Operating Manual

OPTIMOD-FM

5518

FM Stereo Encoder

Version 2.1 Software

orban

IMPORTANT NOTE: Refer to the unit's rear panel for your Model Number.

Model Number:	**Description:**
5518	5518 Stereo Encoder. 85-264V operation at 50-60 Hz via universal switching power supply. Switchable to 50µs or 75µs.

CAUTION: TO REDUCE THE RISK OF ELECTRICAL SHOCK, DO NOT REMOVE COVER (OR BACK).
NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

WARNING: TO REDUCE THE RISK OF FIRE OR ELECTRICAL SHOCK,
DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.

This symbol, wherever it appears, alerts you to the presence of uninsulated dangerous voltage inside the enclosure — voltage that may be sufficient to constitute a risk of shock.

This symbol, wherever it appears, alerts you to important operating and maintenance instructions in the accompanying literature. Read the manual.

In accordance to the WEEE (waste electrical and electronic equipment) directive of the European Parliament, this product must not be discarded into the municipal waste stream in any of the Member States. This product may be sent back to your Orban dealer at end of life where it will be reused or recycled at no cost to you.

If this product is discarded into an approved municipal WEEE collection site or turned over to an approved WEEE recycler at end of life, your Orban dealer must be notified and supplied with model, serial number and the name and location of site/facility.

Please contact your Orban dealer for further assistance.

www.orban.com

IMPORTANT SAFETY INSTRUCTIONS

All the safety and operating instructions should be read before the appliance is operated.

Retain Instructions: The safety and operation instructions should be retained for future reference.

Heed Warnings: All warnings on the appliance and in the operating instructions should be adhered to.

Follow Instructions: All operation and user instructions should be followed.

Water and Moisture: The appliance should not be used near water (e.g., near a bathtub, washbowl, kitchen sink, laundry tub, in a wet basement, or near a swimming pool, etc.).

Ventilation: The appliance should be situated so that its location or position does not interfere with its proper ventilation. For example, the appliance should not be situated on a bed, sofa, rug, or similar surface that may block the ventilation openings; or, placed in a built-in installation, such as a bookcase or cabinet that may impede the flow of air through the ventilation openings.

Heat: The appliance should be situated away from heat sources such as radiators, heat registers, stoves, or other appliances (including amplifiers) that produce heat.

Power Sources: The appliance should be connected to a power supply only of the type described in the operating instructions or as marked on the appliance.

Grounding or Polarization: Precautions should be taken so that the grounding or polarization means of an appliance is not defeated.

Power-Cord Protection: Power-supply cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to cords at plugs, convenience receptacles, and the point where they exit from the appliance.

Cleaning: The appliance should be cleaned only as recommended by the manufacturer.

Non-Use Periods: The power cord of the appliance should be unplugged from the outlet when left unused for a long period of time.

Object and Liquid Entry: Care should be taken so that objects do not fall and liquids are not spilled into the enclosure through openings.

Damage Requiring Service: The appliance should be serviced by qualified service personnel when: The power supply cord or the plug has been damaged; or Objects have fallen, or liquid has been spilled into the appliance; or The appliance has been exposed to rain; or The appliance does not appear to operate normally or exhibits a marked change in performance; or The appliance has been dropped, or the enclosure damaged.

Servicing: The user should not attempt to service the appliance beyond that described in the operating instructions. All other servicing should be referred to qualified service personnel.

The Appliance should be used only with a cart or stand that is recommended by the manufacturer.

Safety Instructions (European)

Notice For U.K. Customers If Your Unit Is Equipped With A Power Cord.

WARNING: THIS APPLIANCE MUST BE EARTHED.

The cores in the mains lead are coloured in accordance with the following code:

GREEN and YELLOW - Earth BLUE - Neutral BROWN - Live

As colours of the cores in the mains lead of this appliance may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:

The core which is coloured green and yellow must be connected to the terminal in the plug marked with the letter E, or with the earth symbol, or coloured green, or green and yellow.

The core which is coloured blue must be connected to the terminal marked N or coloured black.

The core which is coloured brown must be connected to the terminal marked L or coloured red.

The power cord is terminated in a CEE7 / 7 plug (Continental Europe). The green / yellow wire is connected directly to the unit's chassis. If you need to change the plug and if you are qualified to do so, refer to the table below.

WARNING: If the ground is defeated, certain fault conditions in the unit or in the system to which it is connected can result in full line voltage between chassis and earth ground. Severe injury or death can then result if the chassis and earth ground are touched simultaneously.

Conductor		WIRE COLOR	
		Normal	Alt
L	LIVE	BROWN	BLACK
N	NEUTRAL	BLUE	WHITE
E	EARTH GND	GREEN-YELLOW	GREEN

AC Power Cord Color Coding

Safety Instructions (German)

Gerät nur an der am Leistungsschild vermerkten Spannung und Stromart betreiben.
Sicherungen nur durch solche, gleicher Stromstärke und gleichen Abschaltverhaltens ersetzen. Sicherungen nie überbrücken.
Jedwede Beschädigung des Netzkabels vermeiden. Netzkabel nicht knicken oder quetschen. Beim Abziehen des Netzkabels den Stecker und nicht das Kabel enfassen. Beschädigte Netzkabel sofort auswechseln.
Gerät und Netzkabel keinen übertriebenen mechanischen Beaspruchungen aussetzen.
Um Berührung gefährlicher elektrischer Spannungen zu vermeiden, darf das Gerät nicht geöffnet werden. Im Fall von Betriebsstörungen darf das Gerät nur Von befugten Servicestellen instandgesetzt werden. Im Gerät befinden sich keine, durch den Benutzer reparierbare Teile.
Zur Vermeidung von elektrischen Schlägen und Feuer ist das Gerät vor Nässe zu schützen. Eindringen von Feuchtigkeit und Flüssigkeiten in das Gerät vermeiden.
Bei Betriebsstörungen bzw. nach Eindringen von Flüssigkeiten oder anderen Gegenständen, das Gerät sofort vom Netz trennen und eine qualifizierte Servicestelle kontaktieren.

Safety Instructions (French)

On s'assurera toujours que la tension et la nature du courant utilisé correspondent bien à ceux indiqués sur la plaque de l'appareil.
N'utiliser que des fusibles de même intensité et du même principe de mise hors circuit que les fusibles d'origine. Ne jamais shunter les fusibles.
Eviter tout ce qui risque d'endommager le câble seceur. On ne devra ni le plier, ni l'aplatir. Lorsqu'on débranche l'appareil, tirer la fiche et non le câble. Si un câble est endommagé, le remplacer immédiatement.
Ne jamais exposer l'appareil ou le câble ä une contrainte mécanique excessive.
Pour éviter tout contact averc une tension électrique dangereuse, on n'oouvrira jamais l'appareil. En cas de dysfonctionnement, l'appareil ne peut être réparé que dans un atelier autorisé. Aucun élément de cet appareil ne peut être réparé par l'utilisateur.
Pour éviter les risques de décharge électrique et d'incendie, protéger l'appareil de l'humidité. Eviter toute pénétration d'humidité ou fr liquide dans l'appareil.
En cas de dysfonctionnement ou si un liquide ou tout autre objet a pénétré dans l'appareil couper aussitôt l'appareil de son alimentation et s'adresser à un point de service aprésvente autorisé.

Safety Instructions (Spanish)

Hacer funcionar el aparato sólo con la tensión y clase de corriente señaladas en la placa indicadora de características.
Reemplazar los fusibles sólo por otros de la misma intensidad de corriente y sistema de desconexión. No poner nunca los fusibles en puente.
Proteger el cable de alimentación contra toda clase de daños. No doblar o apretar el cable. Al desenchufar, asir el enchufe y no el cable. Sustituir inmediatamente cables dañados.
No someter el aparato y el cable de alimentación a esfuerzo mecánico excesivo.
Para evitar el contacto con tensiones eléctricas peligrosas, el aparato no debe abrirse. En caso de producirse fallos de funcionamiento, debe ser reparado sólo por talleres de servicio autorizados. En el aparato no se encuentra ninguna pieza que pudiera ser reparada por el usuario.
Para evitar descargas eléctricas e incendios, el aparato debe protegerse contra la humedad, impidiendo que penetren ésta o líquidos en el mismo.
En caso de producirse fallas de funcionamiento como consecuencia de la penetración de líquidos u otros objetos en el aparato, hay que desconectarlo inmediatamente de la red y ponerse en contacto con un taller de servicio autorizado.

Safety Instructions (Italian)

Far funzionare l'apparecchio solo con la tensione e il tipo di corrente indicati sulla targa riportante i dati sulle prestazioni.
Sostituire i dispositivi di protezione (valvole, fusibili ecc.) solo con dispositivi aventi lo stesso amperaggio e lo stesso comportamento di interruzione. Non cavallottare mai i dispositivi di protezione.
Evitare qualsiasi danno al cavo di collegamento alla rete. Non piegare o schiacciare il cavo. Per staccare il cavo, tirare la presa e mai il cavo. Sostituire subito i cavi danneggiati.
Non esporre l'apparecchio e il cavo ad esagerate sollecitazioni meccaniche.
Per evitare il contatto con le tensioni elettriche pericolose, l'apparecchio non deve venir aperto. In caso di anomalie di funzionamento l'apparecchio deve venir riparato solo da centri di servizio autorizzati. Nell'apparecchio non si trovano parti che possano essere riparate dall'utente.
Per evitare scosse elettriche o incendi, l'apparecchio va protetto dall'umidità. Evitare che umidità o liquidi entrino nell'apparecchio.
In caso di anomalie di funzionamento rispettivamente dopo la penetrazione di liquidi o oggetti nell'apparecchio, staccare immediatamente l'apparecchio dalla rete e contattare un centro di servizio qualificato.

PLEASE READ BEFORE PROCEEDING!

Manual

The Operating Manual contains instructions to verify the proper operation of this unit and initialization of certain options. You will find these operations are most conveniently performed on the bench before you install the unit in the rack.

Please review the Manual, especially the installation section, before unpacking the unit.

Trial Period Precautions

If your unit has been provided on a trial basis:

You should observe the following precautions to avoid reconditioning charges in case you later wish to return the unit to your dealer.

(1) Note the packing technique and save all packing materials. It is not wise to ship in other than the factory carton. (Replacements cost $35.00).

(2) Avoid scratching the paint or plating. Set the unit on soft, clean surfaces.

(3) Do not cut the grounding pin from the line cord.

(4) Use care and proper tools in removing and tightening screws to avoid burring the heads.

(5) Use the nylon-washered rack screws supplied, if possible, to avoid damaging the panel. Support the unit when tightening the screws so that the threads do not scrape the paint inside the slotted holes.

Packing

When you pack the unit for shipping:

(1) Tighten all screws on any barrier strip(s) so the screws do not fall out from vibration.
(2) Wrap the unit in its original plastic bag to avoid abrading the paint.
(3) Seal the inner and outer cartons with tape.

If you are returning the unit permanently (for credit), be sure to enclose:

The Manual(s)
The Registration / Warranty Card
The Line Cord
All Miscellaneous Hardware (including the Rack Screws and Keys)
The Extender Card (if applicable)

Your dealer may charge you for any missing items.

If you are returning a unit for repair, do not enclose any of the above items.

Further advice on proper packing and shipping is included in the Manual (see Table of Contents).

Trouble

If you have problems with installation or operation:

(1) Check everything you have done so far against the instructions in the Manual. The information contained therein is based on our years of experience with 5518 and broadcast stations.

(2) Check the other sections of the Manual (consult the Table of Contents and Index) to see if there might be some suggestions regarding your problem.

(3) After reading the section on Factory Assistance, you may call Orban Customer Service for advice during normal Arizona business hours. The number is +1 856.719.9900.

WARNING

This equipment generates, uses, and can radiate radio-frequency energy. If it is not installed and used as directed by this manual, it may cause interference to radio communication. This equipment complies with the limits for a Class A computing device, as specified by FCC Rules, Part 15, subject J, which are designed to provide reasonable protection against such interference when this type of equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference. If it does, the user will be required to eliminate the interference at the user's expense.

WARNING

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the radio Interference Regulations of the Canadian Department of Communications. (Le present appareil numerique n'emet pas de bruits radioelectriques depassant les limites applicables aux appareils numeriques [de las class A] prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.)

IMPORTANT

Perform the installation under static control conditions. Simply walking across a rug can generate a static charge of 20,000 volts. This is the spark or shock you may have felt when touching a doorknob or some other conductive surface. A much smaller static discharge is likely to destroy one or more of the CMOS semiconductors employed in OPTIMOD-FM. Static damage will not be covered under warranty.

There are many common sources of static. Most involve some type of friction between two dissimilar materials. Some examples are combing your hair, sliding across a seat cover or rolling a cart across the floor. Since the threshold of human perception for a static discharge is 3000 volts, you will not even notice many damaging discharges.

