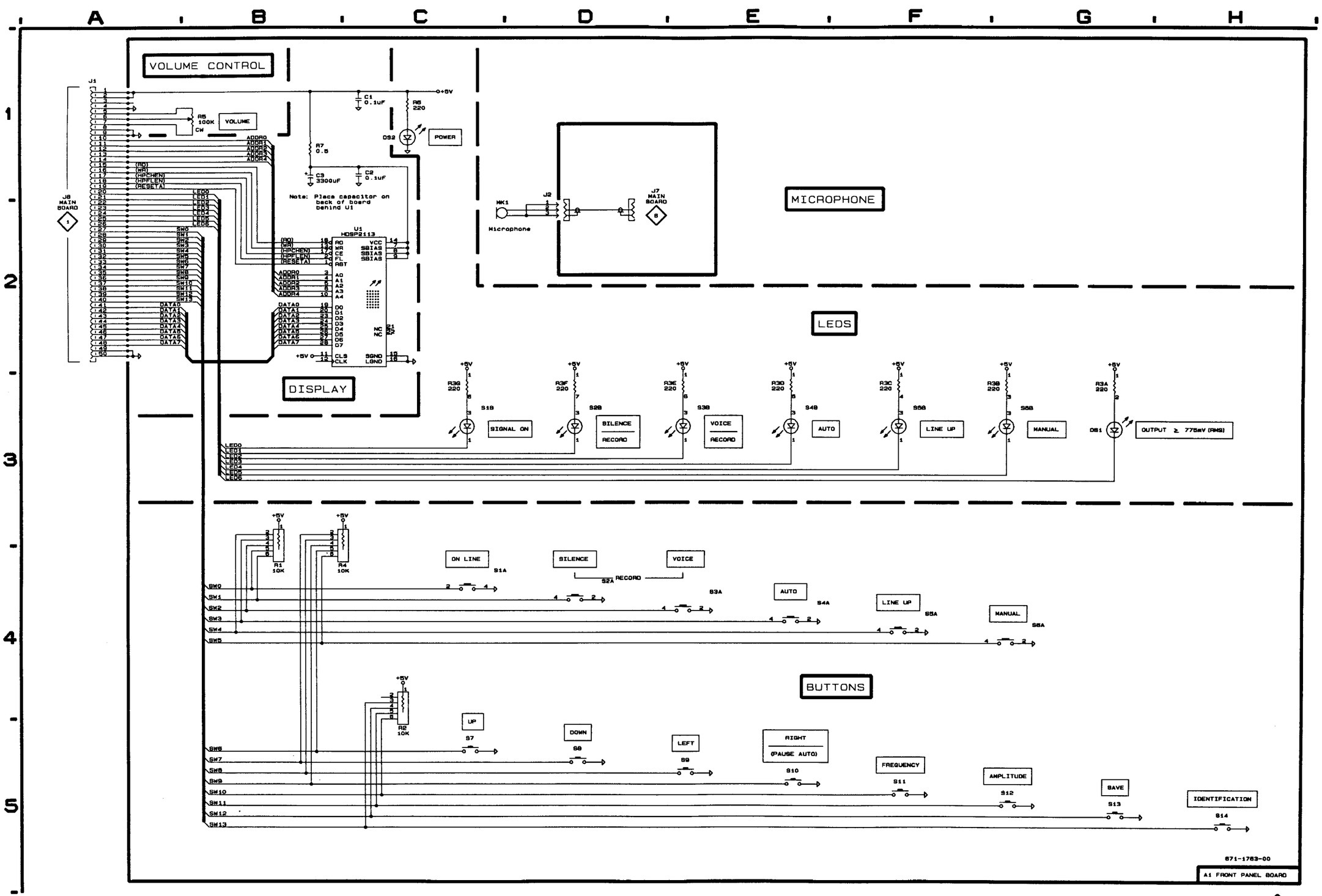
Static Sensitive Devices
See Maintenance Section

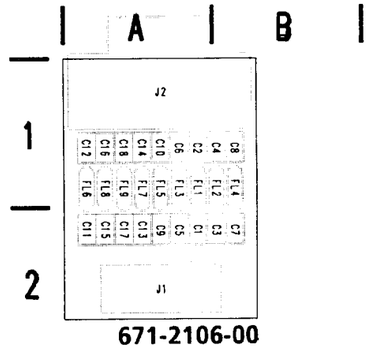
Schematic Diagram 7
FRONT PANEL Board

The schematic diagram has an alpha-numeric grid to assist in locating parts within that diagram.

