m o d u l a t i o n s c i e n c e s , i n c .

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Technical Manual

Model PCG-II
PRO SIDEKICK Generator

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1. SPECIAL FEATURES

1.1 Introduction

The Modulation Sciences PCG-II PRO SIDEKICK Generator brings second generation PRO channel performance to news operations. Combined with the PROceiver II® PRO channel receiver, the resulting system provides:

- Reliable IFB (interruptible foldback) coverage to well beyond the Grade B contour of picture service.
- Selective interruption of one remote unit while the rest continue to receive high-quality main channel audio.
- High-efficiency audio processing of the interrupt channel for greatest intelligibility of vital cues.

1.2 Subcarrier Generator

The PRO SIDEKICK combines all the elements needed for successful PRO channel operation: subcarrier generator, modulation monitor, audio processor, and CTCSS encoder for selective calling. Modulation Sciences has engineered these four devices into one package, designed to work as a system. This system approach provides a level of performance previously unobtainable. A dramatic reduction in crosstalk and a significant improvement in signal-to-noise ratio mean greater and more reliable coverage for news operations. Simplified operation translates into fewer mistakes by busy news crews.

PRO SIDEKICK has a crystal controlled subcarrier generator instead of a simple free-running oscillator. Free-running oscillators are easy to design and frequency modulate, but their frequency stability usually suffers. Because it is crystal controlled, PRO SIDEKICK has a frequency stability of ±0.01% over 0 to 50 degrees C.

There is no need to lock the PRO subcarrier to horizontal sync (genlock) as must be done with BTSC stereo and SAP. The PRO subcarrier is centered at 102.3 kHz or 6.5 times horizontal sync. Stereo and SAP must be H locked because they have spectral components that appear on exact harmonics of H sync, but, since the PRO subcarrier is centered between six and seven times the H sync frequency, there is no need for H lock.

1.3 Aural Transmitter Requirements

The aural transmitter need not be operated in stereo nor even be capable of stereo in order to transmit the PRO channel. Even old-style “indirect FM” aural exciters, such as those found in virtually all RCA UHF transmitters, will transmit PRO, even though they are not capable of stereo.

A common concern with older, pre-stereo transmitters is diplexer bandwidth. Many engineers fear that their diplexers do not have sufficient aural bandwidth to successfully transmit a PRO subcarrier. This is a "non-problem". Modulation Sciences has successfully installed PRO channel equipment on transmitter systems where the diplexer aural passband reduced the PRO channel injection by 2 dB. The PRO channel injection was increased to compensate for the rolloff and the system performed to full specifications. It is important to consider that the PRO channel, unlike BTSC stereo, does not require phase coherence across the baseband or with H sync. In addition, the PRO-II PROceiver® is a true non-intercarrier aural demodulator and is therefore unaffected by any ICPM created at the PRO subcarrier frequency.

1.4 Deviation Monitor

A built-in modulation meter eliminates the need to purchase an additional modulation monitor for the PRO channel. The modulation meter provided in the PCG-II PRO SIDEKICK generator is simple to read and very accurate. The peak/hold indicating circuit causes the meter to hold the maximum deviation and remain there without much bouncing around. The meter can also be easily calibrated in the field with only a frequency counter and a DC voltage source. A later section of this manual provides several methods for setting PRO channel injection without a modulation monitor.

1.5 Selective Calling — CTCSS

The PCG-II PRO SIDEKICK generator includes a subaudible signaling feature. This permits selective addressing of individual Modulation Sciences PRO-II PROceivers® as well as use of the automatic main channel "ducking" feature. The CTCSS (Continuous Tone-Controlled Subaudible Squelch) feature of the Modulation Sciences PRO system complies with a subset of the TIA/EIA-603 Standard. CTCSS is better known to many broadcasters by its Motorola trademark PL®.

The PRO SIDEKICK has three CTCSS operating modes: Local CTCSS, Remote CTCSS, and No CTCSS. These modes are selected via a 25-pin female D connector on the rear of the unit.

1.5.1 NO CTCSS

This is the mode compatible with original Modulation Sciences PROceivers® and all other PRO channel receivers. No subaudible tones are transmitted at any time. This is the state with nothing connected to the D connector.

1.5.2 LOCAL CTCSS

In this mode, one of sixteen CTCSS tones is selected via a four-line binary interface. In addition, the LOCAL CTCSS lines must be enabled. Selecting a CTCSS tone and enabling LOCAL CTCSS will cause a subaudible tone to be transmitted continuously, thus unsquelching any PRO-II PROceivers® set to activate on that specific tone.

To enable LOCAL CTCSS, apply 5 VDC between pins 1 and 2 of the 25-pin D connector on the rear panel.

1.5.3 REMOTE CTCSS

Local operation of the CTCSS encoder in the PRO SIDEKICK is the simplest way to employ selective calling. However, it is often impractical to have five full-period control lines to the transmitter site when the PRO SIDEKICK generator must be located at the transmitter. For that situation, the PRO SIDEKICK is operated in the REMOTE CTCSS mode.

In the REMOTE CTCSS mode, the incoming audio signal is filtered so that the CTCSS tones below 300 Hz are split at the input and blocked from entering the audio processor. They bypass the processor and are reinserted in the audio chain after processing, thus preventing cross-modulation with the audio signal. The audio signal, with all energy below 300 Hz removed, then passes to the audio processor.

The REMOTE CTCSS mode allows insertion of the CTCSS tones at the studio by using inexpensive commercially available single-tone CTCSS encoders. A full line of low-cost CTCSS encoders is available from several vendors. Contact Modulation Sciences for details.

The REMOTE CTCSS mode is the default setting of the PRO SIDEKICK. To operate the PRO SIDEKICK in LOCAL CTCSS mode, apply 5 VDC between pins
1 and 2 of the 25-pin D connector on the rear panel.

1.6 Integrated Audio Processor

Audio processing is often a weak link in PRO channel transmission systems. The audio processor incorporated in the PRO SIDEKICK is a very aggressive, bandwidth-limited communications processor. This is a two-band processor designed to maximize speech intelligibility in a limited-bandwidth channel. It is significantly different from the audio processor included with other broadcast equipment.

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2. SPECIFICATIONS

2.1 Dimensions

Occupies two (2) rack units.

SIZE:

Front Panel:

3.5" H x 19.0" W

88.9 mm H x 482.6 mm W

Chassis:

3.5" H x 16.75" W x 9.25" D

88.9 mm H x 425.5 mm W x 235.0 mm D

2.2 Power

95 to 130 VAC
50 to 60 Hz
12 W maximum

190 to 260 VAC available as an option

2.3 Temperature Range

0 to 50° C

2.4 RFI Protection

All inputs and outputs are RF suppressed. The power supply is RF suppressed and shielded from main circuitry.

2.5 Input/Output Connections

AUDIO IN:

No. 6 screw terminals
-30 to +10 dBm
600Ω resistive, ±2%

REMOTE CONTROL:

25-pin female D-SUB connector on rear apron

COMPOSITE IN:

BNC connector
Unity gain to composite output
10 kΩ unbalanced

COMPOSITE OUT:

BNC connector
Stereo level 0.4 to 4.0 V peak-to-peak
Subcarrier level 0.04 to 0.4 V peak-to-peak
Noise test level 0.4 to 4.0 V peak-to-peak
50Ω output impedance
600Ω minimum load impedance

SCA OUT:

BNC connector
0.35 to 3.5 V peak-to-peak
50Ω output impedance
600Ω minimum load impedance

TELEMETRY IN:

BNC connector
3.5 V peak-to-peak = ±500 Hz deviation
10 kΩ input impedance

2.6 Frequency Response

±3 dB, 300 Hz to 3.0 kHz

2.7 Noise

65 dB below ±5 kHz deviation

2.8 Frequency Accuracy

±0.01% at 25° C

2.9 Frequency Drift

±0.005% from 0 to 50° C

2.10 Metering Circuit

Peak deviation: ±5% accuracy

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3. INSTALLATION AND SETUP

3.1 Installation Location

The preferred location for the PRO SIDEKICK is at the transmitter plant near the aural exciter. Locating the unit at the transmitter site is made easy because the selective calling CTCSS tones may be included in the audio feed. Separate control circuits are **not** required.

In general, our experience with systems that add a wideband aural subcarrier to video STLs has not been good. Some models of these systems do not have adequate frequency response at the PRO channel center frequency of 102.3 kHz. In other cases, we have found excessive intermodulation with sync.

The PRO SIDEKICK should be installed in a location where the ambient temperature will remain between 0 and 50° C and where it will not be exposed to extremely high magnetic fields. It may be installed in an equipment rack immediately adjacent to most pieces of processing or test equipment; however, a separation of at least 6 to 12 inches from any high-power transformers should be maintained. The only other restriction on location is that cable lengths should not exceed 30 feet (9.14 m).

3.2 Composite and Subcarrier Connections

The COMPOSITE and SCA outputs are driven by high slew rate amplifiers have a 50Ω output impedance and are able to drive loads as low as 600Ω. Up to 30 feet (9.14 m) of cable may be used between the PRO SIDEKICK and the exciter or stereo generator inputs. Note that the PRO SIDEKICK does not have sufficient current capability to drive a 75Ω input directly. Some TV aural exciters have 75Ω termination resistors at their subcarrier and composite inputs. We suggest that these input resistors be removed. If that is not possible, a composite distribution amplifier such as the Modulation Sciences CLD-2504 is required.

3.3 Composite Loopthrough

Any signal at the COMPOSITE input appears at the same level at the COMPOSITE output. In addition, the PRO subcarrier signal will normally appear at this output unless an internal strap has been changed. Only the subcarrier signal appears at the SCA output. The subcarrier level at the COMPOSITE output is approximately 10% of the subcarrier level at the SCA output. A number of connections are possible depending on the inputs available on the exciter and the desired operation.