Basic damage prevention consists of minimizing generation, discharging any accumulated static charge on your body or workstation, and preventing that discharge from being sent to or through an electronic component. You should use a static grounding strap (grounded through a protective resistor) and a static safe workbench with a conductive surface. This will prevent any buildup of damaging static.

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Operating Manual

OPTIMOD-FM

5518

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Version 2.1 Software

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Section 1
Introduction

About this Manual

The Adobe pdf form of this manual contains numerous hyperlinks and bookmarks. A reference to a numbered step or a page number (except in the Index) is a live hyperlink; click on it to go immediately to that reference.

> If the bookmarks are not visible, click the "Bookmarks" tab on the left side of the Acrobat Reader window.

This manual has a table of contents and index. To search for a specific word or phrase, you can also use the Adobe Acrobat Reader's text search function.

The 5518 FM Stereo Encoder

Orban's all-digital 5518 FM Stereo Encoder is a high-quality stand-alone stereo encoder that operates at 64 kHz to 512 kHz sample rates and offers lowpass filtering, overshoot limiting, composite limiting, diversity delay, and an ITU412 multiplex power controller. The 5518 must be driven (usually via an STL) by a full-featured FM audio processor (like Orban's 8600) that incorporates preemphasis-aware HF limiting and peak control.

Take a little time now to familiarize yourself with the 5518. A small investment of your time now will yield large dividends in audio quality.

The rest of Section 1 explains how the 5518 fits into the FM broadcast facility. Section 2 explains how to install it and set it up. Section 3 tells how to operate the 5518. Sections 4 through 6 provide reference information.

Flexible Configuration

- A built-in **RDS/RBDS encoder** supports the most important RDS features and can be associated with processing presets so that mixed-format stations can automatically update the "program type" field to complement the programming by recalling a audio processing preset for a given program type.

- There are **two composite outputs with independent level controls**, each capable of driving 75Ω in parallel with 47,000pF, (100ft/30m of coaxial cable). In addition, the overshoot-limited left/right domain audio appears at the 5518's analog and AES3 digital outputs.

- The 5518 includes **analog** and **AES3 digital** inputs and outputs. Both digital input and digital output are equipped with sample-rate converters and can operate at 32 kHz, 44.1 kHz, 48, 88.2, and 96 kHz sample rates. The preemphasis status and output levels are separately adjustable for the analog and digital outputs.

- The analog inputs are **transformerless, balanced 10kΩ instrumentation-amplifier circuits**, and the analog outputs are transformerless balanced, and floating (with 50Ω impedance) to ensure highest transparency and accurate pulse response.

- The 5518 has two **subcarrier inputs** that are mixed with the output of the 5518's stereo encoder before application to the composite output connectors. One input can be re-jumpered to provide a 19 kHz pilot reference output. Rear-panel accessible PC-board-mounted trim pots allow the user to adjust the sensitivities of the two SCA inputs, allowing both inputs to accommodate subcarrier generators with output levels as low as 100 mV p-p.

- The 5518 has a **Wordclock/10 MHz Sync Reference Input**, which can be used to lock the stereo pilot tone to a high precision external reference like a GPS-based frequency standard. This facilitates using the 5518 in single-frequency network applications.

- **Silence alarm** and **digital audio fault tally** outputs are available.

- All input, output, and power connections are **rigorously RFI-suppressed** to Orban's traditional exacting standards, ensuring trouble-free installation.

- The 5518 is designed and certified to **meet all applicable international safety and emissions standards**.

Signal Processing Features

- The **sample rate is 64 kHz and multiples thereof**, up to 512 kHz. The internal audio bandwidth is high enough to prevent overshoot caused by spectral truncation of the left/right input signals that are band-limited to 18 kHz or lower. This makes the 5518 compatible with all Orban OPTIMOD-FM audio processors.

- 15, 16, or 17 kHz linear-phase **lowpass filtering** can be applied to the input signal. To minimize input/output delay, this filter can be bypassed, which is ap-

propriate if the input signal is correctly band-limited by the audio processor driving the 5518.

- A **left/right domain overshoot limiter** is available. This combines look-ahead and band-limited clipping techniques to control STL-induced overshoots while minimizing artifacts.

- A **dual-mode composite limiter** is available. The composite limiter uses a unique, "you can only do this in DSP" process that beats composite clippers by **preserving stereo imaging** while **fully protecting the stereo pilot tone, RDS/RBDS, and subcarriers**. It can operate in either "Half-Cosine Interpolation" mode or conventional hard clipper mode. The "Half-Cosine" mode provides better separation and preservation of stereo imaging, while the "Hard" mode provides brighter sound because it creates waveforms that are closer to square waves. Both modes provide excellent spectral protection of the pilot tone and subcarrier regions. To ensure accurate peak control, the limiter operates at 512 kHz sample rate.

- Using its built-in left/right domain and composite peak limiters, the 5518 achieves extremely tight **peak control**.

- A high-accuracy **ITU412 multiplex power controller** is available, with user control over the multiplex power threshold. This allows you to compensate for overshoots in the signal path upstream from the 5518, preventing excessive reduction of the multiplex power.

- The input signal can be **flat or pre-emphasized** to 50 µs or 75 µs.

- The 5518 can apply **J.17 deemphasis** to the input signal.

- The 5518 can **delay its output** by as much as 16 seconds. This delay can be used as the **diversity delay** in HD Radio™ installations, which allows the 5518's stereo encoder (including composite limiter) to be used in an HD Radio installation.

- The stereo encoder's stereo subchannel modulator can operate in normal double sideband mode and in an experimental **compatible single sideband mode** that is offered to enable users to compare and assess the two modes. See *SSB Stereo Encoder Operation* on page 3-6.

Controllable

- An **LCD** and **full-time LED meters** make setup, adjustment and programming of the 5518 easy — you can always see the metering while you are adjusting the processor. Navigation is by dedicated buttons, soft buttons (whose functions are context-sensitive), and a large rotary knob.

- The 5518 **can be remote-controlled** by 5-12V pulses applied to eight programmable, optically-isolated "general-purpose interface" (GPI) ports available at the REMOTE INTERFACE connector on the rear panel.

- **PC Remote software** is a graphical application that runs under Windows 2000/XP/Vista/7. It communicates with a given 5518 **via TCP/IP** over **modem, direct serial,** and **Ethernet** connections. You can configure PC Remote to switch between many 5518s via a convenient organizer that supports giving any 5518 an alias and grouping multiple 5518s into folders. Clicking a 5518's icon causes PC Remote to connect to that 5518 through an Ethernet network, or initiates a Windows Dial-Up or Direct Cable Connection if appropriate. The PC Remote software allows the user to access all 5518 features and allows the user to archive and restore presets, automation lists, and system setups (containing I/O levels, digital word lengths, GPI functional assignments, etc.).

- The 5518 contains a versatile **real-time clock**, which allows automation of various events (including recalling presets) at pre-programmed times. The clock can be set automatically from an Internet timeserver.

- A Bypass Test Mode can be invoked locally, by remote control (from either the 5518's GPI port or the 5518 PC Remote application), or by automation to permit broadcast system **test and alignment** or "proof of performance" tests.

- The 5518 contains a built-in **line-up tone generator**, facilitating quick and accurate level setting in any system.

- The 5518's **software can be upgraded** by running Orban-supplied downloadable upgrade software on a PC. The upgrade can occur remotely through the 5518's Ethernet port or serial port (connected to an external modem), or locally (by connecting a Windows® computer to the 5518's serial port through the supplied null modem cable).

- The **SNMP** (Simple Network Management Protocol) features allow you to monitor your Optimod's status and to send Alarm notifications via your Optimod's Ethernet connection to your network.

Presets in the 5518

There are two distinct kinds of presets in the 5518: **factory presets** and **user presets**.

The 5518 used the same preset logic as other OPTIMOD-FMs and should be familiar to users of the OPTIMOD-FM family of products. Like other 5518s, it offers Factory and User Presets. Because the 5518 is a dedicated stereo encoder, it comes with only one Factory Preset, which allows you to set up the parameters of the stereo encoder. Normally, when you have finished setting up the 5518 by editing its Factory Preset, you will then save the result as a User Preset. You can save many different custom-

ized settings as different User Presets. For example, you could activate and defeat the left/right domain overshoot limiter by creating two User Presets, one with the limiter turned on and one with the limiter turned off.

The Factory Preset is stored in the 5518's non-volatile memory and cannot be erased. You can change the settings of the Factory Preset but you must then store those settings as a User Preset, which you are free to name as you wish. The Factory Preset remains unchanged.

User Presets are stored in non-volatile memory that does not require battery backup. *To Create or Save a User Preset* on page 3-3 has more about User Presets.

To recall a preset:

A) Turn the knob until your desired preset is visible in the lower line of the display.

B) Press the *Recall Next* button to put your desired preset on-air.

Input/Output Configuration

The 5518 simultaneously accommodates:

- Digital AES3 left/right inputs and outputs.
- Analog left/right inputs and outputs.
- Composite stereo outputs.
- Subcarrier (SCA and RDS/RBDS) inputs.
- A sync reference input that can accept 10 MHz or 1 x wordclock (32, 44.1, 48, 88.2, and 96 kHz) and lock the digital output sample rate and the 19 kHz pilot tone frequency to this input.

Digital AES3 Left/Right Input/Output

The digital input and output conform to the professional AES3 standard. They both have sample rate converters to allow operation at 32, 44.1, 48, 88.2, and 96 kHz sample frequency.

The left/right digital input is on one XLR-type female connector on the rear panel; the left/right digital output is on one XLR-type male connector on the rear panel.

The 5518 provides digital and analog inputs and outputs. You select whether the 5518 uses the digital or analog input either locally or by remote interface. If the 5518 is set to accept a digital input and the feed fails, the 5518 will automatically switch back to the analog input.

Level control of the AES3 input is accomplished via software control through System Setup (see step 4 on page 2-23) or through PC Remote.

Both analog and digital outputs are active continuously.

The 5518's output sample rate can be locked either to the 5518's internal crystal clock or to the sample rate present at its AES3 input.

The 5518 can apply J.17 deemphasis to signals applied to its digital input and J.17 preemphasis to the processed signal emitted from its digital output. J.17 is a 6 dB/octave shelving preemphasis/deemphasis standard with break points at 400 Hz and 4 kHz. It is used mainly in older studio/transmitter links that use NICAM technology. The 5518's provisions for J.17 make it fully compatible with systems using this standard.

The analog and digital outputs emit the same signal that drives the 5518's stereo encoder DSP block. This signal may be lowpass filtered and/or protection-limited, depending on control settings in the active preset. The level, deemphasis, and other parameters of these outputs are set in System Setup.

Analog Left/Right Input/Output

The left and right analog inputs are on XLR-type female connectors on the rear panel. Input impedance is greater than 10kΩ; balanced and floating. Inputs can accommodate up to +27 dBu (0 dBu = 0.775Vrms).

The left and right analog outputs are on XLR-type male connectors on the rear panel. Output impedance is 50Ω; balanced and floating. The outputs can drive 600Ω or higher impedances, balanced or unbalanced. The peak output level is adjustable from –6 dBu to +24 dBu.

Level control of the analog inputs and outputs is accomplished via software control through System Setup (see step 2 on page 2-23 and step 6 on page 2-25) or through PC Remote.

Stereo Analog Baseband Composite Output

The stereo encoder has two unbalanced analog baseband outputs on two BNC connectors on the rear panel. Each output can be strapped for 0 or 75Ω source impedance and can drive up to 16dBu (±13.82V peak) into 75Ω in parallel with up to 0.047μF (100ft/30m of RG-59/U cable) before any significant audible performance degradation occurs.

Refer to Figure 2-3 on page 2-8.

Independent level control of each output is available via software (see step 5 on page 2-23.

Subcarriers

The stereo encoder has two unbalanced 600Ω subcarrier (SCA) inputs with rear-panel BNC connectors to accept any subcarrier at or above 23 kHz. The subcarriers are mixed into each composite output and their level is not affected by the composite level control for that output. The 5518 does not digitize subcarriers; the mixing occurs after D/A conversion and is analog.

Subcarrier inputs sum into the composite baseband outputs. Rear-panel accessible PC-board-mounted trim pots allow the user to adjust the sensitivities of the two SCA inputs from <100 mV p-p to >10 V p-p to produce 10% injection with respect to 100% modulation = 4 V p-p at the 5518's composite outputs (the factory setting is 4 V p-p to produce 10% injection). Thus both inputs accommodate subcarrier generators with output levels as low as 100 mV p-p.

The correct peak level of the stereo program applied to the stereo encoder sometimes depends on the number of subcarriers in use. Some regulatory authorities require that total baseband peak modulation be maintained within specified limits. The 5518's remote control feature allows you to reduce the stereo main level by connecting an on/off signal from your subcarrier generator (See page 2-7). You define the amount of reduction in percent using the procedure in step 17 on page 2-15. See page 2-34 for information on programming the remote control.