ASSEMBLY A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1	C1	D1	S1A	C4	A1
C2	C1	G1	S1B	C3	A1
C3	B1	D1	S2A	D4	B1
			S2B	D3	B1
DS1	G3	A2	S3A	E4	B1
DS2	C1	G2	S3B	D3	B1
			S4A	E4	C1
J1	A1	D1	S4B	E3	C1
J2	D2	A1	S5A	F4	C1
			S5B	F3	C1
R1	B3	C2	S6A	G4	D1
R2	C4	C2	S6B	F3	D1
R3A	G3	B2			
R3B	G3	B2	S7	C5	E2
R3C	F3	B2	S8	D5	E2
R3D	E3	B2	S9	E5	F2
R3E	E3	B2	S10	E5	F2
R3F	D3	B2	S11	F5	D2
R3G	C3	B2	S12	G5	D2
R4	B3	E1	S13	G5	G2
R5	B1	G1	S14	H5	C2
R6	C1	H2			
R7	B1	D1	U1	B2	E2


VOLUME CONTROL
J1
J8 MAIN BOARD
R5 100K VOLUME CW
C1 0.1uF
+5V
R6 220
DS2
POWER
R7 0.5
C3 3300uF
C2 0.1uF
Note: Place capacitor on back of board behind U1
U1 HDSP2113
ADDR0
ADDR1
ADDR2
ADDR3
ADDR4
(RD)
(WR)
(HPCHEN)
(HPFLEN)
(RESETA)
LED0
LED1
LED2
LED3
LED4
LED5
LED6
SW0
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10
SW11
SW12
SW13
DATA0
DATA1
DATA2
DATA3
DATA4
DATA5
DATA6
DATA7
DISPLAY
MK1
Microphone
J2
J7 MAIN BOARD
MICROPHONE
LEDS
R36 220
S1B
SIGNAL ON
R3F 220
S2B
SILENCE
RECORD
R3E 220
S3B
VOICE
RECORD
R3D 220
S4B
AUTO
R3C 220
S5B
LINE UP
R3B 220
S6B
MANUAL
R3A 220
DS1
OUTPUT ≥ 775mV (RMS)
R1 10K
R4 10K
ON LINE
S1A
SILENCE
S2A
RECORD
VOICE
S3A
AUTO
S4A
LINE UP
S5A
MANUAL
S6A
BUTTONS
R2 10K
UP
S7
DOWN
S8
LEFT
S9
RIGHT
(PAUSE AUTO)
S10
FREQUENCY
S11
AMPLITUDE
S12
SAVE
S13
IDENTIFICATION
S14
671-1763-00
A1 FRONT PANEL BOARD