3.4 Preferred Method Using SAP/PRO Input of the Stereo Generator:

Connect a cable from the SCA output to the PRO or SAP input of the stereo generator. Some stereo generators, such as the Modulation Sciences STV-784, have a specific input for the PRO signal and a meter position to measure injection (deviation of the main channel by the subcarrier). Other generators have only a SAP input. A SAP input is equally useful for injecting the PRO subcarrier.

3.5 CTCSS Control Mode Connections

Control of the CTCSS subsystem is via a 25-pin female D connector on the rear apron of the PRO SIDEKICK. Each function is asserted by applying 5 volts DC (or a higher voltage through a series resistor) to two terminals. Each input is controlled by a floating optoisolated input. If it is more convenient, all of the negative or positive inputs of the optoisolators may be bussed together. Note that these are **not** pulse input. They require continuous application of voltage to maintain the asserted function.

25-Pin D Connector Hookup

FUNCTION	POSITIVE PIN	NEGATIVE PIN
Binary Zero	9	10
Binary 1	7	8
Binary 2	5	6
Binary 3	3	4
Local CTCSS	11	12

Binary Code Table for CTCSS Tone Selection

CTCSS Tone (Hz)	Binary 3	Binary 2	Binary 1	Binary Zero
141.3	On	On	On	On
131.8	On	On	On	Off
127.3	On	On	Off	On
123.0	On	On	Off	Off
118.8	On	Off	On	Off
114.8	On	Off	Off	On
110.9	On	Off	Off	Off
107.2	Off	On	On	On
103.5	Off	On	On	Off
100.0	Off	On	Off	On
94.8	Off	On	Off	Off
88.5	Off	Off	On	On
82.5	Off	Off	On	Off
77.0	Off	Off	Off	On
71.9	Off	Off	Off	Off

3.6 Eliminating Hum Problems

Although the PRO SIDEKICK has sufficient output drive capability to drive long cables, hum due to ground loops may still be a problem at some installations if the stereo generator or exciter has an unbalanced input. If you have a hum problem, try improving the ground connection between the PRO SIDEKICK and the stereo generator or exciter. Rerouting the cable away from sources of strong magnetic fields may also help. In extreme cases, the only solution may be to locate PRO SIDEKICK closer to the stereo generator or exciter or to use an msi CLD-2500 Composite Line Driver system for balanced transmission.

3.7 Audio Input Connections

Connect the audio signal to the screw terminals on the rear apron of the PRO SIDEKICK. Shielded twisted-pair cable is recommended for the audio connection. However, due to the extremely good common-mode rejection of the audio input

circuit, unshielded twisted-pair wiring may work acceptably in many installations. The input impedance is 600Ω resistive, thus ensuring proper termination of telephone lines without the use of external pads. Input signal levels as low as -30 dBm can be accommodated. In most cases, this will allow direct connection to telephone lines without the use of external amplifiers. The terminal connections for various input levels can be determined from the following table:

Input Level (dBm)	Audio Terminals	Strap
+6 to +10	1,2	5,6
-14 to +5	1,2	none
-30 to -15	4,5	none

If you are unsure of the audio level in your application, start with the highest level connection and proceed with the rest of the installation instructions. If sufficient gain reduction cannot be achieved with the INPUT LEVEL control at maximum sensitivity, move the input connection to the next lower level setting and try again.

3.8 Audio Processor Controls

The INPUT LEVEL control is used to adjust the amount of gain reduction. Set the meter switch to the GR position. The meter should read full scale with no audio input. Now apply normal program audio and adjust the INPUT LEVEL control for the desired amount of gain reduction. For most IFB applications, 15 to 18 dB of gain reduction should be employed.

The processor controls should initially be set as follows: (These are the factory settings.)

DEViation	1 o'clock
LIMIT	12 o'clock
High **F**requency **R**eduction	12 o'clock

Because of the limited audio bandwidth (300 Hz to 3 kHz) of the PRO SIDEKICK and the communications nature of the material being transmitted, audio setup should not be viewed as a critical item as it would be in a typical broadcast system. For the vast majority of applications, the default factory adjustments given above should suffice. However, for those with special applications, the following are the details for processor setup:

1. Set the meter switch to the HFR position. If no high frequency reduction is taking place, the meter should read full scale (0 dB gain reduction). "Bright" (rich in high frequencies) material will cause gain reductions of 5 to 15 dB. The amount of high frequency reduction is adjusted by the HFR control and is also affected by the setting of the LIMIT control. These two controls should be adjusted while listening to the signal until the desired sound is obtained. The following paragraphs outline the effects and interactions of these controls.
2. The high-frequency limiter is effectively a program-controlled equalizer. When it detects excessive amounts of high-frequency signal, it introduces a high-frequency rolloff to keep peaks below its threshold. The broadband limiter sets an instantaneous deviation limit, removing any peaks which exceed its threshold. The threshold control circuit continuously monitors the amount of broadband limiting and will reduce the threshold levels of both the high-frequency limiter and the compressor if an excessive amount of broadband limiting takes place. The LIMIT control sets the threshold of both the high-frequency limiter and the compressor relative to the broadband limiter.
3. Turning the HFR control clockwise will cause increasing amounts of high-frequency rolloff, thus causing the signal to sound "duller". However, since high-frequency peaks will be reduced in level, this will allow increased RMS modulation. Turning the LIMIT control clockwise causes less compression and high-frequency limiting to occur. Thus, increasing numbers of peaks will be removed by the broadband limiter. When done in moderation, this will increase the RMS modulation of the signal and will usually make it sound somewhat brighter. When done excessively, this will cause transients to sound "splashy" and distorted. In general, the maximum clockwise setting of both controls cannot be used at the same time. A compromise setting must be found which yields maximum RMS modulation without making the signal sound dull or distorted.
4. After appropriate settings for the processor controls have been found, set the meter switch to the DEV position and adjust the DEV control for ±5 kHz peak deviation. Although the FCC has no specification for PRO channel deviation, Modulation Sciences recommends ±5 kHz.

3.9 Audio Level

Once the input connections are made as described earlier, audio level should be adjusted with the INPUT control. Using "real world" interrupt audio driving the unit with **no** CTCSS tones active, the INPUT control should be adjusted for 15 to 20 dB of gain reduction. Keep in mind that the PRO channel is a communications channel, not a broadcast program circuit. Less processing is **not** better. Less processing will only reduce the subjective signal-to-noise ratio.

3.10 Subcarrier Modulation

Setting the modulation of the PRO subcarrier by the interrupt audio is critical to reliable operation of the PRO channel system. It is important to distinguish deviation of the PRO subcarrier by interrupt audio (PRO modulation) from deviation of the main carrier by the PRO subcarrier (PRO injection). PRO modulation is a constantly varying parameter. It carries the audio of the PRO channel.

PRO injection is a steady, unvarying parameter. It is the PRO subcarrier itself. Although it is frequency modulated by the PRO audio, this subcarrier remains at a constant, unvarying amplitude.

For proper operation of the PRO channel system, the PRO modulation must be set at ± 5 kHz deviation. This should be adjusted by using the DEV metering position on the front panel of the PCG-II.

Be advised that several BTSC modulation monitors, including the Tektronix 751 (now discontinued) consider ± 3 kHz deviation as 100% modulation. This is an arbitrary decision on the manufacturers' part and has **no** basis in either the FCC Rules (47 CFR, Part 73) or in the description of the BTSC system in OET Bulletin Number 60, Revised. Thus, PRO channel overmodulation indications from these monitors must be disabled or ignored.

Failure to set PRO modulation to ± 5 kHz will result in loss of signal-to-noise performance and reduced coverage.

3.11 Subcarrier Injection

There is some controversy about the maximum allowable injection of the PRO channel. Unlike the deviation of the PRO channel by cue information (PRO modulation), PRO injection is discussed by the FCC in the Rules and Regulations (Title 47 CFR, Part 73) and in OET Bulletin 60, Revised.

Part 73 allows a total modulation of the aural carrier of ± 75 kHz which would allow for a PRO channel injection of 5 kHz. However, OET 60 limits the injection to 3 kHz for a maximum total deviation of the aural carrier of ± 73 kHz.

4. THEORY OF OPERATION

4.1 Power Supply

AC line voltage is stepped down by transformer T1, rectified by a bridge rectifier consisting of diodes D201-D204, and filtered through a network consisting of R201, R202, C201, and C202. To minimize hum pickup by the audio circuits in the PRO SIDEKICK, these components are located in a shielded compartment away from the main circuitry. The positive bus is regulated to +12 volts by U302 on the SCAR board and the negative bus is regulated to -12 volts by U301 on that same board.

4.2 Subcarrier Generator and Modulator

(SCAM Board)

A 3.2768 MHz square wave signal is generated by crystal oscillator U24 and is divided by programmable divider U25 and flip-flops U26A and U26B. This signal is used to lock voltage-controlled oscillator U21 to exactly 102.3 kHz. The loop for locking U21 to the divider chain is completed by U27. U21 is frequency modulated by audio and telemetry through a network consisting of R134, R135, and R188.

4.3 Audio Input

(NOTE: All components are on the SCAM Board unless otherwise noted)

Program audio is connected to a barrier strip on the rear apron of the PRO SIDEKICK. These terminals are connected to the SCAT board, which contains ferrite beads for RFI suppression and attenuators that are selectable by the user. These attenuators allow the PRO SIDEKICK to accommodate audio levels of -30 to +10 dB. The audio is then routed to the SCAM board, where it is amplified through Q1, Q2, and U33. From there, components below 50 Hz are removed by a high-pass filter consisting of U1A and its associated components. Audio at this point contains both program information and any CTCSS tones to be passed through the PRO SIDEKICK when REMOTE CTCSS mode is used.

4.4 Program Audio Processing

4.4.1 Input Processing

Audio from U1A then enters the SCAP (CTCSS) board. Program audio is filtered to remove all components below 300 Hz. This high-pass filter is located on the SCAP board and consists of U1, U2, and U3B. The program audio then re-enters the SCAM board, where it is filtered through U1B to remove all components above 3 kHz.

Peaks are limited by D5 and voltage-controlled amplifier U20B provides automatic level control. Program audio is then routed through a compressor consisting of U2, U3, and U4.