A jumper (J6) on the circuit board can reconfigure the SCA 2 input to provide the stereo pilot tone only, which can provide a pilot reference for an RDS subcarrier generator.

Remote Control Interface

The Remote Control Interface is a set of eight optically-isolated GPI inputs on a DB-25 connector, which can be activated by 5-12V DC. They can control various functions of the 5518:

- Recall any Factory Preset, User Preset, Test Mode state (Bypass or Tone), or exit from a Test Mode to the previous processing preset.
- Switch the stereo encoder to stereo, mono from left, mono from right, or mono from sum audio input. This also determines the feed to the entire processing chain so that facilities that do not use the 5518's stereo encoder can change stereo/mono mode and select the source when in mono mode.
- Switch the 5518 to use either the analog input or the digital input.
- Independently activate and defeat the diversity delay applied to the analog, digital, and composite outputs.
- Reduce the stereo main and subchannel modulation to compensate for transmitter overshoot and subcarrier inputs (SCAs).

The remote control of overshoot compensation and SCA modulation (see page 2-34) is not latching. You must supply a continuous current to the programmed remote input to hold the gain at its compensated level. Use the status outputs of your transmitter and/or SCA generators to provide the switching signal so the compensation will automatically follow the transmitter and/or subcarrier generator on the air.

- Reset the 5518's internal clock to the nearest hour or to midnight.

The tally outputs can be programmed to indicate the following:

- Input: Analog: Indicates that the 5518 is using audio from its analog input.
- Input: Digital: Indicates that the 5518 is using audio from its AES3 digital input.
- Analog Input Silent: Indicates that the level at either or both analog input channels is below the threshold set in step (A) on page 2-20.
- AES Input Silent: Indicates that the level at either or both digital input channels is below the threshold set in step in step (A) on page 2-20.
- AES Input Error: Indicates that the 5518's AES input receiver chip has detected a problem with the data being received such that the data is unusable. When the chip detects such an error, it automatically switches the input to Analog.
- No Function: Tally output is disabled.

You can reconfigure the functions of the inputs and outputs via System Setup.

See page 2-34 for information on programming the remote control interface.

Computer Interface

On the rear panel of the 5518 are an RS-232 serial port and an Ethernet port for interfacing to IBM-compatible PCs. These computer interfaces support remote control and metering, and allow downloading software upgrades.

Each 5518 package ships with 5518 PC Remote software, an application for any IBM-compatible PC running Microsoft Windows 2000 (Service Pack 3 or higher), XP, Vista, or 7. 5518 PC Remote permits you to adjust any 5518 preset by remote control or to do virtually anything else that you can do from the 5518's front panel controls. The program displays all of the 5518's LCD meters on the computer screen to aid remote adjustment.

RS-232 Serial Port

5518 PC Remote can communicate at up to 115 kbps via modem or direct connection between the computer and the 5518 through their RS-232 serial ports.

RJ45 Ethernet Connector

The 5518 can be connected to any Ethernet network that supports the TCP/IP protocol.

See *Networking and Remote Control* on page 2-42 for more information.

Wordclock/10 MHz Sync Reference Input

The sync reference input appears on a female BNC jack grounded to the 5518's chassis. It accepts a 1x 5V p-p squarewave wordclock signal at 32, 44.1, 48, 88.2, or 96 kHz, or a 10 MHz sinewave or squarewave signal, 0.5 to 5 V peak. 10 MHz is a common output frequency produced by GPS and rubidium frequency standards. You can configure the 5518 to lock its 19 kHz pilot tone and output sample frequency to this input.

The sample frequency at the 5518's digital output does not have to be the same as the reference frequency. If the output frequency is different, the output sample frequency will be the product of a quotient of integers times the reference frequency. For example, if the reference frequency is 96 kHz and the output frequency is set to 32 kHz, the actual output frequency will be 1/3 x the reference frequency. If the reference frequency is 48 kHz and the output frequency is set to 44.1 kHz, the actual output frequency will be 147/160 x the reference frequency.

Location of the 5518

Optimal Control of Peak Modulation Levels

An OPTIMOD-FM audio processor produces a signal that is pre-emphasized to either the 50µs or 75µs standard preemphasis curve. It is precisely and absolutely high-frequency-controlled and peak-controlled to prevent over-modulation, and is filtered at 15 kHz to protect the 19 kHz pilot and prevent distortion caused by aliasing-related non-linear crosstalk. If this signal is fed directly into a stereo encoder without overshoot limiters, peak modulation levels on the air will nevertheless be precisely controlled. However, if the audio processor's signal is fed to such a stereo encoder through any circuitry with frequency response errors and/or non-constant group delay, the peaks will be magnified. Peak modulation will increase, but average modulation will not. The 5518's overshoot limiters must then be enabled, avoiding the need to reduce the modulation level to accommodate the larger peaks. Reduced average modulation level will cause reduced loudness and a poorer signal-to-noise ratio at the receiver.

Because the 5518's overshoot limiters (like any such limiters) can introduce undesirable audible artifacts, minimizing the overshoot in the signal path between your audio processor and the 5518 will make your transmission as clean-sounding as possible.

Landline equalizers, transformers, and 15 kHz lowpass filters and preemphasis networks in stereo encoders typically introduce frequency response errors and non-constant group delay. There are three criteria for preservation of peak levels through the audio system:

1) The system group delay must be essentially constant throughout the frequency range containing significant energy (30-15,000Hz). If lowpass filters are present, this may require the use of delay equalization. The deviation from linear-phase must not exceed $\pm 10°$ from 30-15,000Hz.

2) The low-frequency –3 dB point of the system must be placed at 0.15Hz or lower (this is not a misprint!). This is necessary to ensure less than 1% overshoot in a 50Hz square wave and essentially constant group delay to 30Hz.

3) Any preemphasis used in the audio transmission system prior to the stereo encoder must be canceled by a precisely complementary deemphasis: Every pole and zero in the preemphasis filter must be complemented by a zero and pole of identical complex frequency in the deemphasis network. An all-pole deemphasis network (like the classic series resistor feeding a grounded capacitor) is not appropriate. However, this network could be corrected by adding a second resistor between ground and the capacitor, which would introduce a zero.

Lowpass filters (including anti-aliasing filters in digital links), highpass filters, transformers, distribution amplifiers, and long transmission lines can all cause the above criteria to be violated and must be tested and qualified. It is clear that the above criteria for optimal control of peak modulation levels are most easily met when the audio processor directly feeds the 5518.

Best Location for the 5518

The best location for the 5518 is as close as possible to the transmitter, so that its composite output can be connected to the transmitter through a circuit path that introduces the least possible change in the shape of the 5518's carefully peak-limited composite output waveform — a short length of coaxial cable.

If the transmitter is not accessible:

All audio processing must be done at the studio and you must tolerate any damage that occurs later. The 5518 is only applicable to this situation if a broadband (0-75 kHz) phase-linear link to the transmitter is available.

If the transmitter is accessible:

You can achieve the most accurate control of modulation peaks by locating the 5518 at the transmitter site and then using its composite output to drive the transmitter. You can usually also obtain good results by locating the 5518 at the studio and connecting the baseband output of its stereo encoder to the transmitter through a composite baseband STL (see page 1-13). However, many composite baseband STLs do not control peaks perfectly because of bounce (see page 1-13), and locating the 5518 at the transmitter site (where it can control peaks just prior to the transmitter's RF exciter) is thus likely to maximize loudness.

We strongly recommend that you use the 5518's internal stereo encoder to feed the output of the encoder directly to the baseband input of the exciter through less than 100 feet (30 meters) of coaxial cable.

The shorter the baseband cable from OPTIMOD-FM to exciter, the less likely that ground loops or other noise problems will occur in the installation. If you require a long cable run, you can use a Jensen JT-123-BMCF transformer[1] to break any ground loops. This transformer will ordinarily cure even the most stubborn hum or noise caused by the composite connection between OPTIMOD-FM and the exciter. For connection instructions, please refer to the Orban CIT25 Composite Isolation Transformer schematic diagram, which is shown on page 12 of the CIT25 manual. This is available from: ftp.orban.com/CIT25/CIT25_Instructions.pdf (Please note that Orban no longer manufactures the CIT25, which used the Jensen transformer.)

If you need to drive an auxiliary or standby transmitter, the best way to connect it to the 5518 is via the 5518's second composite output. If this transmitter has a built-in stereo encoder and no composite input, the 5518's left and right analog or (preferably) digital outputs can be useful because these follow the 5518's left/right domain overshoot limiters. This allows you to use the 5518's overshoot limiters to drive both transmitters.

If possible, bypass the preemphasis network and the input lowpass filters in the second transmitter's stereo encoder so that they cannot introduce spurious peaks. The 5518's preemphasis network and lowpass filters can perform the same functions while retaining tight peak control.

Studio-Transmitter Link

Transmission from Studio to Transmitter

There are five types of studio-transmitter links (STLs) in common use in broadcast service: uncompressed digital, digital with lossy compression (like MPEG, Dolby®, or APT-x®), microwave, analog landline (telephone/post line), and audio subcarrier on a video microwave STL.

STLs are used in two fundamentally different ways with the 5518. They can either (1) pass your FM audio processor's peak-controlled analog or digital left and right audio outputs to the 5518 when the 5518 is located at the transmitter, or (2) pass your 5518's peak-controlled composite stereo baseband output to the transmitter's composite input when the 5518 is located at the studio. In both cases, the link's transient response is critical. At the current state of the art, an uncompressed digital link using digital inputs and outputs is preferable.

Digital Links

Digital links may pass audio as linear PCM encoding or they may apply lossy data reduction processing to the signal to reduce the number of bits per second required for transmission through the digital link. Only linear PCM is appropriate for links that pass the FM composite signal. Lossy data reduction is only appropriate (al-

[1] http://www.jensen-transformers.com/wp-content/uploads/2014/08/jt-123-bmcf.pdf

though never ideal) when passing your FM audio processor's peak-controlled analog or digital left/right outputs to a 5518 at the transmitter.

Lossy processing will almost invariably distort peak levels, so such links must be carefully qualified before you use them to carry the peak-controlled output of your audio processor to the 5518 at the transmitter. For example, the MPEG Layer 2 algorithm can increase peak levels up to 4 dB at 160kB/sec by adding large amounts of quantization noise to the signal. While the desired program material may psychoacoustically mask this noise, it is nevertheless large enough to affect peak levels severely. This will force you use the 5518's left/right overshoot limiters to apply heavy limiting, which can reduce audio quality. For any lossy compression system the higher the data rate, the less the peak levels will be corrupted by added noise, so use the highest data rate practical in your system. For MPEG Layer 2 encoding, we recommend 384 kB/second or higher.

Some links may use straightforward PCM (pulse-code modulation) without lossy data reduction. If you connect to these through an AES3 digital interface, these can be very transparent if they do not truncate the digital words produced by the devices driving their inputs. If the audio processor's output is tightly band-limited to 15 kHz (which is true for OPTIMOD-FM 8200, 2200, 2300, 5300, 5500, 8300, and 8400), it can be passed without additional overshoot by equally well by any link with 32 kHz or higher sample frequency.

Currently available sample rate converters use phase-linear filters (which have constant group delay at all frequencies). If they do not remove spectral energy from the original signal, the sample rate conversion, whether upward or downward, will not add overshoot to the signal. This is not true of systems that are not strictly band-limited to 15 kHz, where downward sample rate conversion will remove spectral energy and will therefore introduce overshoot.

OPTIMOD-FM 8500 and 8600 require an STL bandwidth of 17 kHz or greater, so a 44.1 kHz sample rate is the lowest commonly used sample rate that will not add overshoot. If you are using an 8500 or 8600 with a 32 kHz STL, you must activate the 5518's left/right overshoot limiter to remove the resulting overshoot.

If the link does not have an AES3 input, you must drive its analog input from your audio processor's analog output. This is less desirable because the link's analog input circuitry may not meet all requirements for passing processed audio without overshoot.

NICAM is a sort of hybrid between PCM and lossy data reduction systems. It uses a block-companded floating-point representation of the signal with J.17 preemphasis. It cannot be used to pass FM composite signals.

Older technology converters (including some older NICAM encoders) may exhibit quantization distortion unless they have been correctly dithered. Additionally, they can exhibit rapid changes in group delay around cut-off because their analog filters are ordinarily not group-delay equalized. The installing engineer should be aware of all of these potential problems when designing a transmission system.

Any problems can be minimized by driving a digital STL the digital output of your audio processor, which will provide the most accurate interface to the STL.

Composite Baseband Microwave STLs

The composite baseband microwave STL carries the standard pilot-tone stereo baseband, and therefore receives the output of a stereo encoder (like the 5518) located at the studio site. The receiver output of the composite STL is the stereo baseband signal, which is applied directly to the wideband input of the FM broadcast transmitter's exciter. Thus, no stereo encoder is needed at the transmitter.