671-2106-00

A4 SERIAL FILTER Board

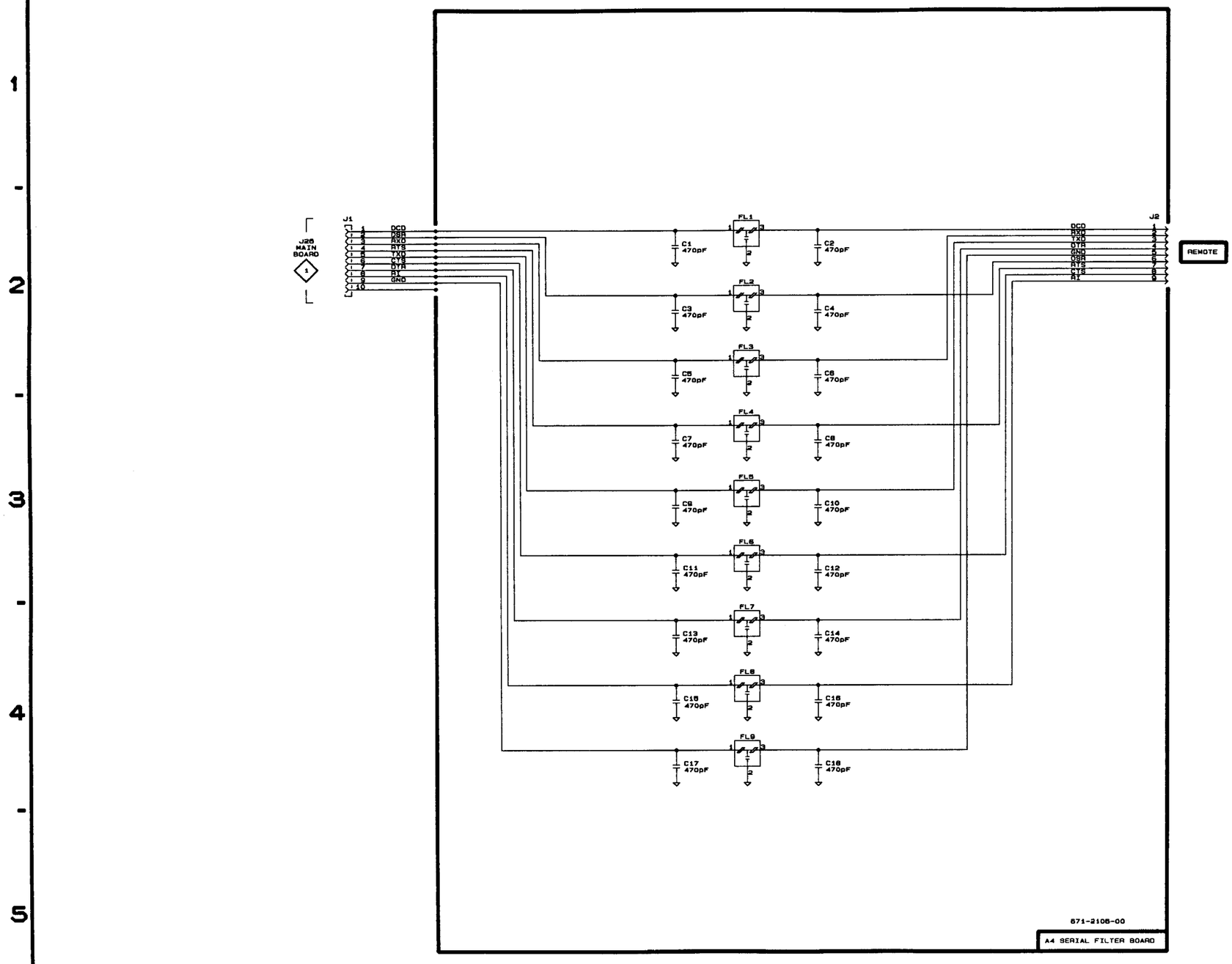
Static Sensitive Devices
See Maintenance Section

Schematic Diagram 8
SERIAL FILTER Board

The schematic diagram has an alpha-numeric grid to assist in locating parts within that diagram. The etched circuit boards follow a numbering sequence starting with the lowest number at the upper left corner, as pictured in this manual.

ASSEMBLY A4

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1	D2	A2
C2	E2	A1
C3	D2	B2
C4	E2	B1
C5	D2	A2
C6	E2	A1
C7	D3	B2
C8	E3	B1
C9	D3	A2
C10	E3	A1
C11	D3	A2
C12	E3	A1
C13	D4	A2
C14	E4	A1
C15	D4	A2
C16	E4	A1
C17	D4	A2
C18	E4	A1
FL1	D2	A1
FL2	D2	B1
FL3	D2	A1
FL4	D3	B1
FL5	D3	A1
FL6	D3	A1
FL7	D4	A1
FL8	D4	A1
FL9	D4	A1
J1	B2	A2
J2	F2	A1