4.4.2 Pre-Emphasis and High-Frequency Limiting

The compressed program audio then undergoes high-frequency limiting and pre-emphasis. The pre-emphasis used as the factory setting in the PRO SIDEKICK is the two-way radio standard pre-emphasis curve defined in Section 1.3.4.3 of the TIA/EIA-603 Standard. This pre-emphasis is a 6 dB per octave increasing slope from 300 Hz to 3 kHz. Other values of pre-emphasis may be selected by strapping P1, P2 and/or P3, P4. This is useful if the PRO SIDEKICK is being used with PRO channel receivers other than the Modulation Sciences PRO-II PROceiver® or for purposes other than communications audio. Contact the factory for details. The pre-emphasis is introduced by a network consisting of R40, R41, R42, R43, R44, R45, C17, C19, U5A, and U13. Voltage-controlled amplifier U20A acts as a program-controlled equalizer. Limiting of high-frequency peaks is provided by U5B, U6, and U7. HFR control RV5 adjusts the threshold of high-frequency limiting relative to the broadband compressor threshold. Turning RV5 clockwise will increase the high-frequency limiting and it will cause the audio to sound “duller”. However, by limiting high-frequency peaks, a higher RMS level of modulation may be obtained without overmodulating the PRO subcarrier.

4.4.3 Broadband Limiting

After pre-emphasis and high-frequency limiting, the program audio is branched into two circuits. One branch goes to the broadband limiter consisting of Diodes D40-D43. Diodes D40-D43 form a bridge circuit that sets an absolute limit on program level to prevent overmodulation of the PRO subcarrier. The other leg drives a threshold circuit consisting of U8, Q8, U9A, and U11. This circuit provides feedback control to the compressor and high-frequency limiter and controls the balance between limiting and compression. LIMIT control RV7 sets the desired balance between limiting and compression. By adjusting this control and the INPUT LEVEL control, any desired combination of limiting and compression can be achieved.

4.4.4 Summing and Harmonic Filtering

After broadband limiting by diodes D40-D43, the program audio is routed to the CTCSS board (SCAP board). There, it is resistively summed with the remote or local CTCSS tones through R32, R33, and R34. Transistor Q1 is a gate that allows remote CTCSS tones to pass through. The summed audio is amplified by U3A and routed back to the main (SCAM) board. On the main board, U9B and U10 form an active low-pass filter which eliminates any harmonics above 5 kHz. DEVIATION control RV6, located at the input of U9B, sets the modulation of the PRO channel by the total audio (program plus CTCSS tones).

4.5 CTCSS

4.5.1 Remote CTCSS

In installations where the PRO SIDEKICK is located at the transmitter site, CTCSS tones may be fed together with the PRO audio coming from the studio. After amplification by Q1, Q2, and U33 and bandpass filtering by U1A, this audio is routed to the CTCSS (SCAP) board. There, U3C and U3D form an active low-pass filter which passes frequencies between 50 and 300 Hz while rejecting program audio. U4A then amplifies the remote CTCSS tones. The REMOTE CTCSS LEVEL TRIM control (RV1) is at the output of U4A. From there, the remote CTCSS tones pass through R32 (part of the audio summing network) and gate Q1. A control voltage applied to optoisolator U6 turns on Q1, allowing the remote CTCSS tones to pass and to be amplified with the program audio in U3A. The combined audio is then sent to the DEVIATION control (RV9) on the main (SCAM) board. **This is the default setting of the PRO SIDEKICK.**

4.5.2 Local CTCSS

CTCSS tones may also be generated locally in the PRO SIDEKICK. All local CTCSS generation and control takes place on the CTCSS (SCAP) board. The +12 volt bus is regulated down to +5 volts by U12. This is the voltage supply for CTCSS generator U13 and its clock, U5. U5 combines a 4 MHz crystal oscillator and divider. The 4 MHz signal is divided down to 1 MHz to provide the clock signal for U13. Various CTCSS tone frequencies may be selected by applying control voltage to the desired combination of optoisolators U7, U8, U9, and U10 via the 25-pin D connector on the rear apron. See Section 3.5 of this manual for tables showing the proper control voltage connections. A control voltage applied to optoisolator U11 turns U13 on, enabling local generation of CTCSS tones. The CTCSS TEST push-button switch on the front panel is connected in parallel with U11. CTCSS tones from U13 then pass through LOCAL CTCSS LEVEL TRIM control RV2 and are summed with program audio at R33, R34, and U3A. **To enable local CTCSS generation, connect +5 volts between Pins 1 and 2 of the 25-pin D connector on the rear apron. Pin 1 is positive.**

4.5.3 CTCSS Indicator

The local and incoming remote CTCSS tones are summed by R53 and R54 and amplified by U4D on the SCAP board. U4B, U4C, D7, and D8 form a detector that provides a DC voltage whenever CTCSS tones are present. This voltage turns on Q3, sinking the cathode of the green CTCSS LED on the front panel and turning it on.

4.6 Noise Generator

Most TV aural transmitters have excellent AM noise and crosstalk characteristics. However, the PRO SIDEKICK provides pseudo-random pink noise should it be desired to tune the aural transmitter for minimum AM noise and minimum crosstalk. A clock signal from crystal oscillator/divider circuit U24 drives shift register U28. U28, U29, and U30 form the noise generator. NOISE control RV12 sets the noise level to composite output amplifier U14.

4.7 Composite Amplifier

A composite aural signal may be routed through the PRO SIDEKICK. Composite aural enters composite output amplifier U14 through R148. R148 and R149 form a summing network allowing the PRO subcarrier to be mixed into the composite aural at the input of U14 when a jumper is installed between P17 and P19 (the factory setting). When both the NOISE and READ push-button switches are engaged, the normal composite input to U14 is disconnected and the output of the noise generator is substituted.

4.8 SCA Amplifier

PRO subcarrier output from U21 is amplified by U12. INJECT control RV9 adjusts the level of subcarrier fed from U12 to SCA output amplifier U15 and to composite amplifier U14 through summing resistor R149. The output of U15 consists of PRO subcarrier **only** and is intended for use with aural exciters and stereo generators having an SCA, SAP, or PRO input.

4.9 AM Noise Detector

This section is used in tuning an aural transmitter for minimum AM noise. An RF sample from the transmitter is connected to the RF IN BNC connector on the rear panel. This input is terminated in 50Ω and the RF level must not exceed 2 watts. The RF is rectified through a series diode at the input and this diode, together with U16, detect any AM component in the RF sample. The demodulated AM is amplified by U17A. Metering sensitivity is adjusted by READ control RV13. Then, the AM noise component is further amplified by U17 and routed to the metering section.

With composite aural looped through the PRO SIDEKICK, the aural transmitter may be tuned for minimum AM noise and minimum crosstalk by pressing the NOISE and READ push buttons. **This removes normal program audio from the transmitter.** Then, the transmitter is tuned for a null in the reading on the meter of the PRO SIDEKICK. Our experience with television transmitters shows that this adjustment is rarely necessary.

4.10 Metering

The desired parameter is selected by front panel switches S2 (READ), S3 (**H**igh **F**requency **R**eduction), S4 (**G**ain **R**eduction) and S5 (**DEV**iation). The metering signal is amplified by U31A. U31B, U32A, and D51-D56 form a peak holding circuit.
The signal is then amplified by meter driver U32B.

Operation of the green CTCSS LED was described in Section 4.5.3 of this manual. Since the PRO subcarrier is always on whenever the PRO SIDEKICK receives power, the amber READY LED is simply tied to the +12 volt bus and is always on.

5. WARRANTY

5.1 Three Years on Parts and Labor

Subject to Modulation Sciences, Inc. warranty policy. Annual calibration fee is not included in warranty. However, any repairs needed during calibration are covered for three years.

5.2 MSI Warranty Policy Summary

NOTE: This is not the warranty. It is a summary of MSI's standard warranty and a description of how to obtain warranty service. The current, actual warranty is printed in its entirety on the following pages and supersedes warranty information which may be found elsewhere.

5.2.1 Who receives warranty protection?

Modulation Sciences' standard warranty protects the original end-user purchaser of record but does not apply to subsequent owners.

5.2.2 What does the warranty cover?

Modulation Sciences agrees to repair or replace at its expense any unit which has a defect in materials or workmanship for a period of three (3) years after the date of sale to the original end-user purchaser. This warranty includes all parts, labor, calibration, and packing.

5.2.3 What doesn't the warranty cover?

MSI's warranty does not cover:

a) Freight and insurance charges paid by the purchaser in returning the unit for repair.

b) Defects which result from modifications or repairs to the unit not made by or authorized in writing by Modulation Sciences.

c) Compensation for incidental or consequential damages resulting from any defect.

d) Trivial or cosmetic defects which do not affect the unit's ability to function normally.

5.2.4 How is the warranty period computed?

The warranty period begins on the date of delivery.

5.2.5 What if the unit cannot be repaired or is too expensive to repair?

If Modulation Sciences decides not to repair or replace a given unit, Modulation Sciences agrees to refund to the first end-user purchaser its full purchase price. Payment of that amount will end MSI's responsibilities and Modulation Sciences may keep the unit.

5.2.6 How is warranty service obtained?

To claim your rights under this warranty:

a) Contact the dealer or distributor from whom this product was purchased. Describe the problem and ask if there is an easy solution.

b) If your dealer cannot help, contact Modulation Sciences' service department at (800) 826-2603 or (732) 302-3090 and explain the problem. If the unit requires factory service, you will be given a return authorization number.

c) When you have your return authorization number, you may return the unit. Pack it carefully for shipment, preferably using the original shipping carton and packing materials. **ASSUME THAT THE BOX WILL BE DROPPED SEVERAL TIMES DURING SHIPMENT. USE UPS OR SOME OTHER PRIVATE CARRIER YOU KNOW TO BE RELIABLE. DO NOT USE THE POSTAL SERVICE.** The risk of loss is yours. Modulation Sciences will not be responsible for damage or loss until the package is received by Modulation Sciences. **INSURE THE UNIT FOR ITS FULL REPLACEMENT VALUE. SHIP THE UNIT PREPAID TO THE ADDRESS SPECIFIED WHEN YOU RECEIVE THE RETURN AUTHORIZATION AND BE SURE TO ENCLOSE A NOTE GIVING THE FOLLOWING INFORMATION:**

1. Your company name and shipping address (**not** a P.O. Box).
2. Your return authorization number.
3. A copy of your original invoice establishing the starting date of your warranty.
4. As full a description as possible of the problem(s).