In general, a composite microwave STL provides good audio quality, as long as there is a line-of-sight transmission path from studio to transmitter of less than 10 miles (16 km). If not, RF signal-to-noise ratio, multipath distortion, and diffraction effects can cause serious quality problems. Where a composite STL is used, use the 5518's stereo encoder to drive the composite STL transmitter.

Uncompressed digital composite baseband microwave STLs, if properly designed, have excellent performance and we recommend them highly. They are particularly desirable in a 5518 installation because they allow you to use the 5518's composite limiter to increase on-air loudness. However, the fact that they are digital does not eliminate the requirement that they have low frequency response that is less than 3 dB down at 0.15 Hz. Any such STL should be qualified to ensure that it meets this specification.

Dual Microwave STLs

Dual microwave STLs use two separate transmitters and receivers to pass the left and right channels in discrete form. Dual microwave STLs offer greater noise immunity than composite microwave STLs. However, problems include gain- and phase-matching of the left and right channels, overloads induced by preemphasis, and requirements that the audio applied to the microwave transmitters be processed to prevent over-modulation of the microwave system. In a system using the 5518, preemphasis overload will not be a problem because the STL will be driven by your FM audio processor located at the studio and the 5518 will be located at the transmitter.

Lack of transparency in the path will cause overshoot. Unless carefully designed, dual microwave STLs can introduce non-constant group delay in the audio spectrum, distorting peak levels when used to pass processed audio. In a system using a microwave STL, any overshoots induced by the link should be removed by the 5518's left/right overshoot limiter.

If the STL microwave uses preemphasis, its input preemphasis filter will probably introduce overshoots that will increase peak modulation without any increases in average modulation. If the audio processor at the studio is capable of producing a preemphasized output, we strongly recommend defeating the microwave STL's preemphasis and performing preemphasis in the audio processor at the studio. This frees the system from potential overshoot. Except for the 8000 and 8100, any OPTIMOD-FM can be configured to provide a preemphasized output.

Further, it is common for a microwave STL to bounce because of a large infrasonic peak in its frequency response caused by an under-damped automatic frequency control (AFC) phase-locked loop. This bounce can increase the STL's peak carrier de-

viation by as much as 2dB, reducing average modulation. Many commercial STLs have this problem.

Analog Landline (PTT/Post Office Line)

Analog landline quality is extremely variable, ranging from excellent to poor. Whether landlines should be used or not depends upon the quality of the lines locally available, and upon the availability of other alternatives. Due to line equalizer characteristics and phase shifts, even the best landlines tend to add overshoot and will require use of the 5518's left/right overshoot limiter.

About Transmission Levels and Metering

Meters

Studio engineers and transmission engineers consider audio levels and their measurements differently, so they typically use different methods of metering to monitor these levels. The VU meter is an average-responding meter (measuring the approximate RMS level) with a 300ms rise time and decay time; the VU indication usually under-indicates the true peak level by 8 to 14 dB. The Peak Program Meter (PPM) indicates a level between RMS and the actual peak. The PPM has an attack time of 10ms, slow enough to cause the meter to ignore narrow peaks and under-indicate the true peak level by 5 dB or more. The absolute peak-sensing meter or LED indicator shows the true peak level. It has an instantaneous attack time, and a release time slow enough to allow the engineer to read the peak level easily. Fig. 1-1 shows the relative difference between the absolute peak level, and the indications of a VU meter and a PPM for a few seconds of music program.

Studio Line-up Levels and Headroom

The studio engineer is primarily concerned with calibrating the equipment to provide the required input level for proper operation of each device, and so that all devices operate with the same input and output levels. This facilitates patching devices in and out without recalibration.

For line-up, the studio engineer uses a calibration tone at a studio standard level, commonly called line-up level, reference level, or operating level. Metering at the studio is by a VU meter or PPM (Peak Program Meter). As discussed above, the VU or PPM indication under-indicates the true peak level. Most modern studio audio devices have a clipping level of no less than +21 dBu, and often +24 dBu or more. So the studio standardizes on a maximum program indication on the meter that is lower than the clipping level, so those peaks that the meter does not indicate will not be clipped. Line-up level is usually at this same maximum meter indication. In facilities that use VU meters, this level is usually at 0VU, which corresponds to the studio standard level, typically +4 or +8 dBu.

For facilities using +4 dBu standard level, instantaneous peaks can reach +18 dBu or higher (particularly if the operator overdrives the console or desk). Older facilities with +8 dBu standard level and equipment that clips at +18 or +21 dBu will experience noticeable clipping on some program material.

In facilities that use the BBC-standard PPM, maximum program level is usually PPM4 for music, PPM6 for speech. Line-up level is usually PPM4, which corresponds to +4 dBu. Instantaneous peaks will reach +17 dBu or more on voice.

In facilities that use PPMs that indicate level directly in dBu, maximum program and line-up level is often +6 dBu. Instantaneous peaks will reach +11 dBu or more.

Transmission Levels

The transmission engineer is primarily concerned with the peak level of a program to prevent overloading or over-modulation of the transmission system. This peak overload level is defined differently, system to system.

In FM modulation (FM/VHF radio and television broadcast, microwave or analog satellite links), it is the maximum-permitted RF carrier frequency deviation. In AM modulation, it is negative carrier pinch-off. In analog telephone/post/PTT transmission, it is the level above which serious crosstalk into other channels occurs, or the level at which the amplifiers in the channel overload. In digital, it is the largest possible digital word.

For metering, the transmission engineer uses an oscilloscope, absolute peak-sensing meter, calibrated peak-sensing LED indicator, or a modulation meter. A modulation meter usually has two components — a semi-peak reading meter (like a PPM), and a peak-indicating light, which is calibrated to turn on whenever the instantaneous peak modulation exceeds the overmodulation threshold.

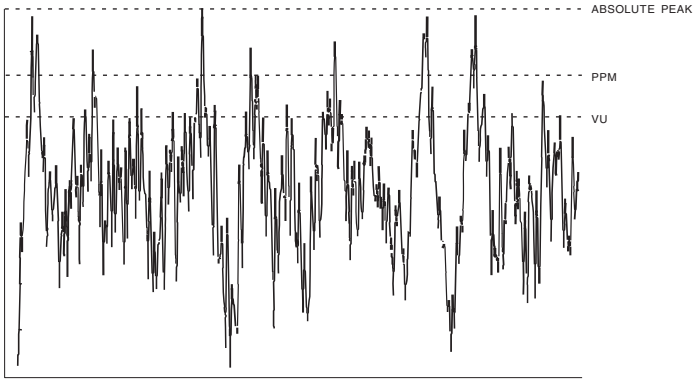


Fig. 1-1: Absolute Peak Level, VU and PPM Reading

Line-Up Facilities

Metering of Levels

The meters on the 5518 show left/right input levels and composite modulation. Left and right input level is shown on a VU-type scale (0 to –27 dB), while the metering indicates *absolute instantaneous peak* (much faster than a standard PPM or VU meter). The input meter is scaled so that 0 dB corresponds to the absolute maximum peak level that the 5518 can accept (+27 dBu). If you are using the AES3 digital input, the maximum digital word at the input corresponds to the 0 dB point on the 5518's input meter.

Composite Output Level

When its left/right overshoot limiter and composite limiter are enabled, the 5518 controls instantaneous, absolute peak levels to a tolerance of approximately ±0.1 dB. Composite modulation is indicated in percentage modulation, absolute instantaneous peak indicating. 100% is calibrated to the highest composite peak modulation level that the processing will produce and ordinarily corresponds to ±75 kHz-carrier deviation.

Note that if the 5518's subcarrier inputs are used, the meter will not indicate the subcarriers' effect on composite modulation because the subcarriers are mixed into the composite signal in the analog domain, after it is metered. Therefore, you must mentally add the subcarriers to the meter indication or refer to an external, calibrated modulation monitor.

Built-in Calibrated Line-up Tones

To facilitate matching the output level of the 5518 to the transmission system that it is driving, the 5518 contains an adjustable test tone oscillator that produces sine waves at 5518's (analog or digital) left, right and composite outputs. The frequency and modulation level of the line-up tones can be adjusted from the front panel (as described in Section 3).

The stereo encoder is calibrated so that 100% left or right modulation will provide 100% modulation of the stereo composite signal, including pilot tone but excluding any SCA subcarriers.

The pilot tone stereo system has an *interleaving* property, which means that the stereo composite modulation is approximately equal to the *higher* of the left or right channels. Because the pilot tone is phase-synchronous with the stereo subcarrier, the composite modulation will actually increase about 2.7% when the modulation is changed from pure single-channel to L+R modulation while the peak audio level is held constant.

You can adjust the frequency and modulation level of the built-in line-up tone. You can use the front panel, the PC Control software, or the opto-isolated remote control interface ports to activate the Test Tone.

The 5518's analog outputs are seldom used, but for completeness we should state that when the 5518's left/right analog output is switched to FLAT, a deemphasis filter is inserted between output of the 5518's audio processing and its line output. Thus, as the frequency of the Test Tone is changed, the level at the 5518's line output will follow the selected deemphasis curve. In most cases, the preemphasis filter in the driven equipment will undo the effect of the 5518's internal deemphasis, so the 5518's output level should be adjusted such that the tone produces 100% modulation of the transmission link as measured after the link's preemphasis filter. At 100Hz, switching the deemphasis out or in will have negligible effect on the level appearing at the 5518's left and right audio outputs.

Built-in Calibrated Bypass Test Mode

A BYPASS Test Mode is available to transparently pass line-up tones generated earlier in the system. It will also pass program material, applying no gain reduction or protection against overmodulation. It can transparently pass any line-up tone applied to its input up to about 130% output modulation, at which point clipping may occur.

PC Control and Security Passcode

PC software control provides access to the 5518 via network, modem or direct (null modem cable) connection, with IBM PC-compatible computers running Windows. PC access is permitted only with a valid user-defined passcode.

PC remote control can be ended from the front panel; this feature effectively prevents simultaneous remote and local control.

See *Security and Passcode Programming* (starting on page 2-31) for more detail.

Warranty, User Feedback

User Feedback

We are very interested in your comments about this product. We will carefully review your suggestions for improvements to either the product or the manual. Please email us at custserv@orban.com.

LIMITED WARRANTY

[Valid only for products purchased and used in the United States]

Orban warrants Orban products against defects in material or workmanship for a period of five years from the date of original purchase for use, and agrees to repair or, at our option, replace any defective item without charge for either parts or labor.

IMPORTANT: This warranty does not cover damage resulting from accident, misuse or abuse, lack of reasonable care, the affixing of any attachment not provided with the product, loss of parts, or connecting the product to any but the specified receptacles. This warranty is void unless service or repairs are performed by an authorized service center. No responsibility is assumed for any special, incidental, or consequential damages. However, the limitation of any right or remedy shall not be effective where such is prohibited or restricted by law.

Simply take or ship your Orban products prepaid to our service department. Be sure to include a copy of your sales slip as proof of purchase date. We will not repair transit damage under the no-charge terms of this warranty. Orban will pay return shipping. (See *Technical Support* on page 5-11.)

No other warranty, written or oral, is authorized for Orban Products.

This warranty gives you specific legal rights and you may have other rights that vary from state to state. Some states do not allow the exclusion of limitations of incidental or consequential damages or limitations on how long an implied warranty lasts, so the above exclusions and limitations may not apply to you.

INTERNATIONAL WARRANTY

Orban warrants Orban products against evident defects in material and workmanship for a period of five years from the date of original purchase for use. This warranty does not cover damage resulting from misuse or abuse, or lack of reasonable care, or inadequate repairs performed by unauthorized service centers. Performance of repairs or replacements under this warranty is subject to submission of this Warranty/Registration Card, completed and signed by the dealer on the day of purchase, and the sales slip. Shipment of the defective item for repair under this warranty will be at the customer's own risk and expense. This warranty is valid for the original purchaser only.

Section 2
Installation

Installing the 5518

Allow about 2 hours for installation.

Installation consists of: (1) unpacking and inspecting the 5518, (2) mounting the 5518 in a rack, (3) connecting inputs, outputs and power, (4) optional connecting of remote control leads and (5) optional connecting of computer interface control leads.

When you have finished installing the 5518, proceed to "Quick Setup," on page 2-11.

DO NOT connect power to the unit yet!

1. Unpack and inspect.

A) If you note obvious physical damage, contact the carrier immediately to make a damage claim. Packed with the 5518 are:

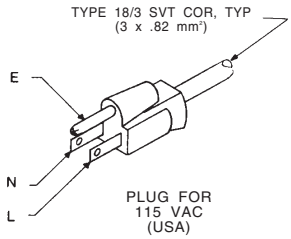
Quantity	Item
1	Operating Manual
2	Line Cords (domestic, European)
4	Rack-mounting screws, 10-32 x ¾—with washers, #10
1	PC Remote Software CD

B) Save all packing materials! If you should ever have to ship the 5518 (e.g., for servicing), it is best to ship it in the original carton with its packing materials because both the carton and packing material have been carefully designed to protect the unit.