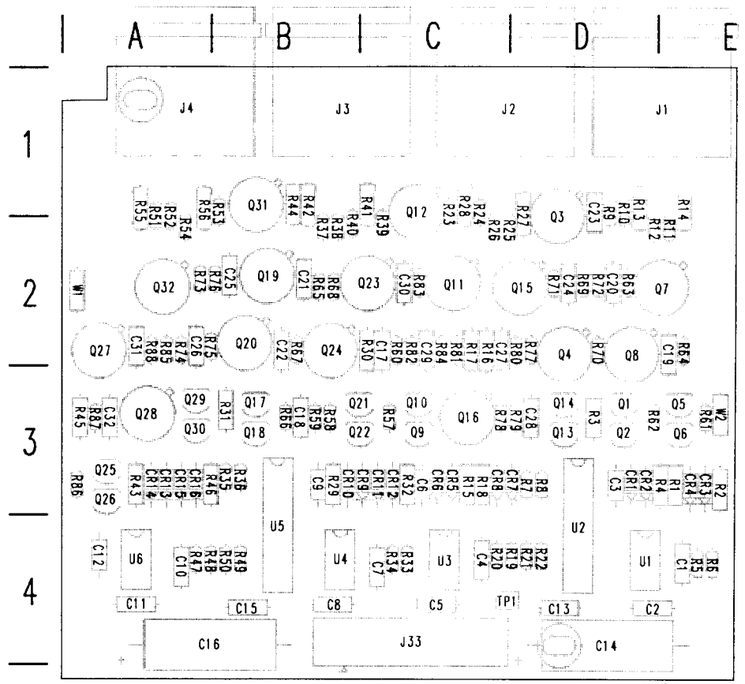

J25
MAIN
BOARD
J1
1 DCD
2 DSR
3 RXD
4 RTS
5 TXD
6 CTS
7 DTR
8 RI
9 GND
10
FL1
FL2
FL3
FL4
FL5
FL6
FL7
FL8
FL9
C1 470pF
C2 470pF
C3 470pF
C4 470pF
C5 470pF
C6 470pF
C7 470pF
C8 470pF
C9 470pF
C10 470pF
C11 470pF
C12 470pF
C13 470pF
C14 470pF
C15 470pF
C16 470pF
C17 470pF
C18 470pF
J2
DCD 1
RXD 2
TXD 3
DTR 4
GND 5
DSR 6
RTS 7
CTS 8
RI 9
REMOTE
671-2106-00
A4 SERIAL FILTER BOARD

Schematic Diagram 9
FOUR BALANCED OUTPUTS Board

The schematic diagram has an alpha-numeric grid to assist in locating parts within that diagram.

ASSEMBLY A2A1 *Partial A2A1 also shown on diagram 10.*

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C4	C3	C4
C5	C3	C4
C6	D3	C3
C10	C1	A4
C11	C2	A4
C12	D1	A4
C13	D5	D4
C14	D5	D4
C15	D5	B4
C16	D5	A4
C25	G2	B4
C26	G3	A2
C27	G4	C2
C28	G4	D3
C29	E3	C2
C30	E3	C2
C31	E1	A2
C32	E1	A3
CR5	D3	C3
CR6	D3	C3
CR7	F4	C3
CR8	F4	C3
CR13	D1	A3
CR14	D2	A3
CR15	F2	A3
CR16	F3	A3
J2	H4	C1
J4	H2	A1
J33	A5	C4
Q9	D3	C3
Q10	D3	C3
Q11	E3	C2
Q12	E4	C2
Q13	F4	D3
Q14	F4	D3
Q15	G4	D2
Q16	G4	C3
Q25	D1	A3
Q26	D2	A3
Q27	E1	A2
Q28	E2	A3
Q29	F2	A3
Q30	F3	A3
Q31	G2	B1
Q32	G3	A2
R15	D4	C3
R16	F4	C2
R17	D3	C2
R18	F5	C3
R19	F3	C4
R20	E3	C4
R21	B3	D4
R22	B3	D4
R23	E3	C1
R24	G4	C1
R25	G4	C2
R26	G4	C2
R27	G4	D1
R28	G3	C1
R43	D2	A3
R44	F2	B1
R45	D1	A3
R46	F3	A3
R47	F2	A4
R48	F2	A4
R49	B2	B4
R50	B1	B4
R51	E2	A1
R52	E1	A1
R53	G2	B1
R54	G3	A2
R55	G2	A1
R56	G2	A1
R73	F2	A2
R74	F3	A2
R75	G3	A2
R76	G2	A2
R77	F4	D2
R75	F4	C3
R76	G2	A2
R77	F4	D2
R78	F4	C3
R79	G4	D3
R80	G4	D2
R81	E3	C2
R82	E3	C2
R83	E3	C2
R84	E3	C2
R85	E1	A2
R86	E2	A3
R87	E2	A3
R88	E1	A2
TP1	E5	C4
U2B	C3	D4
U2C	C2	D4
U3A	D3	C4
U3B	F4	C4
U5B	C1	B4
U5C	C1	B4
U6A	D1	A4
U6B	C1	A4
W1	F5	A2
W2	F5	E3