5.3 MSI Warranty Policy

FOR A SUMMARY OF THIS TEXT AND INFORMATION ON OBTAINING WARRANTY SERVICE, PLEASE SEE THE PAGES PRECEDING THIS WARRANTY.

We warrant the equipment sold shall be free from defects in materials and workmanship under normal use and service for a period of three (3) years from the date of delivery when properly installed. Our sole obligation under this warranty shall be limited to repair or replacement at Our option of any such part or parts of the product which Our examination shall disclose to Our satisfaction to be defective.

If you wish to have warranty services performed at Our facilities, You shall obtain from Us, in advance, permission to return the equipment and shall ship it properly packed with transportation and insurance prepaid. Service performed at Our facilities under this warranty shall include parts plus labor and normal return shipping. It is expressly agreed that Our obligation to repair and replace defective parts is Your sole and exclusive remedy.

The warranty to repair or replace defective parts is expressly in lieu of and hereby in disclaimer of all other express warranties and is in lieu of and in disclaimer and exclusion of any implied warranties or merchantability, fitness for particular purpose, as well as all other implied warranties, in law or in equity, and of all obligations or liability on Our part. There are no warranties which extend beyond the description hereof.

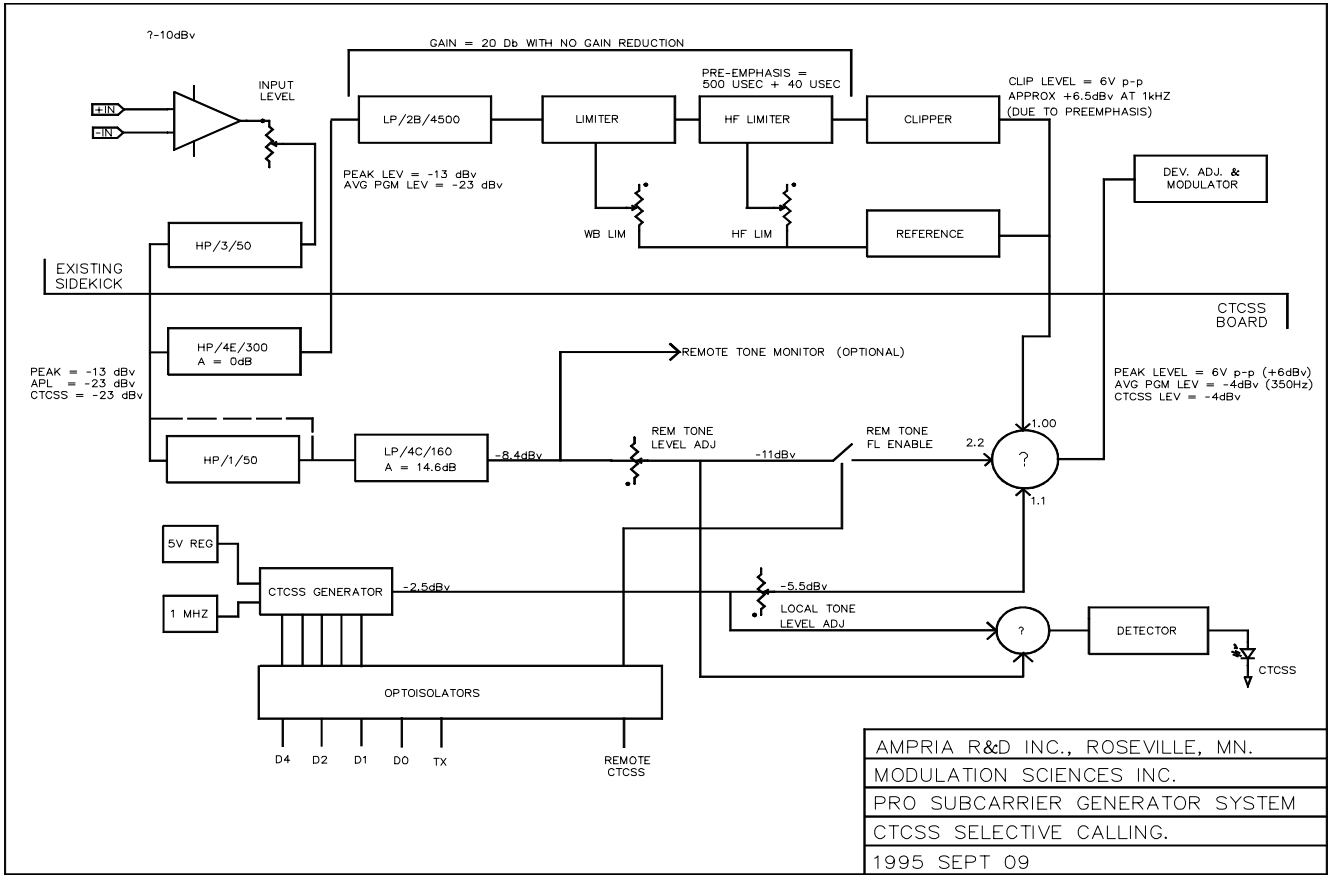
Our liability does not include any labor charges for replacement of parts, adjustments, repairs, or any work done outside Our factory, unless such work is authorized in writing by Us. Our obligation to repair or replace shall not apply to any equipment which shall have been repaired or altered outside Our factory in any way, subject to negligence, misuse, unauthorized alteration or abuse, or damaged in transit.

Our liability hereunder shall not include losses of anticipated profits or special incidental or consequential damages.