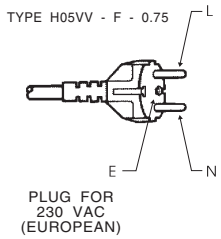
C) Complete the Registration Card and return it to Orban. (please)

The Registration Card enables us to inform you of new applications, performance improvements, software updates, and service aids that may be developed, and it helps us respond promptly to claims under warranty without our having to request a copy of your bill of sale or other proof of purchase. Please fill in the Registration Card and send it to us today. (The Registration Card is located after the cover page).

Customer names and information are confidential and are not sold to anyone.



CONDUCTOR		WIRE COLOR	
		NORMAL	ALT
L	LINE	BROWN	BLACK
N	NEUTRAL	BLUE	WHITE
E	EARTH GND	GREEN-YELLOW	GREEN



CONDUCTOR		WIRE COLOR
L	LINE	BROWN
N	NEUTRAL	BLUE
E	EARTH GND	GREEN-YELLOW

Figure 2-1: AC Line Cord Wire Standard

2. Install the appropriate power cord.

AC power passes through an IEC-standard mains connector and an RF filter designed to meet the standards of all international safety authorities.

The power cord is terminated in a “U-ground” plug (USA standard), or CEE7 / 7 plug (Continental Europe), as appropriate to your 5518’s Model Number. The green/yellow wire is connected directly to the 5518 chassis.

If you need to change the plug to meet your country’s standard and you are qualified to do so, see Figure 2-1. Otherwise, purchase a new mains cord with the correct line plug attached.

3. Mount the 5518 in a rack.

The 5518 requires one standard rack unit (1 ¾ inches / 6.4 cm).

There should be a good ground connection between the rack and the 5518 chassis — check this with an ohmmeter to verify that the resistance is less than 0.5Ω.

Mounting the unit over large heat-producing devices (such as a vacuum-tube power amplifier) may shorten component life and is not recommended. Ambient temperature should not exceed 45°C (113°F) when equipment is powered.

Equipment life will be extended if the unit is mounted away from sources of vibration, such as large blowers and is operated as cool as possible.

4. Connect inputs and outputs.

See the hookup and grounding information on the following pages.

TOPIC	PAGE
Audio Input and Audio Output Connections	2-5
AES3 Digital Input and Output	2-7
Composite Output and Subcarrier Inputs	2-7
Wordclock/10 MHz Sync Reference Input	2-9
Grounding	2-10

5. Connect remote control interface. (optional)

For a full listing of 5518's extensive remote control provisions, refer to *Remote Control Interface Programming* on page 2-34.

Optically-isolated remote control connections are terminated in a type DB-25 male connector located on the rear panel. It is wired according to Figure 2-2. To select the desired function, apply a 5-12V AC or DC pulse between the appropriate REMOTE INTERFACE terminals. The (–) terminals can be connected together and then connected to ground at pin 17 to create a Remote Common. A current-limited +12VDC source is available on pin 25. If you use 48V, connect a 2kΩ ±10%, 2-watt carbon composition resistor in series with the Remote Common or the (+) terminal to provide current limiting.

In a high-RF environment, these wires should be short and should be run through foil-shielded cable, with the shield connected to CHASSIS GROUND at both ends.

PIN ASSIGNMENT

1.	COMMON	
2.	REMOTE	1+
3.	REMOTE	2+
4.	REMOTE	3+
5.	REMOTE	4+
6.	REMOTE	5+
7.	REMOTE	6+
8.	REMOTE	7+
9.	REMOTE	8+
10.	TALLY	1
11.	TALLY	2
12.	N/C	
13.	POWER COMMON	
14.	REMOTE	1-
15.	REMOTE	2-
16.	REMOTE	3-
17.	REMOTE	4-
18.	REMOTE	5-
19.	REMOTE	6-
20.	REMOTE	7-
21.	REMOTE	8-
22-24.	N/C	
25.	+12 VOLTS DC	

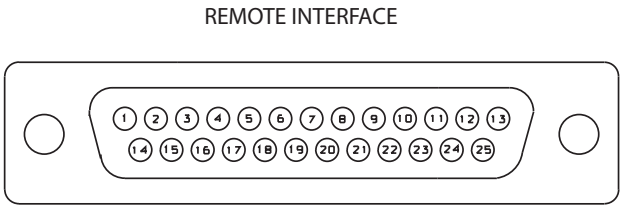


Figure 2-2: Wiring the 25-pin Remote Interface Connector

6. Connect tally outputs (optional)

See the schematic on page 6-32.

The 5518 supports two hardware tally outputs, which are NPN open-collector and operate with respect to pin 1 (common). Therefore, the voltage applied to the load (such as a relay or opto-isolator) must be positive. You can use the 12 VDC source on pin 25 to drive the high side of the load, taking into account the fact that the voltage on pin 25 is current limited by a 300 Ω resistor.

The tally outputs are protected against reverse polarity.

To avoid damaging the 5518, limit the current into a tally output to 30 mA. DO NOT connect a tally output directly to a low-impedance voltage source! The tally outputs are not protected against this abuse and the output transistors are likely to burn out.

Note that the tally outputs have no special RFI protection. Therefore, it is wise to use shielded cable to make connections to them.

See step 28 on page 2-21 for instructions on using the tally outputs.

7. Connect to a computer

You can connect to a computer via the 5518's serial connector or via an Ethernet network. (See *Networking* on page 2-42.)

Procedures and instructions for connecting to a PC are subject to development and change. We advise you to download the latest version of this manual in pdf format from ftp.orban.com/5518/Documentation.

You can use Adobe's .pdf reader application to open and read this file. If you do not have the .pdf reader, it is available for free download from www.adobe.com.

See *Installing 5518 PC Remote Control Software* on page 2-47 for more detail.

5518 Rear Panel

[See page 3-1 for a description of the 5518's front panel.]

The **Power Cord** is detachable and is terminated in a "U-ground" plug (USA standard), or CEE7 / 7 plug (Continental Europe), as appropriate to your 5518's Model Number.

An **RS-232 (PC Remote) Computer Interface,** labeled SERIAL, is provided to connect the 5518 to IBM PC-compatible computers, directly or via modem, for remote control, metering and software downloads.

A **Remote Interface Connector** allows you to connect the 5518 to your existing transmitter remote control or other simple contact-closure control devices. The 5518 remote control supports user-programmable selection of up to eight optically-isolated inputs for any one of the following parameters: recalling any factory- or user presets, tone or bypass modes, selecting stereo encoder modes (stereo, mono-left,

mono-right, mono-sum), selecting analog, digital or digital+J.17 input, overshoot compensation, SCA modulation compensation, and clock synchronization. (See *Remote Control Interface Programming* on page 2-34.) The 5518 remote control accepts a DB-25 connector.

The **Ethernet Port** accepts a 10Mb/second or 100Mb/second Ethernet connection terminated with an RJ45 connector.

Digital AES3 Input and **Output** are provided to support two-channel AES3-standard digital audio signals through XLR-type connectors.

Analog Inputs and **Outputs** are provided to support left and right audio signals through XLR-type connectors.

Two **Composite Baseband Outputs** are provided, each with independent output level control. Each output uses a BNC connector.

Two **SCA Inputs** are provided for stations that use additional subcarriers (SCAs). Each input uses a BNC connector. The second SCA input can be reconfigured via an internal hardware jumper as a Pilot Reference Output useful for RDS (RBDS) subcarrier generators that require an external sync reference.

A **Wordclock/10 MHz Sync Reference Input** on a BNC connector allows you to lock the 5518's internal clock generator (which determines the clock frequency applied to the DSP) to a reference signal. Typically, the reference signal comes, directly or indirectly, from a GPS-derived frequency standard or a rubidium frequency standard. You can lock the 5518's DSP clock to this reference, which in turn locks the 19 kHz pilot tone to the reference. This is useful in single frequency networks to prevent beating between various transmitters' pilot tones in areas of mutual interference.

Input and Output Connections

Cable

We recommend using two-conductor foil-shielded cable (such as Belden 8451 or equivalent) for the audio input and output connections because signal current flows through the two conductors only. The shield does not carry signal and is used only for shielding.

Connectors

- Input and output connectors are XLR-type connectors.

  In the XLR-type connectors, pin 1 is CHASSIS GROUND, while pin 2 and pin 3 are a balanced, floating pair. This wiring scheme is compatible with

any studio-wiring standard: If pin 2 or 3 is considered LOW, the other pin is automatically HIGH.

Analog Audio Input

- Nominal input level between –9 dBu and +8 dBu will result in normal operation of the 5518.

  (0 dBu = 0.775Vrms. For this application, the dBm @600Ω scale on voltmeters can be read as if it were calibrated in dBu.)

- The peak input level that causes overload is +27.0 dBu.

- The electronically balanced input uses an ultra-low-noise-and-distortion differential amplifier for best common mode rejection, and is compatible with most professional and semi-professional audio equipment, balanced or unbalanced, having a source impedance of 600Ω or less. The input is EMI suppressed.

- Input connections are the same whether the driving source is balanced or unbalanced.

- Connect the red (or white) wire to the pin on the XLR-type connector (#2 or #3) that is considered HIGH by the standards of your organization. Connect the black wire to the pin on the XLR-type connector (#3 or #2) that is considered LOW by the standards of your organization.

- In low RF fields (like a studio site not co-located with an RF transmitter), connect the cable shield at 5518 input only—it should not be connected at the source end. In high RF fields (like a transmitter site), also connect the shield to pin 1 of the male XLR-type connector at the 5518 input.

- If the output of the driving unit is unbalanced and does not have separate CHASSIS GROUND and (–) (or LOW) output terminals, connect both the shield and the black wire to the common (–) or ground terminal of the driving unit.

Analog Audio Output

- Electronically balanced and floating outputs simulate a true transformer output. The source impedance is 50Ω. The output is capable of driving loads of 600Ω or higher; the AO 100% control can adjust the 100% modulation level over a –6 dBu to +24 dBu range. The outputs are EMI suppressed.

- If an unbalanced output is required (to drive unbalanced inputs of other equipment), it should be taken between pin 2 and pin 3 of the XLR-type connector. Connect the LOW pin of the XLR-type connector (#3 or #2, depending on your organization's standards) to circuit ground; take the HIGH output from the remaining pin. No special precautions are required even though one side of the output is grounded.

- Use two-conductor foil-shielded cable (Belden 8451, or equivalent).
- At the 5518's output (and at the output of other equipment in the system), do not connect the cable's shield to the CHASSIS GROUND terminal (pin 1) on the XLR-type connector. Instead, connect the shield to the input destination. Connect the red (or white) wire to the pin on the XLR-type connector (#2 or #3) that is considered HIGH by the standards of your organization. Connect the black wire to the pin on the XLR-type connector (#3 or #2) that is considered LOW by the standards of your organization.

AES3 Digital Input and Output

There is one AES3 input and one AES3 output. The program input and output are both equipped with sample rate converters and can operate at 32, 44.1, 48, 88.2, and 96 kHz.

Per the AES3 standard, each digital input or output line carries both the left and right stereo channels. The connection is 110Ω balanced. The AES3 standard specifies a maximum cable length of 100 meters. While almost any balanced, shielded cable will work for relatively short runs (5 meters or less), longer runs require used of 110Ω balanced cable like Belden 1800B, 1801B (plenum rated), multi-pair 180xF, 185xF, or 78xxA. Single-pair category 5, 5e, and 6 Ethernet cable will also work well if you do not require shielding. (In most cases, the tight balance of Category 5/5e/6 cable makes shielding unnecessary.)

The AES3id standard is best for very long cable runs (up to 1000 meters). This specifies 75Ω unbalanced coaxial cable, terminated in BNC connectors. A 110Ω/75Ω balun transformer is required to interface an AES3id connection to your 5518's digital input or output.

The digital input clip level is fixed at 0 dB relative to the maximum digital word. The maximum digital input will make the 5518 input meters display 0 dB. The reference level is adjustable using the DI REF control.

Composite Output and Subcarrier Input

There are two **composite outputs**. They carry the encoded stereo signal, the stereo pilot tone, and any subcarriers that may have been applied to the 5518's **subcarrier inputs**.

These are unbalanced, with the shell connected directly to chassis/circuit ground. Each output's level is independently adjustable from –12 dBu to +16.0 dBu.

The output impedance of composite 1 output and composite 2 output can be set to 0Ω or 75Ω via jumpers J7 and J8 respectively (located on the Composite/SCA daughterboard). As shipped, the link is on pins 3 and 4, yielding 0 Ω impedance. To reset a given output to 75Ω, place the link on pins 1 and 2 of its associated jumper. (See the schematic on page 6-38 and the parts locator diagram on page 6-34.)

Each output can drive up to 75Ω in parallel with 0.047μF before performance deteriorates significantly (see Figure 2-3 on page 2-8).