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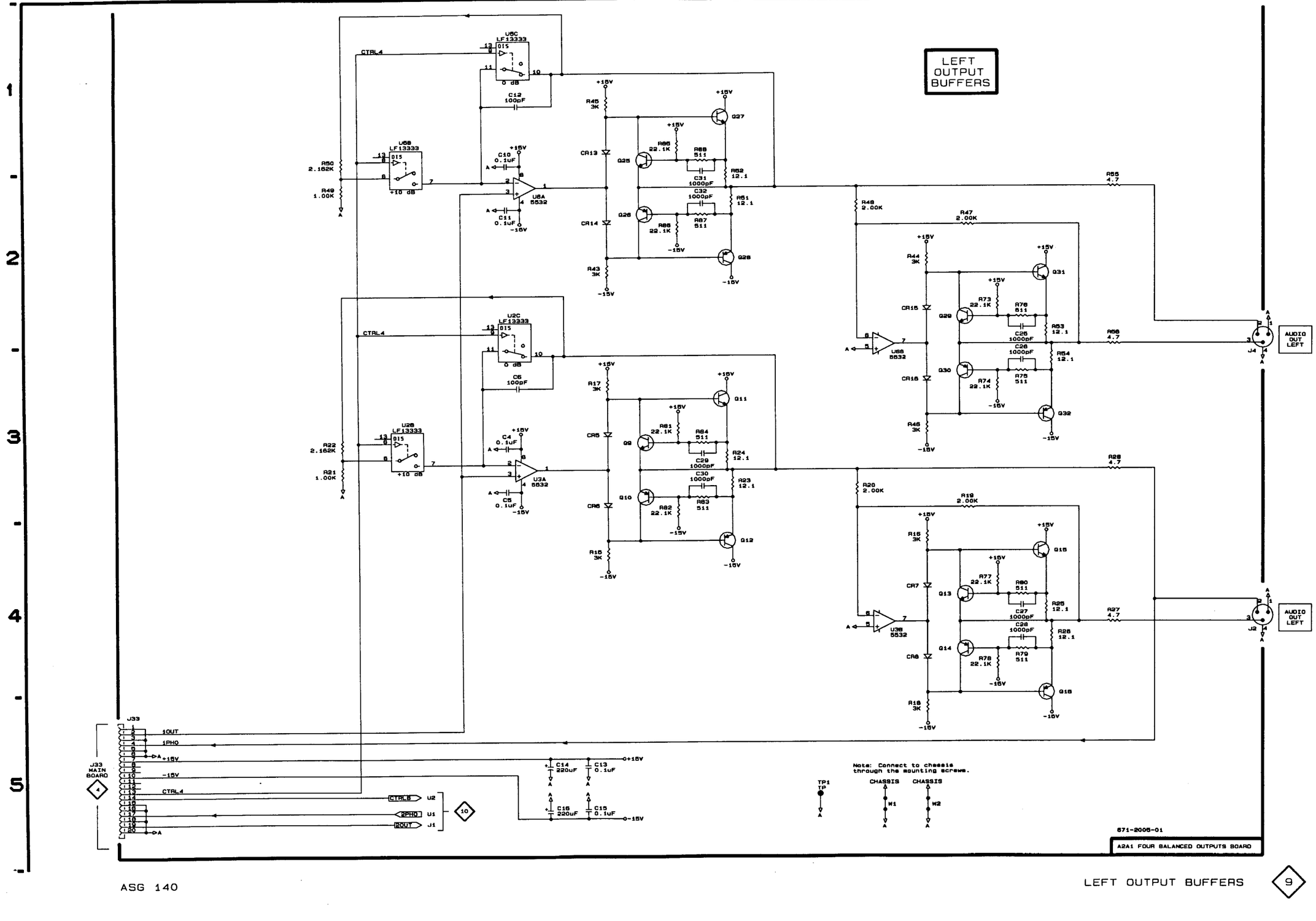
A2A1 FOUR BALANCED OUTPUTS Board