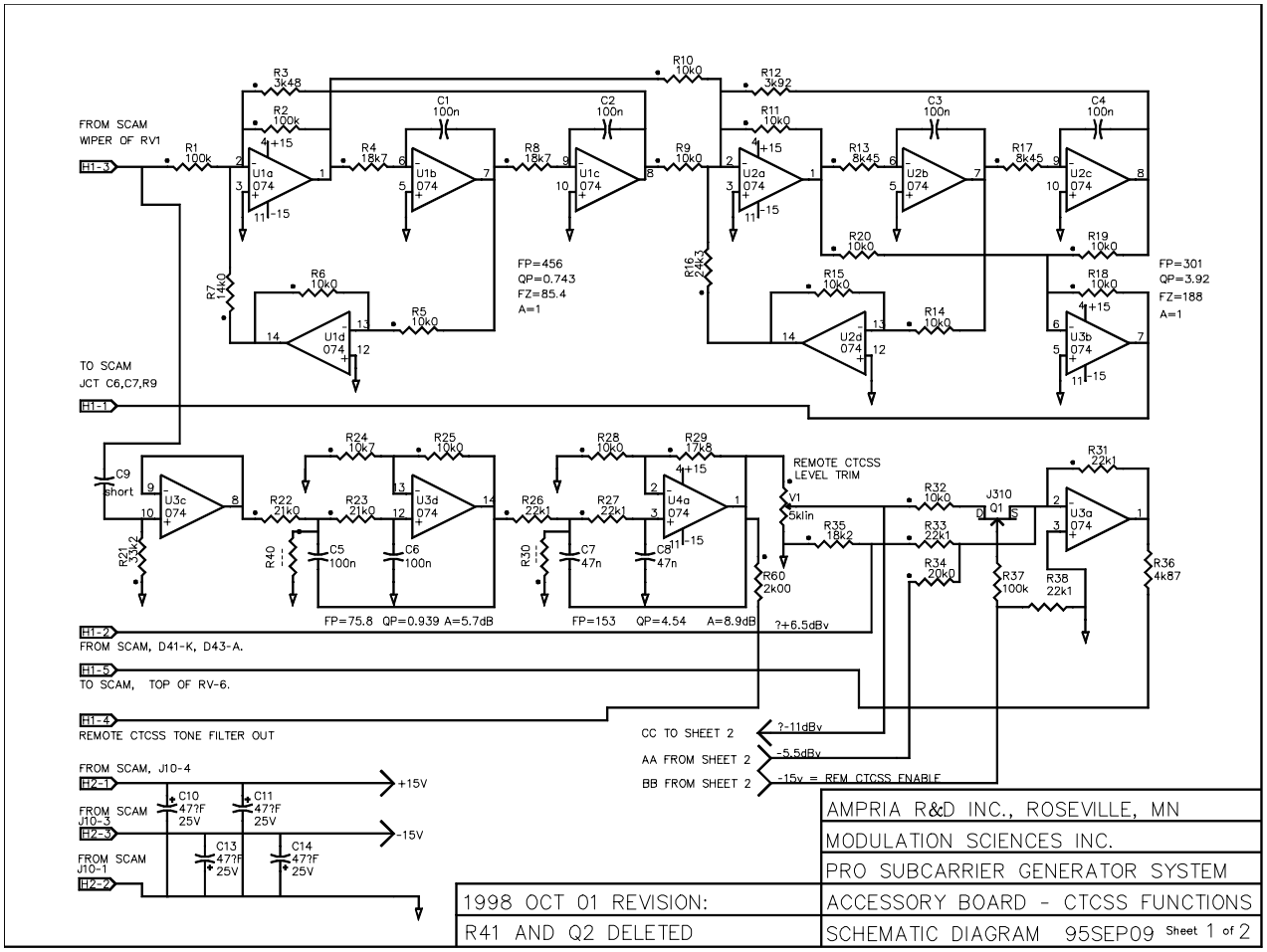
6. DIAGRAMS

6.1 Block Diagram

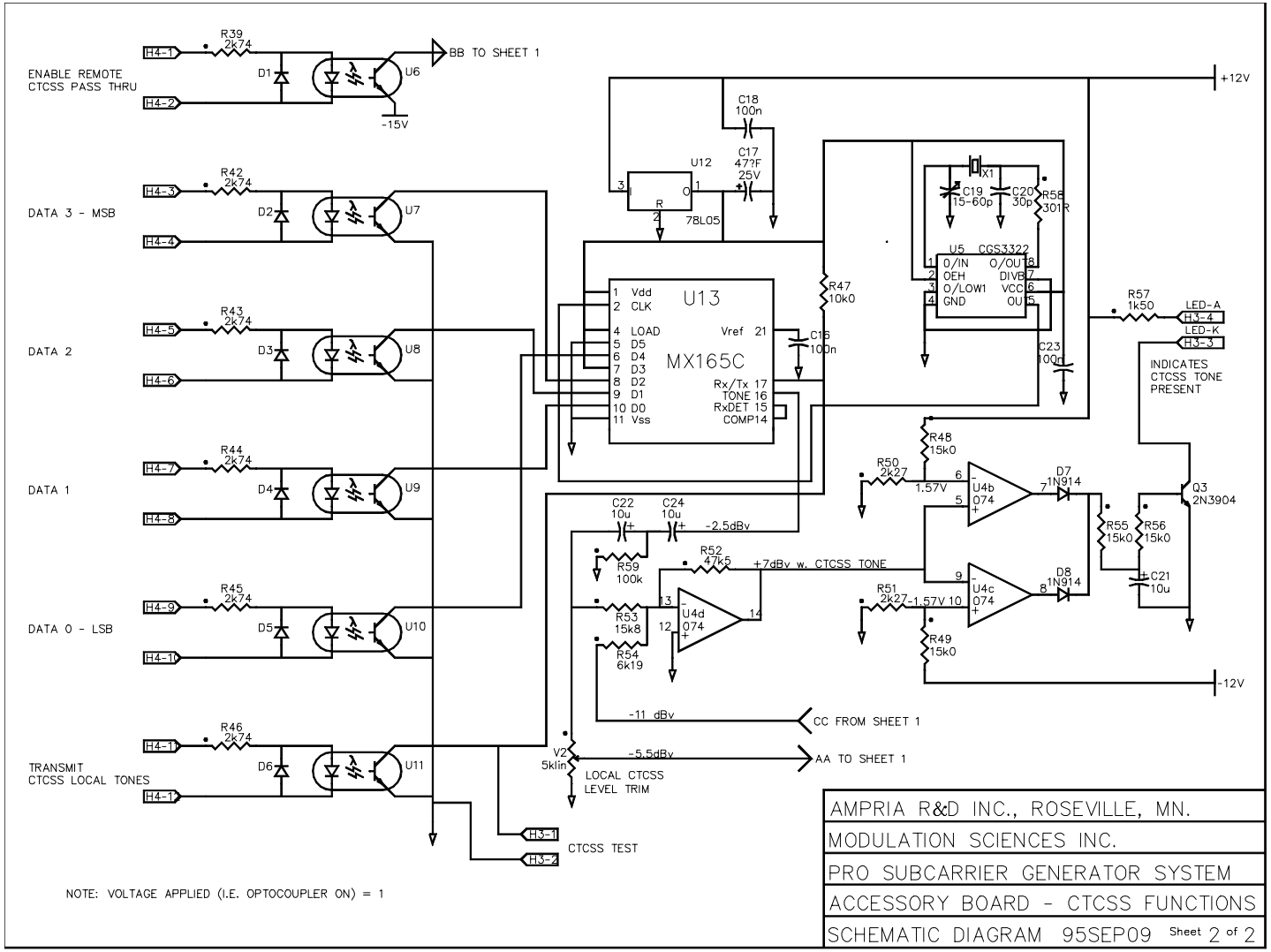
NOTE: A complete schematic diagram of the PCG-II may be found as an insert at the end of this manual.



6.2 Schematic Diagram — CTCSS Section, Part 1



6.3 Schematic Diagram — Remote Control and CTCSS Generator, Part 2



7. PARTS LIST

7.1 Abbreviations of Manufacturers' Names

ACCORD	Accord (crystals)
ALLENBRADL	Allen-Bradley
AMP	AMP
AMPHENOL	Amphenol Corporation
ANALOGDEVI	Analog Devices
ANALOGSYST	Analog Systems
APEXDESIGN	Apex Design
ARCO	Arcolectric Corporation
ASSMAN	Assmann Electronics, Inc.
AVDEL	Avdel Textron
AVX	AVX Corporation
BARRE	Barré Company
BEAUPRODUC	Beau Products
BELDEN	Belden Wire & Cable Company
BIVAR	Bivar, Inc
BOURNS	Bourns, Inc.
BUSSMAN	Bussmann Division, Cooper Industries

CENTRALAB	Centralab
CORNEL	Cornell Dubilier
CRITCHLEY	Critchley, Inc.
CURTIS	Curtis Industries
DALE	Vishay Dale
DENNISON	Dennison Corporation
DIALIGHT	Dialight Corporation
FAIRRITEPR	Fair-Rite Products
HEWLETTPAC	Hewlett-Packard
HEYMANMANU	Heyman Manufacturing, Inc.
HHSMITH	H. H. Smith, Inc.
HP	Hewlett-Packard
IDI	Industrial Devices, Inc.
INTERSIL	Intersil
ITTCAP	ITT Capacitors
ITTSCHADOW	ITT Schadow
JANCRYSTAL	JAN Crystals, Inc.
JETPREC	Jet Precision

KEYSTONE	Keystone Electronics Corporation
KINGS	Kings Electronics Company, Inc.
LEECRAFT	Leecraft (Lighting Components & Design Div.)
LITTELFUSE	Littelfuse, Inc.
MAGNETCOIL	Magnetic Coils, Inc. (MCI Transformer Corp.)
MALLORY	Mallory Capacitor
MICROLAMP	Micro Lamps, Inc.
MOTOROLA	Motorola, Inc.
MSI	Modulation Sciences, Inc.
MURATAERIE	Murata Electronics North America, Inc.
MX-COM	MX-COM, Inc.
NATIONALSE, NSC	National Semiconductor
OPTICALELE	Optical Electronics, Inc.
OXLEY	Oxley, Inc.
PAN, PANA	Panasonic
PANDUIT	Panduit
PHILIPS	North American Philips, Inc.
PRECMONOLI	Precision Monolithic

QUALITYCIR	Quality Circuits
RAYTHEON	Raytheon
RCA	Radio Corporation of America
RCD	RCD Components, Inc.
SAMTEC	Samtec, Inc.
SGSATES	SGS-Thomson Microelectronics, Inc.
SIBLEYCOMP	Sibley Components
SOLIDSTATE	Solid State Devices
SPECTROL	Spectrol Electronics Corporation
SPRAGUE	Sprague
STANDARDRADIO	Standard Radio
SWITCHCRAF	Switchcraft, Inc.
TEXASINSTR, TI	Texas Instruments
TUSONIX	Tusonix
VAR	various manufacturers

7.2 Abbreviations Used in Parts Descriptions

ADJ	adjustable
AE	aluminum electrolytic capacitor
ALUM	aluminum
BH	binding head
BL	black
BUSH	bushing
CC	carbon composition resistor
CER	ceramic
CF	carbon film resistor
CM	cable mount
CONNR	connector
DT	dipped tantalum capacitor
F, FEM	female
FH	flat head
INT	internal
LH	left-hand
LW	lockwasher

M	male
MC	monolithic ceramic capacitor
MF	metal film resistor
MINI-BAY	mini-bayonet base lamp
MOM	momentary
MT	mount
MY	Mylar® capacitor
nF	nanofarads
OX	oxide coated
PC	printed circuit
pF	picofarads
PH	pan head
PHIL	Phillips
PS	polystyrene capacitor
PWB	printed wiring board
PY	polyester capacitor
REG	regulator
RH	right-hand, round head

RND	round
SB	slow-blow
SEG	segment
SM	silvered mica capacitor
SMD	surface-mount device
SMT	surface-mount technology
SPAC	spacer
SS	solder socket
TS	terminal strip
uF	microfarads
WW	wire-wrap

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7.3 Parts List, PCG-II

NOTE: Some parts in the following list are marked with an asterisk (*). When this symbol precedes a component, it means that the part has been tested by Modulation Sciences, Inc. and should not be replaced without consulting the factory.

MSI PART NO.	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUFACTURER'S PART NO.
V02-PCGH		**PCG-II HOUSING**			
A04-1203UCBG1	4	120 pF DISC	C502-C505	SPRAGUE	10TST12
A04-1504XHNI1	4	1.5 nF FEEDTHROUGH	C501,C506-C508	TUSONIX	357-001-X5U0-152M
A04-3301UCBG1	1	3.3 pF DISC	C509	CENTRALAB	DD3R3
A06-FBEAD0001	4	FERRITE BEAD	L501-L504	FAIRRITEPR	2743002111
A08-112202801	1	PWR XFMR, DUAL 28 VCT 0.42 A	T1	MAGNETCOIL	4-07-5028
A09-S3AG01251	1	FUSE, SLOW BLOW, 1/8 A	F1	LITTELFUSE	313.125
B01-000000001	1	SCHOTTKY DIODE	D501	HEWLETTPAC	1N5711
B02-6276A	4	16 V TRANSIENT SUPPRESSOR	D502-D505	MOTOROLA	1N6276A
E01-I40000001	1	YELLOW LED	D38, READY LED	IDI	5100H7
E01-I50000001	1	GREEN LED	D39, CARRIER LED	IDI	5100H5
E02-282080001	1	28 V MINI-BAY LAMP	B1	MICROLAMP	757
G04-GBU	2	PC BOARD	PCB5, PCB6	QUALITYCIR	GBU
H02-002F00002	5	CONNR, BNC FEM, UG1094U	J1-J5	AMPHENOL	31-221
H04-PN0000001	1	FUSE HOLDER	FH1	BUSSMAN	HKP
H08-002CFW001	1	2-PIN FEM END CONNR W/GOLD	J12		
H08-004CFW001	2	4-PIN CM END CONNR W/GOLD	J6,J8	PANDUIT	CE100F24-4-DA
H08-009CFW001	2	9-PIN CM END CONNR W/GOLD	J7,J9	PANDUIT	CE100F24-9-DA
H08-012CFW001	1	12-PIN FEM END CONNR	J11		
H09-002GS0001	1	2 TERMINAL STRIP		HHSMITH	820
H09-012PR0001	1	12-POS 6-32 SCREW TS		BEAUPRODUC	71712
H10-025F00007	1	25-PIN FEM D CONNR FILTERED	J10		
H11-CRN160401	2	CRIMP LUG, #6 SCREW		ZIERICKMAN	A3651W/.144"HOLE
H11-CSI180601	3	NO.6 SPADE LUG		VACO	63206