Connect the 5518's composite output to the exciter input with up to 100 feet (30.5m) of RG-58/U or RG-59/U coaxial cable terminated in BNC connectors.

Longer runs of coax may increase problems with noise, hum, and RF pickup at the exciter. In general, the least troublesome installations place the 5518 close to the exciter and limit the length of the composite cable to less than 6 feet (1.8m).

We do not recommend terminating the exciter input by 50Ω or 75Ω unless this is unavoidable. The frequencies in the stereo baseband are low by comparison to RF and video, and the characteristic impedance of coaxial cable is not constant at very low frequencies. Therefore, the transmission system will usually have more accurate amplitude and phase response (and thus, better stereo separation) if the coax is driven by a very low impedance source and is terminated by greater than 1kΩ at the exciter end. This also eases thermal stresses on the output amplifier in the stereo encoder, and can thus extend equipment life.

Ground loops can occur if your exciter's composite input is unbalanced, although you can usually configure system grounding to break them (for example, by connecting the 5518's and exciter's power cords to adjacent sockets on an AC power strip). In difficult cases, you can always break a ground loop by using a Jensen JT-123-BMCF transformer (see page 1-11). If the isolation transformer is in use, the GROUND LIFT switch will almost always be set to GROUND.

Even when its composite limiter is being used heavily, the 5518 will al-

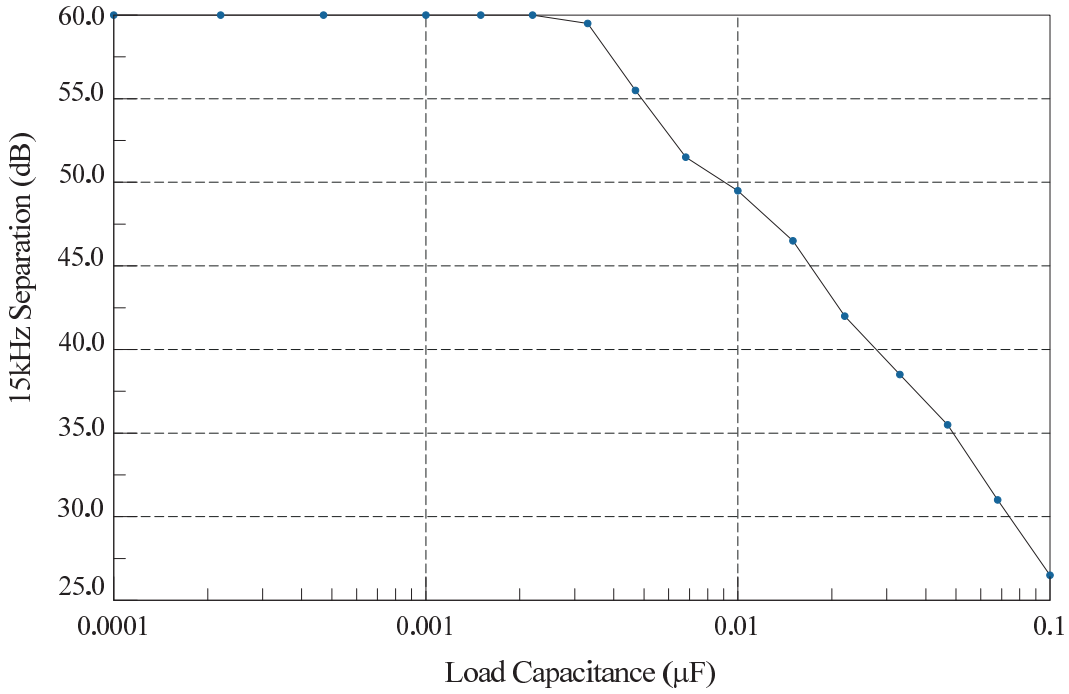


Figure 2-3: Typical Separation vs. load capacitance

ways protect the stereo pilot tone by at least 60 dB (±250Hz from 19 kHz) and will protect the region from 55 kHz to 100 kHz by at least 75 dB (re 100% modulation). See *Figure 5-1* on page 5-3.

The **subcarrier (SCA) inputs** are provided for convenience in summing subcarriers into the baseband prior to their presentation to the FM exciter.

The subcarrier inputs will accept any subcarrier (or combinations of subcarriers) above 23 kHz. Below 5 kHz, sensitivity rolls off at 6 dB/octave to suppress hum that might otherwise be introduced into the subcarrier inputs, which are unbalanced.

The subcarrier inputs are mixed into the 5518's composite output in the analog domain, after D/A conversion of the 5518 stereo encoder's output. Rear-panel accessible PC-board-mounted trim pots allow the user to adjust the sensitivities of the two SCA inputs from <100 mV p-p to >10 V p-p to produce 10% injection with respect to 100% modulation = 4 V p-p at the 5518's composite outputs. (The factory setting is 4 V p-p to produce 10% injection.)

As shipped from the factory, the second SCA connector emits a **stereo pilot tone reference** for RDS or RBDS subcarrier generators. If you wish to reconfigure it to accept an SCA signal, move the link on jumper J6 (on the Composite/SCA daughterboard) from pins 3 and 4 to pins 1 and 2.

To access J6, remove the 5518's top cover according to the instructions in step 1 on page 4-2. The schematic showing J6 is on page 6-38.

Connect your subcarrier generator(s) to the 5518's subcarrier input(s) with coaxial cable terminated with BNC connectors.

The subcarrier inputs have greater than 600Ω load impedance and are unbalanced. The sensitivity of both inputs is user-adjustable from <100 mV p-p to >10 V p-p to produce 10% injection with respect to 100% modulation = 4 V p-p at the 5518's composite outputs. (The factory setting is 4 V p-p to produce 10% injection.)

VR1 and VR2 on the Composite/SCA daughterboard set the sensitivity of SCA1 IN and SCA2 IN respectively and are accessible on the rear panel.

You can use the 19K REF control in *Setup* to determine whether the 19 kHz pilot reference output will be in-phase (0 DEG) with the pilot tone present in the composite output or will lead it by 90 degrees (90 DEG). 0 DEG is correct for most installations. Use 90 DEG only if your RDS/RBDS generator's 19 kHz reference input specifically requires this phase relationship.

Wordclock/10 MHz Sync Reference Input

The sync reference input accepts a 1x 5V p-p squarewave wordclock signal or a 10 MHz sinewave or squarewave signal, 0.5 to 5 V peak. A menu item allows you to synchronize the output sample frequency to the frequency present at the sync. The connector is a female BNC with the shell grounded to chassis.

To permit daisy-chaining sync signals, the input impedance is greater than 1 KΩ. If the 5518 is the last device driven by the sync coaxial cable, you should terminate it

by using a BNC Tee connector and a 75Ω BNC terminator. This will prevent performance-degrading reflections in the cable. This is required for both wordclock and AES11id operation.

Grounding

Very often, grounding is approached in a "hit or miss" manner. However, with care it is possible to wire an audio studio so that it provides maximum protection from power faults and is free from ground loops (which induce hum and can cause oscillation).

In an ideal system:

- All units in the system should have balanced inputs. In a modern system with low output impedances and high input impedances, a balanced input will provide common-mode rejection and prevent ground loops — regardless of whether it is driven from a balanced or unbalanced source.
- The 5518 has balanced inputs. Its subcarrier inputs are unbalanced, but frequency response is rolled off at low frequencies to reject hum.
- All equipment circuit grounds must be connected to each other; all equipment chassis grounds must be connected together.
- In a low RF field, cable shields should be connected at one end only — preferably the source (output) end.
- In a high RF field, audio cable shields should be connected to a solid earth ground at both ends to achieve best shielding against RFI.
- Whenever coaxial cable is used, shields are automatically grounded at both ends through the terminating BNC connectors.

Power Ground

- Ground the 5518 chassis through the third wire in the power cord. Proper grounding techniques never leave equipment chassis unconnected to power/earth ground. A proper power ground is essential for safe operation. Lifting a chassis from power ground creates a potential safety hazard.

Circuit Ground

To maintain the same potential in all equipment, the circuit (audio) grounds must be connected together:

- When the 5518's stereo encoder is driving an **unbalanced exciter input**, you may encounter a ground loop. (Some older exciters have unbalanced inputs.) Unlike some older Orban FM processors, the 5518 does not have a ground lift switch. If you cannot reconfigure your grounding scheme to eliminate such a loop, you can balance and float the exciter input with a Jensen JT-123-BMCF transformer (see page 2-11).

- In high RF fields, the system is usually grounded through the equipment rack in which the 5518 is mounted. The rack should be connected to a solid earth ground by a wide copper strap — wire is completely ineffective at VHF because of the wire's self-inductance.

Quick Setup

Quick Setup guides you through 5518 setup. Following this section, you can find more detailed information regarding setup beyond the Quick Setup screens.

For the following adjustments, use the appropriately labeled soft button to choose the parameter you wish to adjust. To change a parameter (like an output level), it is usually necessary to hold down the soft button while turning the knob. However, if there is only one parameter on a screen (like choosing 50 or 75µs preemphasis), you can change this with the knob alone. (You do not have to hold down a button.) Let the text on the screen guide you through the process.

1. **Press the front-panel Setup button.**

2. **Press the Quick Setup soft button when its label appears on the display.**

   Quick Setup presents a guided sequence of screens into which you must insert information about your particular requirements. In general, the screens are self-explanatory.

   Use the *Next* and *Prev* buttons to navigate between screens. These buttons will flash to indicate that they are active.

   > If you leave Quick Setup before you complete all of the setup screens, re-invoking Quick Setup will return you to the screen you were on before you left Quick Setup.

3. **Set the time.**

   Note that if your 5518 can be connected to the Internet via its Ethernet jack, you can configure the 5518's internal clock to sync to an Internet timeserver. See *Synchronizing 5518 to a Network Time Server* on page 2-45. If you intend to synchronize the 5518's clock to a timeserver, you may skip setting the time, date, and daylight savings time setting steps below. In this case, press the *Next* button six times, or until "Select Preemphasis

with knob" appears. At this point, you will be at step 5.F) in this Quick Setup procedure.

When you enter Quick Setup for the first time, the set time screen appears.

A) Hold down the appropriate soft button while turning the knob to enter the hour, minute, and seconds. Enter seconds slightly ahead of the correct time.

B) Wait until the entered time agrees with the correct time. Then press the ENTER TIME button to set the clock.

4. Set the date.

Hold down the appropriate soft button while turning the knob to enter the day, month, and year.

5. Set up Daylight Saving Time (Summer Time).

A) After you press ENTER DATE, you will see the SET DAYLIGHT SAVING screen. Turn the knob to specify the date at which Daylight Saving Time begins in your area.

B) Press the *Next* button.

C) Turn the knob to specify the date at which Daylight Saving Time begins in your area.

D) Press the *Next* button.

E) Turn the knob to specify the date at which Daylight Saving Time ends in your area.

F) Press the NEXT button.

G) Turn the knob to specify the week of the month when Standard Time begins.

6. Set transmission preemphasis.

A) Press the *Next* button.

B) Select the transmission preemphasis (either 75μS or 50μS) used in your country by turning the knob.

7. Select your primary input (analog or digital).

A) Press the *Next* button.

B) If your main input source is digital, turn the knob to select DIGITAL or DIGITAL+J17. Otherwise, select ANALOG.

> DIGITAL, not DIGITAL+J17, is appropriate for almost anyone using the digital input. The only digital encoding that typically uses J.17 preemphasis (of which we are aware) is NICAM.

8. Set analog output feed.

The analog output emits the signal driving the 5518's internal stereo encoder after the overshoot limiter. In most installations, this output is not used. However, this overshoot-controlled output can be useful to drive other stereo encoders that have no overshoot limiters.

A) Press the *Next* button.

B) [Skip this step if you will not be using the analog left/right outputs.]

Turn the knob to choose FM or FM+DELAY.

FM+DELAY applies diversity delay to the analog output.

9. Set analog output to be flat or pre-emphasized.

A) Press the *Next* button.

B) [Skip this step if you will not be using the analog left/right outputs.]

Turn the knob to choose PRE-E (for preemphasis) or FLAT.

If you will use the analog output to drive a stereo encoder, PRE provides the best performance because the stereo encoder that receives the analog output does not have to restore the preemphasis. However, if you cannot defeat the preemphasis in your stereo encoder, or if you will use the analog output for monitoring, set the output FLAT.

If you are sending the analog output of the 5518 through a digital link that uses lossy compression (like MPEG, APT-X, or Dolby), set the output FLAT. Lossy codecs cannot handle pre-emphasized signals.

10. Set digital output to be flat or pre-emphasized.

(See the notes in step 8 above.)

A) Press the *Next* button.

B) [Skip this step if you will not be using the digital output.]

Turn the knob to choose PRE-E (for a 50 or 75µs pre-emphasized output), J.17 (for a J.17 pre-emphasized output), PRE+J17 (for 50 or 75µs preemphasis cascaded with J.17 preemphasis), or FLAT (which applies 50 or 75µs deemphasis after the processing).