Static Sensitive Devices
See Maintenance Section

LEFT OUTPUT BUFFERS



Schematic Diagram 10
FOUR BALANCED OUTPUTS Board

The schematic diagram has an alpha-numeric grid to assist in locating parts within that diagram.

ASSEMBLY A2A1 *Partial A2A1 also shown on diagram 9.*

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1	C4	E4	R6	E4	E4
C2	C4	D4	R7	B4	D3
C3	C3	D3	R8	B4	D3
C7	C2	C4	R9	E4	D1
C8	C2	B4	R10	E4	D1
C9	C1	B3	R11	G4	E2
C17	F3	C2	R12	G5	D2
C18	F3	B3	R13	G4	D1
C19	F4	E2	R14	G5	E1
C20	F5	D2	R29	D2	B3
C21	D2	B2	R30	F2	C2
C22	D2	B2	R31	D1	B3
C23	D4	D1	R32	F3	C3
C24	D4	D2	R33	F2	C4
			R34	E2	C4
CR1	D3	D3	R35	B2	B3
CR2	D4	D3	R36	B2	B3
CR3	F4	E3	R37	E2	B2
CR4	F5	E3	R38	E1	B2
CR9	D2	B3	R39	G3	C2
CR10	D2	B3	R40	G3	B1
CR11	F2	C3	R41	G2	C1
CR12	F3	C3	R42	G3	B1
			R57	G2	C3
J1	H4	D1	R58	F3	B3
J3	H3		R59	F3	B3
			R60	F3	C2
Q1	D3	D3	R61	F4	E3
Q2	D4	D3	R62	F5	D3
Q3	E3	D2	R63	F5	D2
Q4	E4	D2	R64	F4	E2
Q5	F4	E3	R65	D2	B2
Q6	F5	E3	R66	D2	B3
Q7	F4	D2	R67	D2	B2
Q8	F5	D2	R68	D2	B2
Q17	D2	B3	R69	D3	D2
Q18	D2	B3	R70	D4	D2
Q19	E1	B2	R71	D4	D2
Q20	E2	B2	R72	D4	D2
Q21	F2	B3			
Q22	F2	B3	U1A	C4	D4
Q23	F2	C2	U1B	E5	D4
Q24	F3	B2	U2A	C3	D4
			U2D	C3	D4
R1	D4	E3	U4A	C2	B4
R2	F4	E3	U4B	E2	B4
R3	D3	D3	U5A	C2	B4
R4	F5	D3	U5D	C1	B4
R5	F4	E4			