H99-001000001	1	PANEL MT BNC GND LUG		AMPHENOL	31-759
J07-P18000001	1	6 FT LINE CORD (1.8 m)	CH1	BELDEN	17237B
K04-1450C	4	4-40 x 1/2" HEX SPACER	UPSA PWBA	KEYSTONE	1450C
K05-E02000001	1	MINI-BAY LAMP HOLDER	BH1	LEECRAFT	
K06-D08461	4	ADHESIVE WIRE TIE MT		DENNISON	8461
K06-H3510NT90	14	5 1/2" CABLE TIE		HEYMANMANU	3510NT90
K06-PTM2S6M	3	WIRE TIE MOUNT		PANDUIT	TM2S6-M
K09-H10SCL001	1	D SUB SCREWLOCK-SET OF 2	25-P D CONNR		
K99-000000003	1	3/8" STEEL HOLE PLUG			
L03-PWBSERLAB	1	PWB SERIAL LABEL		CRITCHELY	CR3-KG10F
L03-SCA186FP5	1	PCG-II FP BLUE PAINT/SCREENED		JETPREC	SCA-186-PF
L03-SCA186L1	1	SCA COMPOSITE LABEL		APEXDESIGN	SCA186L1
L03-SCA186L12	1	PRO2 REAR LABEL	25-P D CONNR		
L03-SCA186L13	1	SCA TERMINAL STRIP LABEL		APEXDESIGN	SCA186L2
L03-SCA186L3	1	LINE/FUSE LABEL		APEXDESIGN	SCA186L3
L03-SCA186L4	1	RF IN LABEL		APEXDESIGN	SCA186L4
L03-SCA186MC	1	SCA MAIN CHASSIS (REV B)		JETPREC	SCA-186-MC
L03-SCA186RE	2	SCA RACK EAR (SETS)		JETPREC	SCA-186-RE
L03-SCA186RP	1	REFLECTOR PLATE	BHR1	MSI	SCA-186-BX-RP
L03-SCA186SP	1	SCA SHIELD PLATE REV B		JETPREC	SCA-186-SP
L03-SCA186TC	1	SCA TOP COVER		JETPREC	SCA-186-TC
L03-SERIALNO2	1	COMPACT SERIAL LABEL		APEXDESIGN	SERIALNO2
O03-4/40B3801	2	4-40 x 3/8" SOCKET H		VARIOUS	NONE
O03-4/40E2501	2	4-40 x 1/4 , PHIL PAN HEAD	SCAP PWBA		
O03-4/40E2501	32	4-40 x 1/4 , PHIL PAN HEAD		VARIOUS	NONE
O03-4/40E5001	2	4-40 x 1/2	SCAP PWBA, RV1,RV2		
O03-4/40F2501	10	4-40 x 1/4 FH BL OX		VARIOUS	NONE
O03-4/40F7501	2	4-40 x 3/4 PHIL FH BL OX		VARIOUS	NONE
O03-4/40M2500	1	4-40 x 1/4" PHIL, NYLON		VARIOUS	NONE
O03-4/40N0001	2	4-40 HEX NUT, STEEL Zn		VARIOUS	NONE
O03-6/32E3801	8	6-32 x 3/8 , PHIL PH STEEL Zn		VARIOUS	NONE

O03-6/32M3801	2	6-32 x 3/8 FH MACH SCREW		VARIOUS	NONE
O03-6/32M8801	2	6-32 x 7/8 MACH SCREW, PHIL		VARIOUS	NONE
O03-6/32N0001	11	6-32 HEX NUT		VARIOUS	NONE
O03-NO.4I0001	2	#4 INT LW, STEEL Zn		VARIOUS	NONE
O03-NO.6I0001	7	#6 INT LW, STEEL Zn		VARIOUS	NONE
O05-000000001	1	STRAIN RELIEF		HEYMANMANU	5N-4BLACK
O09-000000001	13	SMALL POP RIVET		AVDEL	1693-0410
Q20-SCA186	1	ENDCAPS & BOX			
V03-SCAR	1	PWB ASSY, REG, SCA		MSI	
V03-SCAT	1	PWB ASSY, TERM, SCA		MSI	
V03-UPSA	1	PWB ASSY, PWR SUPPLY		MSI	
V04-SCA186M1	1	PEAK DEVIATION METER	M1	MODUTEC	01-130-039
V05-APC1	1	CABLE ASSY		MSI	
Z05-512	1	51 OHM 2 W 5% CC HB	R501	ALLENBRADL	HB TYPE 2W 5% CC
Z10-103	1	100 OHM 10% 1 W GB	R502	ALLENBRADL	GB TYPE 1 W 10 % CC
V01-PCGM		**MAIN BOARD**			
A02-M104FS001	1	TRIMPOT, 20T 1K00 FS SIDE	RV9	BOURNS	3006P1-102
A02-M106UT001	1	TRIMPOT, 20T 100K UR TOP	RV2	SPECTROL	64Y-104
A02-M204FS001	2	2 K 20-T TRIMPOT	RV1, RV12	BOURNS	3006P1-202
A02-M205FS001	1	20 K 20-T TRIMPOT	RV13	BOURNS	3006P1-203
A02-S106FT001	2	100 K 1T FLAT TRIMPOT	RV4, RV11	BOURNS	3386P1-104
A02-S205FT001	1	TRIMPOT, 1T 20K0 FS TOP	RV10	BOURNS	3386P1-203
A02-S205US001	1	20 K UPRIGHT TRIMPOT	RV7	BOURNS	3386W1-203
A02-S504US001	2	5 K UPRIGHT TRIMPOT	RV5, RV6	BOURNS	3386W1-502
A02-S505FT001	1	50 K 1-T FLAT TRIMPOT	RV8	BOURNS	3386P1-503
A04-1002JMEG1	3	10 pF MC 10%	C59,C63,C85	AVX	SR151A100K
A04-1004RSND3	6	1 nF 1% SM 8.50MM LS 100V	C9,C10,C36-C39	CORNEL	CD19FA102F03
A04-1004SCDG1	1	1 nF 10% DISC	C48	CENTRALAB	CE102
A04-1005HMBG1	3	0.01 uF 50 V 10% MC	C50,C82,C86	MURATA ERIE	RPE110X7R103K50V

A04-1006HMCH1	14	0.1 uF 50 V 20% MC	C45,C58,C70-C81	MALLORY	C20C104M5UICA
A04-1006JPNF1	5	0.1 uF 5% 100 V PY	C6-C8,C35,C47	WIMA	MKS4RM7 0.1/100/5 (7.5MM)
A04-1007GTNH1	4	1 uF 35 V DT	C23,C28,C54,C65	SPRAGUE	199D105X0035BB1
A04-1007HPNF1	1	1 uF 5% 63V PY LS 10MM	C44	WIMA	MKS4RM10 1uF/5%/63V/PY/LS 10 mm
A04-1007HPNF1	2	1 uF 5% 63V PY LS 10MM	C1*,C2*	WIMA	MKS4RM10 1uF/5%/63V/PY/LS 10 mm
A04-1008FTNH1	1	10 uF 25 V DT	C67	SPRAGUE	199D106X0025CB1
A04-1009FANI1	2	100 uF 25 V AE	C68,C69	STANDARD RADIO	ECE-B1EU01Y
A04-1203UCBG1	1	120 pF DISC	C13	SPRAGUE	10TST12
A04-1503UCBG1	3	150 pF DISC	C12,C26,C60	SPRAGUE	10TST15
A04-1506GTNH1	1	0.15 uF 35 V DT	C46	SPRAGUE	199D154X0035AB1
A04-1506JPNF1	1	0.15 uF 5% 100 V PY	C51	WIMA	MKS4RM10 .15/5/100 (10MM)
A04-1804JPNG1	1	1.8 nF 5% 100 V PY	C56	WIMA	FKS3RM7 1800/100/5(7.5MM)
A04-2205JRNG1	2	0.022 uF 100 V 10% P	C17,C18	WIMA	
A04-2704MCFG1	1	2.7 nF 100 V DISC Y5P 10%	C49	MALLORY	SM272K
A04-3302JMAG1	1	33 pF 100 V 10% MC	C20	AVX	SR151A330KAA
A04-3303RSNE1	1	330 pF 2% SM 300 V	C66	VARIOUS	DM15FD331G03
A04-3307FTNH1	4	3.3 uF 25 V DT	C21,C22,C27,C33	SPRAGUE	199D335X0025BB1
A04-3902UCBG1	1	39 pF 1 KV CER DISC	C61	SPRAGUE	10TSQ39
A04-3903RSND1	3	390 pF 1% SM	C3,C4,C53	VARIOUS	CM05FD391F03
A04-3903UCBG1	3	390 pF DISC 5%	C32,C43,C52	ARCO	CCD391
A04-4708BTNH1	1	47 uF 6 V DT	C64	ITTCAP	TAP47M6.3
A04-5001UCBG1	3	5 pF DISC	C19,C24,C57	ARCO	CCD-050
A04-5604JMEG1	2	5.6 nF 100 V 10% MC	C11,C25	CENTRALAB	CW15A562K
A04-6802JMAG1	2	68 pF 100 V 10% MC	C40,C41	CENTRALAB	CN15A680K
A04-6804JRNF1	1	6.8 nF 5% 100 V PC	C55	WIMA	FKC2 6800/100/5 (7.5M)
A04-6807FTNH1	3	6.8 uF 25 V DT	C34,C42,C62	ITTCAP	68K35
A05-550118021	1	5.5-18 pF TRIM CAP	CV1	TUSONIX	538-011A-5.5-18
A06-FCORE0001	2	POT CORE (2 / UNIT)	T2	PHILIPS	2213P-L00-3B7
A10-032768001	1	3.2768 MHz XTAL HC-33/U	X1	JANCRYSTAL	MP-HC33
BT1-000000001	5	SCHOTTKY DIODE	D15*,D40*-D43*	HP	1N5711