Regardless of the setting of this control, the processing is always internally pre-emphasized and thus always controls peaks to follow the 50 or 75µs preemphasis curve.

11. Set the digital output sample rate.

A) Press the *Next* button.

B) [Skip this step if you will not be using the digital output.]

Turn the knob to set the Digital OUTPUT SAMPLE RATE to 32, 44.1, 48, 88.2, or 96 kHz.

The internal sample rate converter sets the rate at the 5518's digital output. This adjustment allows you to set the output sample rate to ensure compatibility with equipment requiring a fixed sample rate. In all cases, the 5518's fundamental sample rate is 32 kHz, ensuring that the output bandwidth is always strictly limited to 16 kHz and that the processed signal can be passed through a 32 kHz uncompressed STL without addition of overshoot.

> If the DO SYNC and PILOT SYNC controls have been previously set in the IO / DIGITAL OUT calibration screens, the OUTPUT SAMPLE RATE control might be defeated. To set this control internally you must have the PILOT SYNC set to Internal and the DO SYNC set to PILOT SYNC.

12. Prepare to set output levels.

A) Press the *Next* button.

***Warning**: The next step will put a line-up tone on-air!*

B) Press the YES button.

13. Set the composite output level.

[Skip this step if you will not be using the composite output(s).]

A) Observe the modulation produced by the 5518's COMPOSITE OUTPUT 1 on a modulation monitor or modulation analyzer. Turn the knob to make the modulation monitor read 100% modulation (usually ±75 kHz deviation).

B) Press the *Next* button and repeat for COMPOSITE OUTPUT 2.

14. Set the digital output level.

(See the notes in step 8 above.)

A) Press the *Next* button.

B) [Skip this step if you are not using the digital output.]

Turn the knob to set the desired digital output level corresponding to 100% modulation, in units of dB below full-scale.

> The most accurate way to set this control is by observing a modulation monitor or analyzer connected to your transmitter.

15. Set the analog output level.

(See the notes in step 8 above.)

A) Press the *Next* button.

B) [Skip this step if you are not using the analog output.]

Turn the knob to set the desired analog output level corresponding to 100% modulation, in units of dBu (0 dBu = 0.775 Vrms).

> The most accurate way to set this control is by observing a modulation monitor or analyzer connected to your transmitter.

C) Press the *Next* button.

The line-up tone will turn off.

D) Press the *Next* button.

This concludes the guided part of Quick Setup. To complete the setup, you must also perform the steps below unless they are indicated as "optional."

16. Complete Station ID (optional).

The Station ID is an optional setting that you can provide to associate the 5518 with the station providing the program material (e.g., "Z-100"). The name can be up to eight characters long. It is used to identify your 5518 to Orban's PC Remote application, and appears on the Main Screen when the 5518 is being controlled by the PC Remote application.

A) Navigate to *Setup* > *Next* > TIME DATE AND ID > STATION ID.

B) Use the knob to set the each character in the ID. Use the *Next* and *Prev* buttons to control the cursor position.

C) When finished entering your name, press the SAVE button. If you escape to the main screen from Setup, you can now see the station name toggle on the main screen.

17. Set up modulation reduction to compensate for subcarriers (optional).

In the United States, F.C.C. Rules permit you to add 0.5% modulation for every 1% increase in subcarrier injection. For example, if your subcarrier injection totals 20%, you can set the total modulation to 110% (±82.5 kHz deviation). The 5518 has the ability to reduce audio modulation to compensate for subcarriers.

The advantage of using the modulation reduction function is that the pilot injection stays constant when the audio modulation is reduced. However, using the modulation reduction function is slightly inconvenient because it requires programming and activating at least one 5518 GPI input. *If you have the same subcarrier injection at all times*, a more convenient alternative is to set the desired modulation level by using the COMPOSITE LEVEL control(s). Then turn up the pilot injection control until the injection equals 9% modulation.

If you wish to use the modulation reduction function anyway:

A) Navigate to *Setup* > *Next* > MODULATN REDUCTN.

B) Hold down the appropriate MOD. REDUCTION button and turn the knob to set the amount of modulation reduction produced by the MOD. REDUCTION 1 and MOD. REDUCTION 2 functions.

You can program these to be activated via any rear-panel GPI input or by the 5518's clock-based automation.

When both modulation reduction functions are active, the modulation reduction is the sum of their settings.

To comply with FCC Rules, set the modulation reduction to one-half the injection of the associated subcarrier. For example, if your subcarrier injection totals 20% from two 10% subcarriers, set MODULATION REDUCTION 1 TO "5%" and MODULATION REDUCTION 2 to 5%. This will reduce your audio modulation to 90% (100% – 5% – 5%). When you add back the 20% modulation due to the subcarriers, you get the required 110% total modulation.

The Modulation Reduction function is active as long as signal is applied to its associated GPI input.

C) Program the GPI input(s).

a) Navigate to *Setup* > *Next* > NETWORK&REMOTE > REMOTE INTERFACE.

b) Using the *Next* button, scroll the screen until you see the button corresponding to the GPI terminal you wish to program.

c) Hold down this button and turn the knob until you see MOD. REDUCTION 1 or MOD. REDUCTION 2 as desired.

To program clock-based automation to activate modulation reduction, follow the instructions found in "Using Clock-Based Automation" on page 2-27.

18. Turn the 5518's ITU-412 MPX power controller off.

If the MPX power controller is turned on, turn it off. When on, it causes gain reduction that makes it impossible to set the AI and DI reference level controls correctly with test tones generated by the equipment driving the 5518's input. See step 29 on page 2-22.

19. Recall the ST ENC NO LIM preset.

A) Press the *Recall* button on the 5518's front panel.

B) Turn the knob until ST ENC NO LIMIT is visible in the lower line of the display.

It is likely that the ST ENC NO LIMIT is already active because it is the only factory preset in the 5518. However, user presets might exist unless your 5518 is brand new or has been reset to its factory defaults. (To set the 5518 to its factory defaults, see *If You Have Forgotten Your Passcode* on page 2-33.)

C) Press the *Recall Next* button.

The L/R protection limiting and composite limiter are now inactive. This makes it easier to adjust modulation using a test tone.

20. Adjust the input to accept a flat or preemphasized signal.

Note for users of J.17 preemphasis: If you are using the digital input and set it to DIGITAL+J17 in step (7.B) on page 2-12, the 5518 will first apply J.17 deemphasis to the digital input signal. It will then preemphasize it at 50 or 75 µs or leave it unchanged, following the setting of the INPUT PRE-EMPH CONTROL, as adjusted in the steps immediately below.

The J.17 option is rarely used; it applies mainly to NICAM links. You can set most OPTIMOD-FMs to emit a J.17-preemphasized signal with or

without additional 50 or 75 µs preemphasis. For example, see step (10.B) on page 2-13.

A) Press the *Modify* button.

B) If you do not see the APPLY EMPH soft button, press the *Next* button until it appears.

C) While holding down the APPLY EMPH soft button, rotate the knob to match the 5518 to the input signal's preemphasis.

All FM audio processing chains must include a preemphasis limiter to prevent high frequency overmodulation. Therefore, regardless of whether you choose YES or NO in this step, you must ensure that the signal driving the 5518 stereo encoder has already received 50 µs or 75 µs preemphasis limiting. (Any OPTIMOD-FM will perform preemphasis limiting.) You must set the 50 or 75 µs preemphasis in the audio processor driving the 5518 to be the same as the 5518's preemphasis setting.

- Choose YES if the input signal has no 50 or 75 µs preemphasis.

  YES causes the 5518 to apply 50 or 75 µs preemphasis to the input signal, following the preemphasis setting you specified in step (6.B) in Quick Setup (page 2-12).

- Choose NO if your input signal has already been pre-emphasized to 50 or 75 µs.

  In step 6 in Quick Setup (page 2-12), make sure that you have set the 5518's preemphasis to match the preemphasis (50 or 75 µs) of the input signal. Even though the 5518 is not applying preemphasis, its L/R overshoot limiter needs to be aware of the input signal's preemphasis because the overshoot limiter uses different algorithms for 50 and 75 µs. This minimizes audible limited-induced artifacts.

  Usually, the STL adds less peak overshoot to its input signal if its input and output signals are preemphasized. Doing this eliminates several stages of deemphasis and preemphasis. However, if the STL uses lossy digital compression (like MP2), you must apply a flat signal to the STL and restore the preemphasis in the 5518. *Studio-Transmitter Link* (starting on page 1-11) has a thorough discussion of these issues.

21. Adjust the input lowpass filter.

A) If you do not see the INPUT LPF soft button, press the *Next* button until it appears.

B) While holding down the INPUT LPF soft button, rotate the knob to set the cutoff frequency of the phase-linear lowpass filter at the 5518's input.

It is usually unnecessary to use this filter; you may set it OUT unless you need to remove out of band noise from a noisy STL.

To minimize filter-induced overshoot, set the cutoff frequency as high as possible. While this filter introduces no phase distortion, it will add overshoot if it removes a significant amount of the high frequency energy that was present at the output of the audio processing driving the 5518.

If you are using an OPTIMOD-FM 8000, 8100, 8500, or 8600 audio processor to drive the STL, set the 5518's LOWPASS FILTER to OUT or 17 KHZ. If you are using any other OPTIMOD-FM, set the filter to OUT, 16 KHZ or 17 KHZ.

22. Set the analog input reference level.

[Skip this step if you will not be using the analog input.]

A) Navigate to *Setup* > I/O CALIB > ANLG IN CALIB > INPUT.

B) Set the INPUT to Analog.

The 5518 will automatically switch to analog input if signal lock is unavailable at the AES3 input.

C) Apply a 50 Hz sine wave the 5518's analog input (usually through an STL) and set the peak level of the tone to equal the maximum peak output level produced by the FM audio processor driving the 5518.

All digital OPTIMOD-FM processors have a built-in tone oscillator that can generate this tone. Set the modulation in the driving OPTIMOD-FM's tone generator to 100%.

Tone alignment does not account for any overshoots that the STL might generate with program material. Normally, you will use the 5518's left/right overshoot limiter and/or composite limiter to eliminate such overshoots. Do not substitute these limiters for the peak limiters in the audio processor driving the STL. The 5518's overshoot limiters should *only* be used to eliminate 3 dB or less STL-induced overshoot.

D) Navigate to *Setup* > I/O CALIB > ANLG IN CALIB > AI REF. Adjust the AI REF control to produce 100% composite modulation (usually ±75 kHz carrier deviation) as indicated on a modulation monitor or analyzer connected to your FM transmitter's output.

If you set the composite output level correctly in step 13 on page 2-14, you should see the 5518's composite level meter indicate 100% modulation when the AI REF control is set correctly. It is very important to have set the composite output level correctly in this earlier step. This will correctly match the 5518's composite limiter threshold to the FM carrier deviation produced by the transmitter and will ensure that the 5518's headroom is used correctly. If you are not sure whether the 5518's composite output level was set correctly, refer to step (5.C) on page 2-24. Use "tone" method to set modulation. This uses the 5518's internal tone oscillator.

23. Set the digital input reference level.

[Skip this step if you will not be using the digital input.]

Refer to the notes in step 22 above.

A) Navigate to *Setup* > I/O CALIB > DIG IN CALIB > INPUT and set the input to DIGITAL.

B) Apply a 50 Hz sine wave the 5518's digital input (usually through an STL) and set the level of the tone to correspond to 100% peak modulation of the composite stereo baseband signal. This level should be the same as the maximum peak output level produced by the FM audio processor driving the 5518. If

you are driving the 5518 with a digital OPTIMOD-FM, use its lineup tone oscillator.

C) Navigate to *Setup* > I/O CALIB > DIG IN CALIB > DI REF. Adjust the DI REF control to produce 100% composite modulation (usually ±75 kHz carrier deviation) as indicated on a modulation monitor or analyzer connected to your FM transmitter's output.

24. Activate the L/R Peak Limiter (optional)

A) Press the *Modify* button.

B) If you do not see the L/R LIM soft button, press the *Next* button until it appears.

C) Set the control to IN.

> This activates a peak limiter that controls peaks with a combination of look-ahead limiting and band-limited clipping. There are two limiters, operating independently on the left and right channels. They are intended only to remove overshoots caused by the STL. If used for more than 3 dB of peak reduction, they can cause audible side effects. To minimize audible distortion, it always better to minimize overshoots in the STL itself instead of relying on the L/R peak limiter to remove them.

25. Activate the Composite Limiter (optional)

To operate successfully in SSB/VSB mode, you must activate the composite limiter.

A) Press the *Modify* button.

B) If you do not see the MPX LIMIT MODE soft button, press the *Next* button until it appears. Then select either HARD or HALFCOS modes.