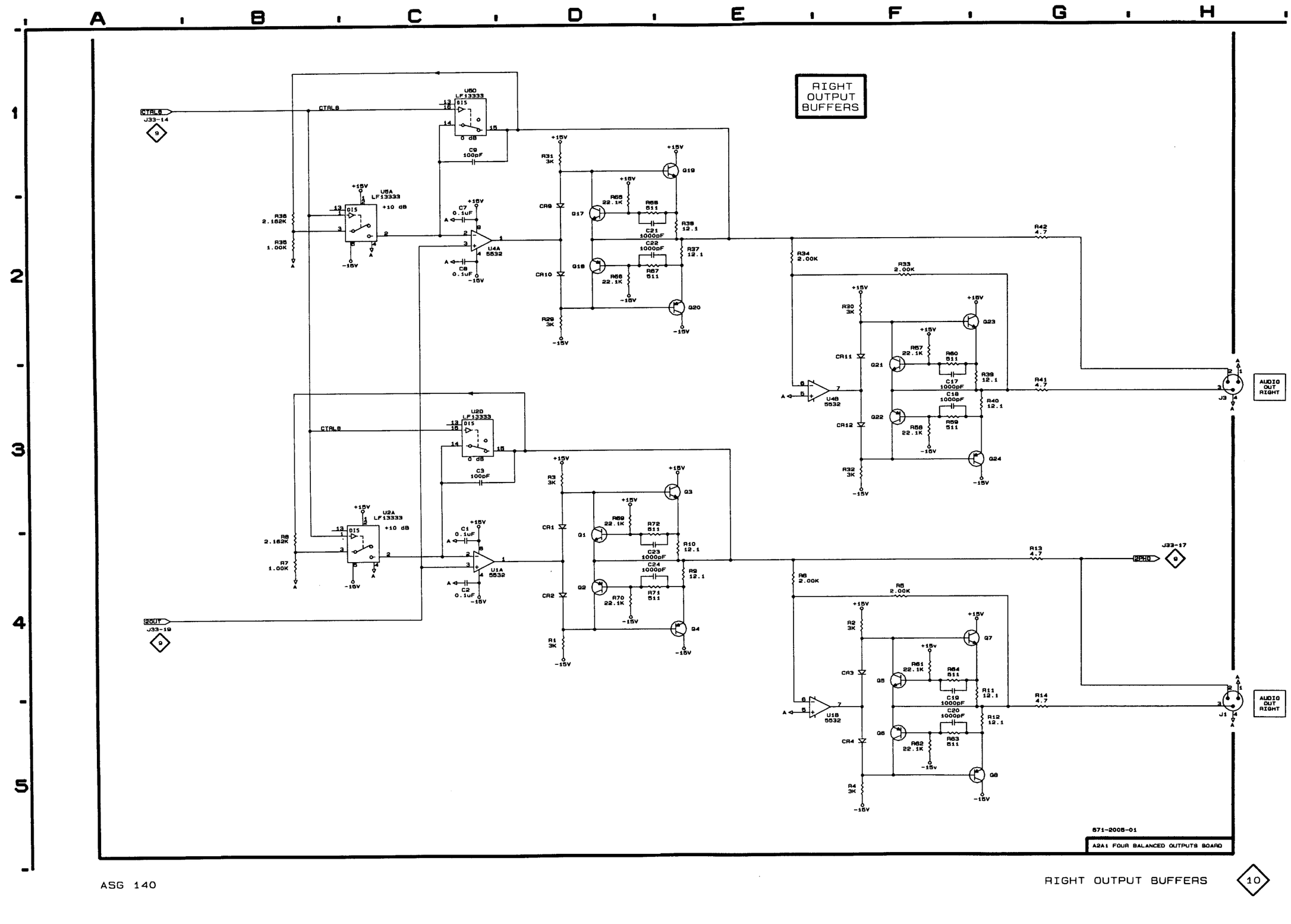
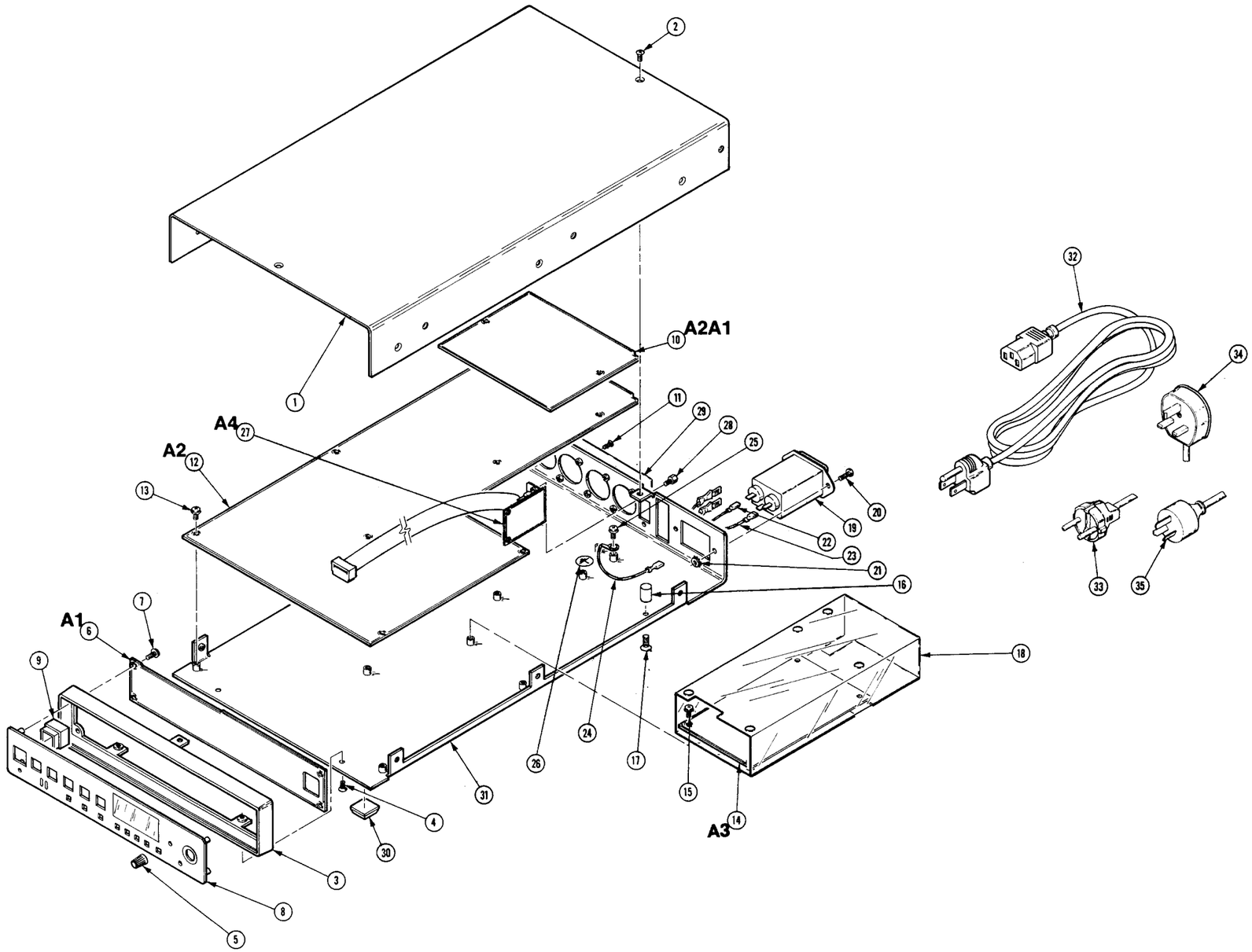