B01-4148	44	GLASS DIODE	D1-D5,D9-D14, D16-D33,D44-D58	VARIOUS	1N4150
B04-N3904	2	NPN TRANSISTOR TO-92	Q7,Q10	VARIOUS	2N3904
B04-P3906	1	LOW POWER PNP TRANSISTOR	Q8	VARIOUS	2N3906
B04-P5087	1	LOW POWER TRANSISTOR	Q9	VARIOUS	2N5087
B05-N15202001	1	MED POWER TRANSISTOR	Q1	MOTOROLA	MPSU05
B05-P15202001	1	MED POWER TRANSISTOR	Q2	MOTOROLA	MPSU55
C01-1B0000003	2	OP AMP, PLASTIC	U13,U15	TEXASINSTR	NE5534P
C01-1B0000004	1	OP AMP	U14	ANALOGSYST	MA332CP
C01-2F0000002	3	DUAL OP AMP	U1,U2,U5	NATIONALSE	LF412CN
C01-2F0000007	13	DUAL OP AMP	U3,U4,U6-U12, U17,U30-U32	RAYTHEON	TL082CP
C03-100000002	1	WAVEFORM GEN, CERAMIC	U21	INTERSIL	ICL8038CCJD
C05-100000001	1	TRANSCOND AMP	U16	RCA	CA3080E
C07-200000002	1	DUAL VCA	U20*	CURTIS	CEM3330 or CEM3335
C99-100000001	1	BALANCED INPUT AMP	U33	ANALOGDEVI	AD524AD
D01-4006X0001	1	18 BIT SHIFT REG	U28	SGSATES	HCF4006BE
D01-401030001	1	PROGRAMMABLE DIVIDER	U25	RCA	CD40103BE
D01-401300001	1	DUAL D FLIP-FLOP	U26	MOTOROLA	MC14013
D01-4020X0001	1	14-BIT BINARY COUNTER	U27	RCA	CD4020BE
D01-4060X0001	1	XTAL OSC/FREQ DIV	U24	SOLIDSTATE	SCL4060BE
D01-4070X0001	1	QUAD EXCL OR GATE	U29	NATIONALSE	CD4070BCN
G04-SCAM	1	PWB MASTER, SCAM, REV 3			
H05-008000001	20	8-PIN EDGE GRIP SS	US1-US17,US30-US32	TEXASINSTR	C930802
H05-014000002	5	14-PIN FACE GRIP SS	US20,US21,US26, US28,US29	AMP	2-641261-20
H05-016000002	3	16-PIN FACE GRIP SS	US24,US27,US33	AMP	2-641262-20
H06-016000001	1	16-PIN WW SOCKET	US25	ASSMAN	AR16-HZW
H08-001PMS001	1	TEST POINTS	P20	OXLEY	040/30P/KP2/L
H08-001PMW001	16	SINGLE WW PIN	P1-P4,P8-P19	SAMTEC	TSW-101-09-GS
H08-002CFW001	1	2-PIN FEM END CONN W/GOLD	J1	PANDUIT	

H08-002PMW002	1	2-PIN WW STRIP			
H08-003PMW001	1	3-PIN WW STRIP	PS11	SAMTEC	TSW-103-09-GS
H08-004PMS002	3	MASCON HEADER, 4-PIN W/GOLD	J6,J8,J10	PANDUIT	MLSS100-4-DA
H08-005CFW001	1	5-PIN END CONNR, GOLD PLATED	J2		
H08-009PMS002	2	STRAIGHT MASCON HEADER	PS7,PS9	PANDUIT	MLSS100-9-DA
I02-020100201	1	ALT ACT DPDT PC SW	S6	ITTSCHADOW	F2UEE
I02-050400201	1	5 STA INTERLOCK SW		ITTSCHADOW	F17.5054UGRN
K01-A02COV001	4	20-T TRIMPOT COVER	RVC1, RVC9, RVC12, RVC13	BOURNS	H-83-P
K01-I02IND001	1	LAMPLESS INDICATOR, BLK/YEL	SC6	ITTSCHADOW	FA201 BLACK/YELLOW
K01-I02IND002	3	LAMPLESS INDICATOR, BLK/GRN	SC3-SC5	ITTSCHADOW	FA101 BLACK/GREEN
K01-I02IND003	1	LAMPLESS INDICATOR, BLK/ORG	SC1	ITTSCHADOW	FA101 BLACK/ORANGE
K01-I02IND004	1	LAMPLESS INDICATOR, BLK/YEL	SC2	ITTSCHADOW	FA101 BLACK/YELLOW
K04-1450D	9	4-40 x 3/4 HEX SPACER		KEYSTONE	1450D
K04-1902E	1	4-40 x 1" HEX SPACER, NYLON			
K04-2205	3	4-40 x 1" HEX SPACER, ALUM	RV5,RV6,RV7		
L03-PWBSERLAB	1	PWB SERIAL LABEL		CRITCHELY	CR3-KG10F
O03-4/40M2500	1	4-40 x 1/4" PHIL, NYLON			
O03-4/40E2501	5	4-40 x 1/4 , PHIL PAN HEAD		VARIOUS	NONE
O03-4/40M2501	3	4-40 x 1/4 RND HD, SLOTTED		VARIOUS	NONE
O03-6/32M8801	1	6-32 x 7/8 MACH SCREW, PHIL		VARIOUS	NONE
O03-6/32N0001	1	6-32 HEX NUT		VARIOUS	NONE
O03-NO.6I0001	1	#6 INT. LW, STEEL Zn		VARIOUS	NONE
O03-NO.6L0001	1	#6 FLAT WASHER		VARIOUS	NONE
V04-SCA186T2	1	XFMR, WIRE/BOBBIN*			
Z01-000	5	0 OHM 1/4 W 5% CF	BY SCAM LOGO		
Z01-103	2	100 OHM 1/4 W 5% CF	R19,R60	VARIOUS	1/4 W 5 % CF
Z01-104	4	1 K 1/4 W 5% CF	R17,R22,R61,R62	VARIOUS	1/4 W 5 % CF
Z01-105	15	10 K 1/4 W 5% CF	R11,R54,R73-R74, R88-R89,R115,R121, R128,R148,R153,	VARIOUS	1/4 W 5 % CF

			R175,R177,R178,R184		
Z01-106	7	100 K 1/4 W 5% CF	R68,R122,R140,R142, R170,R171,R180	VARIOUS	1/4 W 5 % CF
Z01-107	1	1 M 1/4 W 5% CF	R123	VARIOUS	1/4 W 5 % CF
Z01-108	3	10 M 1/4 W 5% CF	R86,R113,R166	VARIOUS	1/4 W 5 % CF
Z01-125	2	12 K 1/4 W 5% CF	R161,R163	VARIOUS	1/4 W 5 % CF
Z01-126	3	120 K 1/4 W 5% CF	R24,R59,R157	VARIOUS	1/4 W 5 % CF
Z01-127	1	1.2 M 1/4 W 5% CF	R185	VARIOUS	1/4 W 5 % CF
Z01-155	2	15 K 1/4 W 5% CF	R52,R69	VARIOUS	1/4 W 5 % CF
Z01-156	2	150 K 1/4 W 5% CF	R91,R173	VARIOUS	1/4 W 5 % CF
Z01-186	3	180 K 1/4 W 5% CF	R10,R18,R134	VARIOUS	1/4 W 5 % CF
Z01-203	1	200 OHM 1/4 W 5% CF	R168	VARIOUS	1/4 W 5 % CF
Z01-204	1	2 K 1/4 W 5% CF	R129	VARIOUS	1/4 W 5 % CF
Z01-222	2	22 OHM 1/4 W 5% CF	R5,R6	VARIOUS	1/4 W 5 % CF
Z01-224	2	2.2 K 1/4 W 5% CF	R79,R188	VARIOUS	1/4 W 5 % CF
Z01-225	5	22 K 1/4 W 5% CF	R1,R80,R126,R133,R141	VARIOUS	1/4 W 5 % CF
Z01-226	3	220 K 1/4 W 5% CF	R82,R85,R125	VARIOUS	1/4 W 5 % CF
Z01-227	1	2.2 M 1/4 W 5% CF	R71	VARIOUS	1/4 W 5 % CF
Z01-274	1	2.7 K 1/4 W 5% CF	R112	VARIOUS	1/4 W 5 % CF
Z01-275	2	27 K 1/4 W 5% CF	R9,R72	VARIOUS	1/4 W 5 % CF
Z01-333	3	330 OHM 1/4 W 5% CF	R162,R174,R187	VARIOUS	1/4 W 5 % CF
Z01-334	5	3.3 K 1/4 W 5% CF	R81,R116,R118, R183,R186	VARIOUS	1/4 W 5 % CF
Z01-335	3	33 K 1/4 W 5% CF	R16,R131,R176	VARIOUS	1/4 W 5 % CF
Z01-363	1	360 OHM 1/4 W 5% CF	R20	VARIOUS	1/4 W 5 % CF
Z01-435	1	43 K 1/4 W 5% CF	R154	VARIOUS	1/4 W 5 % CF
Z01-474	1	4.7 K 1/4 W 5% CF	R169	VARIOUS	1/4 W 5 % CF
Z01-475	4	47 K 1/4 W 5% CF	R51,R56,R70,R83	VARIOUS	1/4 W 5 % CF
Z01-476	1	470 K 1/4 W 5% CF	R55	VARIOUS	1/4 W 5 % CF
Z01-477	2	4.7 M 1/4 W 5% CF	R87,R165	VARIOUS	1/4 W 5 % CF
Z01-512	2	51 OHM 1/4 W 5% CF	R147,R152	VARIOUS	1/4 W 5 % CF

Z01-514	1	5.1 K 1/4 W 5% CF	R130	VARIOUS	1/4 W 5 % CF
Z01-515	1	51 K 1/4 W 5% CF	R23	VARIOUS	1/4 W 5 % CF
Z01-563	1	560 OHM 1/4 W 5% CF	R172	VARIOUS	1/4 W 5 % CF
Z01-564	1	5.6 K 1/4 W 5% CF	R132	VARIOUS	1/4 W 5 % CF
Z01-565	4	56 K 1/4 W 5% CF	R67,R90,R124,R155	VARIOUS	1/4 W 5 % CF
Z01-567	1	5.6 M 1/4 W 5% CF	R57	VARIOUS	1/4 W 5 % CF
Z01-624	1	6.2 K 1/4 W 5% CF	R53	VARIOUS	1/4 W 5 % CF
Z01-625	2	62 K 1/4 W 5% CF	R46,R58	VARIOUS	1/4 W 5 % CF
Z01-683	1	680 OHM 1/4 W 5% CF	R111	VARIOUS	1/4 W 5 % CF
Z01-684	3	6.8 K 1/4 W 5% CF	R4,R21,R179	VARIOUS	1/4 W 5 % CF
Z01-685	1	68 K 1/4 W 5% CF	R158	VARIOUS	1/4 W 5 % CF
Z01-823	1	820 OHM 1/4 W 5% CF	R108	VARIOUS	1/4 W 5 % CF
Z01-824	1	8.2 K 1/4 W 5% CF	R156	VARIOUS	1/4 W 5 % CF
Z01-825	2	82 K 1/4 W 5% CF	R78,R127	VARIOUS	1/4 W 5 % CF
Z01-826	1	820 K 1/4 W 5% CF	R84	VARIOUS	1/4 W 5 % CF
Z01-XXX	2	RESISTOR 5% SEL AT TEST	R137*,R181*	VARIOUS	1/4 W 5 % CF
Z02-1005	15	10.0 K 1/4 W 1% MF	R2,R3,R15,R47-R50, R63-R66,R95,R101, R146,R160	VARIOUS	1/4 W 1 % MF
Z02-1006	4	100 K 1/4 W 1% MF	R114,R117,R119,R120	VARIOUS	1/4 W 1 % MF
Z02-1007	2	1.00 M 1/4 W 1% MF	R7,R8	VARIOUS	1/4 W 1 % MF
Z02-1215	1	12.1 K 1/4 W 1% MF	R164	VARIOUS	1/4 W 1 % MF
Z02-1504	1	1.5 K 1/4 W 1% MF	R143	VARIOUS	1/4 W 1 % MF
Z02-1625	1	16.2 K 1/4 W 1% MF	R135	VARIOUS	1/4 W 1 % MF
Z02-1824	2	1.82 K 1/4 W 1% MF	R40,R41		1/4 W 1% MF
Z02-2104	1	2.10 K 1/4 W 1% MF	R159	VARIOUS	1/4 W 1 % MF
Z02-2105	2	21.0 K 1/4 W 1% MF	R43,R44	VARIOUS	1/4 W 1 % MF
Z02-2265	2	22.6 K 1/4 W 1% MF	R42,R45		1/4 W 1% MF
Z02-2675	2	26.7 K 1/4 W 1% MF	R99,R151	VARIOUS	1/4 W 1 % MF
Z02-3015	3	30.1 K 1/4 W 1% MF	R75,R76,R149	VARIOUS	1/4 W 1 % MF
Z02-3244	1	3.24 K 1/4 W 1% MF	R139	VARIOUS	1/4 W 1 % MF

Z02-3404	1	3.40 K 1/4 W 1% MF	R138	VARIOUS	1/4 W 1 % MF
Z02-3924	1	3.92 K 1/4 W 1% MF	R96	VARIOUS	1/4 W 1 % MF
Z02-3925	1	39.2 K 1/4 W 1% MF	R93	VARIOUS	1/4 W 1 % MF
Z02-4424	1	4.42 K 1/4 W 1% MF	R167	VARIOUS	1/4 W 1 % MF
Z02-4994	4	4.99 K 1/4 W 1% MF	R94,R100,R144,R145	VARIOUS	1/4 W 1 % MF
Z02-5114	1	5.11K 1/4 W 1% MF	R14	VARIOUS	1/4 W 1 % MF
Z02-5625	1	56.2 K 1/4 W 1% MF	R13	VARIOUS	1/4 W 1 % MF
Z02-7154	1	7.15 K 1/4 W 1% MF	R92	VARIOUS	1/4 W 1 % MF
Z02-7503	1	750 OHM 1/4 W 1% MF	R97	VARIOUS	1/4 W 1 % MF
Z02-7684	2	7.68 K 1/4 W 1% MF	R98,R150	VARIOUS	1/4 W 1 % MF
Z02-8664	1	8.66 K 1/4 W 1% MF	R136	VARIOUS	1/4 W 1 % MF
Z03-2215	1	22.1 K 1/4 W 1% MF RN55 50 PPM	R12	RCD	MF55C - SORTED
V01-SCAP		**PCG-II SCAP BOARD**			
A02-S105US001	2	10 K UPRIGHT TRIMPOT	RV1, RV2	BOURNS	3386W-1-103
A04-1006JPNG1	9	0.1 uF 100 V MET/PY 10%	C1-C6,C16,C18,C23	PAN	ECQ-E1104KF
A04-1008FANH1	3	10 uF 35 V EL 20%	C21,C22,C24		
A04-3302RCAF1	1	33 pF 100 V CER NPO 5%	C20	PAN	ECC-F2A330JCE
A04-4705JPNF1	2	0.047 uF 100 V MET/PY FILM	C7,C8	PAN	ECQ-E1473KF
A04-4708HANG1	5	47 uF 50 V 10% EL 2.5mmLS	C10,C11,C13,C14,C17	PAN	ECE-A1HU470
A05-150260021	1	15-60 pF TRIM CAP	C19	MURATA	DV11PS60Q
A10-040000001	1	4.000 MHz CRYSTAL	XTAL1	ACCORD	4.000 MHZ CRYSTAL
B01-1N914	8	GLASS DIODE	D1-D8	VAR	1N914
B04-N3904	2	NPN TRANSISTOR TO-92	Q2,Q3	VAR	2N3904
B05-J310	1	N-CHANNEL FET	Q1	MOT	J310
C01-2F0000012	4	DUAL OP AMP, PLASTIC	U1-U4	TI	TL074CN
C01-MX165CP	1	TONE DECODER, PLASTIC	U13	MX-COM	MX165CP
C02-1P501L001	1	+5 VOLT 5% LOW PWR REG	U12	NSC	LM78L05ACZ
C06-100000002	6	OPTOISOLATOR	U6-U11	VAR	4N37
D01-CGS3322M	1	OCS/DRIVER, SMD	U5	NSC	CGS3322M
G04-SCAP	1	SCAP PWB	PWB		

H08-003PMS001	1	MASCON 3-PIN LATCHEAD	H2 POWER	PANDUIT	MLSS100-3-CB OR DB
H08-004PMS002	1	MASCON HEAD,4-PIN W/GOLD	H3 IND	PANDUIT	MLSS100-4-DA OR DB
H08-005PMS001	1	MASCON 5-PIN HEAD W/ GOLD	H1 AUDIO	PANDUIT	MLSS100-5-DA OR DB
H08-012PMS001	1	MASCON 0.1" 12-PIN HEADER	H4 CTL	PANDUIT	MLSS100-12-CB OR DB
L03-PWBSERLAB	1	PWB SERIAL LABEL (KAPTON)		CRITCHELY	CR3-KG10F
Z02-1005	15	10.0 K 1/4 W 1% MF	R5-R7,R9-R11, R14,R15,R18-R20, R25,R28,R32,R47		
Z02-1006	4	100 K 1/4 W 1% MF	R1,R2,R37,R59		
Z02-1075	1	10.7 K 1/4 W 1% MF	R24		
Z02-1504	1	1.50 K 1/4 W 1% MF	R57		
Z02-1505	4	15.0 K 1/4 W 1% MF	R48,R49,R55,R56		
Z02-1585	1	15.8 K 1/4 W 1% MF	R53		
Z02-1785	1	17.8 K 1/4 W 1% MF	R29		
Z02-1825	1	18.2 K 1/4 W 1% MF	R35		
Z02-1875	2	18.7 K 1/4 W 1% MF	R4,R8		
Z02-2004	1	2.0 K 1/4 W 1% MF	R60		
Z02-2005	1	20.0 K 1/4 W 1% MF	R34		
Z02-2105	2	21.0 K 1/4 W 1% MF	R22,R23		
Z02-2215	5	22.1 K 1/4 W 1% MF	R26,R27,R31,R33,R38		
Z02-2264	2	2.26 K 1/4 W 1% MF	R50,R51		
Z02-2435	1	24.3 K 1/4 W 1% MF	R16		
Z02-2744	6	2.74 K 1/4 W 1% MF	R39,R42-R46		
Z02-3013	1	301 OHM 1/4 W 1% MF	R58		
Z02-3325	1	33.2 K 1/4 W 1% MF	R21		
Z02-3484	1	3.48 K 1/4 W 1% MF	R3		
Z02-3924	1	3.92 K 1/4 W 1% MF	R12		
Z02-4755	2	47.5 K 1/4 W 1% MF	R41,R52		
Z02-4874	1	4.87 K 1/4 W 1% MF	R36		
Z02-6194	1	6.19 K 1/4W 1% MF	R54		
Z02-8454	2	8.45 K 1/4 W 1% MF	R13,R17		