RIGHT OUTPUT BUFFERS
CTRL8
J33-14
U5D LF13333
0 dB
C9 100pF
U5A LF13333
+10 dB
R36 2.182K
R35 1.00K
C7 0.1uF
C8 0.1uF
U4A 5532
R31 3K
CR9
CR10
R29 3K
Q19
Q17
Q18
Q20
R65 22.1K
R66 511
C21 1000pF
R38 12.1
C22 1000pF
R37 12.1
R67 511
R34 2.00K
R33 2.00K
R42 4.7
R30 3K
CR11
CR12
Q23
Q21
Q22
Q24
R57 22.1K
R60 511
C17 1000pF
R39 12.1
C18 1000pF
R40 12.1
R58 22.1K
R59 511
R32 3K
U4B 5532
R41 4.7
J3
AUDIO OUT RIGHT
U2D LF13333
C3 100pF
U2A LF13333
C1 0.1uF
C2 0.1uF
U1A 5532
R8 2.182K
R7 1.00K
R3 3K
CR1
CR2
R1 3K
Q3
Q1
Q2
Q4
R69 22.1K
R72 511
C23 1000pF
R10 12.1
C24 1000pF
R9 12.1
R70 22.1K
R71 511
R13 4.7
J33-17
2PH0
R6 2.00K
R5 2.00K
R2 3K
CR3
CR4
Q7
Q5
Q6
Q8
R61 22.1K
R64 511
C19 1000pF
R11 12.1
C20 1000pF
R12 12.1
R62 22.1K
R63 511
R4 3K
U1B 5532
R14 4.7
J1
AUDIO OUT RIGHT
2OUT
J33-19
671-2005-01
A2A1 FOUR BALANCED OUTPUTS BOARD

FIG 1 EXPLODED VIEW



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