> When operating as a hard clipper, the composite limiter will produce maximum brightness in the frequency range from 5 to 15 kHz because, unlike left/right audio-domain clippers, it can produce square waves in this frequency range. The downside compared to Half-Cosine mode is that it can noticeably compromise stereo imaging.
>
> When operating in Half-Cosine mode, the composite limiter produces somewhat less brightness but does not compromise stereo imaging. Because this mode produces lower subjective distortion, Orban's factory programmers prefer the sound of the Half-Cosine mode.
>
> In either mode, the baseband output is overshoot compensated and bandlimited to 53 kHz, unlike conventional composite clippers.
>
> The HARD mode is only available when the 5518 is operated as a standalone stereo encoder. In the 5518's audio processor mode, its composite limiter always operates in Half-Cosine mode.

C) If you do not see the MPX LIM DR soft button, press the *Next* button until it appears.

D) Adjust the control as desired.

We recommend setting the control to "0." This sets the limiter threshold to be the same as the analog and digital reference levels, which correspond to 100% baseband tone modulation. This setting only removes overshoots.

Setting the control higher than "0" drives the limiter harder, causing progressively more limiting action but also more distortion, the texture of which depends on whether the MPX LIMIT MODE is set to HARD or HALFCOS. The composite limiter is less forgiving than the L/R Peak Limiter because it operates more like a pure clipper.

26. Save your work as a User Preset.

It is important to save your settings as a User Preset to preserve your work. You can create as many User Presets as you wish, each customized for a particular application, although most stand-alone stereo encoder applications will require only one User Preset. See *To Create or Save a User Preset* on page 3-3.

27. Program Silence Sense (optional)

If you are using the 5518 in stereo encoder mode, you can program the 5518 to switch automatically from its digital input to its analog inputs if the INPUT SOURCE is set to DIGITAL and the signal at the digital input falls silent.

There are two silence detectors, one for the analog input and one for the digital input. The silence sense parameters apply to both simultaneously. Both detectors are available to drive the 5518's tally outputs but only the "digital input" silence detector is used for automatic input switching. (See step 28 below.)

Silence sense will be activated if either channel falls silent, thus also protecting against "loss-of-one-stereo-channel" faults.

If silence is detected at the analog input as well as the digital input (as in the case of a studio operational fault), automatic switching will not occur.

When an active signal is restored to the digital input, the 5518 will automatically switch back to that input.

A) Navigate to *Setup* > SILENCE THRESHOLD and set the Silence Threshold to the level below which the 5518 will interpret the input as being silent.

This setting is with respect to the current analog reference level and digital reference level.

B) Press *Next* as necessary to see the SILENCE DELAY control. Set it to the amount of time that the input must be below the Silence Threshold before the 5518 automatically switches to the analog input.

C) Press *Next* as necessary to see the ANALOG FALLBACK control. Set it to YES if you wish the 5518 to switch automatically from the digital to analog input when silence is detected. Set the control to NO to defeat automatic switching.

28. Program Tally Outputs.

[Skip this step if you do not wish to use the tally outputs.]

See step 6 on page 2-4 for wiring instructions.

You can program the two tally outputs to indicate a number of different operational and fault conditions.

A) Navigate to *Setup* > NETWORK REMOTE > REMOTE INTERFACE > TALLY 1.

B) Program tally output #1.

To program a given tally output, press and hold the soft button associated with the output you are programming. As you turn the control knob, the functions listed below will appear in the highlighted field.

- **Input: Analog**: Indicates that the 5518 is processing audio from its analog input.
- **Input: Digital**: Indicates that the 5518 is processing audio from its AES3 digital input.
- **Analog Input Silent**: Indicates that the level at either or both analog input channels is below the threshold set in step 26 on page 2-20.
- **AES Input Silent**: Indicates that the level at either or both digital input channels is below the threshold set in step 26 on page 2-20.

  Currently, this feature applies only to the stand-alone stereo encoder mode.
- **AES Input Error**: Indicates that the 5518's AES input receiver chip has detected a problem with the data being received such that the data is unusable. When the chip detects such an error, it automatically switches the input to ANALOG.
- **Sync Reference Input Error**: Indicates that the 5518 has detected a problem with the signal being received at the sync reference input such that the signal is unusable.
  - When pilot sync is specified (SETUP > I/O CALIB > DIG OUT CALIB > DO SYNC) and such an error is detected, the 5518 automatically switches the sync source to the digital input.
  - If there is no valid digital input signal at the digital input, the sync source defaults to the 5518's internal clock.
- **No Function**: Tally output is disabled.

C) Program tally output #2 if you wish, following the procedure in step (B) above with the TALLY OUT2 button.

29. Activate the 5518's ITU-R BS412-9 multiplex power controller (optional).

[Skip this step if ITU-R BS412 is not enforced in your country. At the time of this writing, it is only enforced in certain European countries. If your country does not enforce ITU-R BS412, set the ITU412-9 control to OFF.]

[Be sure that the multiplex power controller is turned off until you have finished setting up the other stereo encoder parameters. Otherwise, it will interfere with setting output levels.]

If you are driving the 5518 with an OPTIMOD-FM that includes a MPX power controller and you need to obey BS412-9, turn on the MPX Power Controller in the OPTIMOD-FM driving the 5518 and do not turn on the 5518's MPX power controller. This will minimize peak limiting artifacts in the OPTIMOD-FM. If your BS412 modulation monitor indicates too much or too little MPX power, adjust the ITU412 control on the driving OPTIMOD-FM until the monitor indicates that the power is being controlled correctly. Only if the MPX power changes as a function of program material (which might occur if the path between the driving OPTIMOD-FM and the 5518 introduces severe overshoots) should you activate the 5518's MPX power controller to correct this problem. In this case, adjust the ITU412 control of the driving Optimod so that all program material produces at least the maximum permitted MPX power. The MPX power controller in the 5518 will then only eliminate power overshoots caused by the STL instead of controlling all MPX power itself.

To activate the 5518 MPX power controller:

A) Navigate to *Setup* > STEREO ENCODER > *Next* > ITU412.

B) Set the multiplex power threshold by holding the ITU412 button down and turning the knob so that the display indicates 0.0 dB.

If your transmission system introduces overshoot in the signal path after the 5518 (including the transmitter), instead set the multiplex power threshold so that it equals the amount of peak overshoot (in dB) in the transmission system. If you do not do this, the 5518's ITU-R BS412 controller will set the average multiplex power too low.

The easiest way to measure system overshoot is to turn the multiplex power controller off temporarily. Then set the 5518's output level (using its built-in 100Hz reference tone) so that the transmitter produces ±75 kHz deviation. Finally, play program material with lots of high frequency energy and bass transients (like bright rock music with heavy kick drum) and observe the peak deviation produced by the program material. The overshoot is the amount (in dB) by which the deviation with program material exceeds ±75 kHz deviation.

See ITU-R Multiplex Power Controller on page 3-4.

The following material provides detailed instructions on how to set up the 5518. If QUICK SETUP does not fully address your setup needs or if you wish to customize your system beyond those provided with QUICK SETUP, then you may need the additional information in the sections below. However, for most users, this material is

only for reference because QUICK SETUP has enabled them to set up the 5518 correctly.

Analog and Digital I/O Setup

For the following adjustments, use the appropriately labeled soft button to choose the parameter to be adjusted. To change a parameter (like an output level), it is usually necessary to hold down the soft button while turning the knob.

1. Adjust Input selector.

A) Navigate to *Setup* > I/O CALIB > ANLG IN CALIB > INPUT.

B) Set the INPUT to ANALOG.

The 5518 will automatically switch to analog input if signal lock is unavailable at the AES3 input.

2. Adjust Analog Input Reference Level.

[–9 dBu to +13 dBu (VU), or –1 to +21 dBu (PPM)] in 0.5 dB steps

See step 22 on page 2-18.

3. Adjust Right Channel Balance.

[Skip this step if the channels are already satisfactorily balanced.]

[–3 dB to +3 dB] on right channel only, 0.1 dB steps

Adjust the R CH BAL control to achieve correct left/right channel balance.

> This is not a balance control like those found in consumer audio products. This control changes gain of the right channel only. Use this control if the right analog input to the 5518 is not at exactly the same level as the left input. This control should only be use if the left and right gains between the output of your audio processor and the input to the 5518 are not identical. Normally, this control should be set to 0 dB.

4. Adjust the Digital Input Reference Level and Right Balance controls.

[Skip this step if you will not be using the digital input.]

A) Navigate to *Setup* > I/O CALIB > DIG IN CALIB > INPUT and set the input to Digital.

B) Repeat steps 2 through 3 (starting on page 2-23), but use the DI REF (VU OR PPM) and R CH BAL controls for the digital section. See also step 23 on page 2-18.

5. Configure Composite Outputs

A) Navigate to *Setup* > STEREO ENCODER > *Next* > PRE-EMPH. Set the preemphasis to 50µs or 75µs, depending on your country's standard.

B) Set PILOT LVL to 9%.

> If you have to reduce the setting of the composite level (COMP1 LV or COMP2 LV) control to accommodate overshoots in the transmission path following the 5518 (including the transmitter), you may have to increase the setting of the PILOT LEVEL so that the pilot is still at 9% modulation.

C) Set the peak modulation using the 5518's built-in calibration tone oscillator.

a) Navigate to *Setup* > TEST.

b) Set the MODE to TONE.

c) Set TONE FREQ to 100 HZ.

d) Set TONE LVL to 91%. (This assumes you are using 9% pilot injection, in which case the peak level at the composite output is now the same as the maximum peak level under program conditions.)

e) Press the *Next* key.

f) Set TONE CHAN to L+R.

g) Verify that PILOT is ON.

h) Adjust the relevant output level control so that your peak modulation is 100%.

i) When you have finished with the tone, set the MODE to OPERATE.

D) If your country enforces the ITU-412 multiplex power standard, set ITU412 to ON. See step 29 on page 2-22.

E) If you are using the 5518's pilot reference output to drive a subcarrier generator, set the 19K REF control to the phase relationship between the 19 kHz reference and the 5518's pilot tone required by your subcarrier generator. In most cases, this will be 0 degrees.

F) Press the *Next* button. If you need to apply the 5518's diversity delay to the composite outputs, set DVRSTY DLY to IN. Otherwise, set it to OUT.

> It is not possible to apply the delay to only one of the two composite outputs.

G) If you are using the diversity delay, set its value using the DVRSTY DLY TRIM control. The control sets the delay applied to the composite, analog, and digital outputs when these outputs have been configured to receive delay.

> While it is possible to activate or defeat the diversity delay independently for the analog output, digital output, and composite outputs, it is not possible to apply different amounts of delay to different outputs.

H) Press the *Next* button. Be sure that MODE is set to STEREO and XTALK TEST is set to OPERATE. Reset these parameters if necessary.

I) You can specify the amount by which the 5518 automatically reduces main and stereo subchannel modulation to accommodate subcarriers within the modulation limits specified by the governing authority. See step 17 on page 2-15.

6. Set analog output and configuration level.

(Usually, the analog output will not be used and you can skip this step. However, the analog output can be useful in some facilities. See the notes in step 8 on page 2-13.)

A) Navigate to *Setup* > I/O CALIB > ANLG OUT CALIB > AO PRE-E. Set the analog output preemphasis to PRE-E (for preemphasis) or FLAT.

If you will use the analog output to drive a stereo encoder, PRE-E provides the best performance because the stereo encoder does not have to restore the preemphasis. (Its magnitude and phase response may not perfectly complement that of the deemphasis applied by the 5518 to its processed output when the 5518's output is set FLAT. This can introduce overshoots in the overall transmission chain.) However, if you cannot defeat the preemphasis in your stereo encoder or if you will use the analog output for monitoring, set the output FLAT.

If you are sending the analog output of the 5518 through a digital link that uses lossy compression (like MPEG, APT-X, or Dolby), set the output FLAT. Lossy codecs cannot handle pre-emphasized signals.

B) Set the AO SOURCE to FM, FM+DELAY, or MONITOR.

FM: This produces a fully peak-controlled output suitable for driving a transmitter.

FM+Delay: This produces a fully peak-controlled output suitable for driving a transmitter. Up to 16 seconds of diversity delay can be applied to this output. To set the amount of delay, refer to step (5.G) on page 2-24.

C) To set your on-air modulation, turn on the 100 Hz calibration tone and set it to 100%.

The peak level at the analog output is now the same as the maximum peak level under program conditions when the AO PRE-E control is set to PRE-E and the AO REF or DO REF controls have been set correctly (step 22 on page 2-18 and step 23 on page 2-18).

This peak level should agree with the setting of the AO 100% control. AO 100% is equal to the RMS value of a sinewave whose peak value is equal to the maximum peak output of the analog output under program conditions if the AO PRE-E control is set to PRE-E. For example, when AO PRE-E = +10.0 dBu, the peak output is 5.77 volts, which corresponds to a sinewave whose RMS values is 4.08 volts. Program material peaks of frequent recurrence will not exceed 5.77 volts peak.

See step (5.C) on page 2-24 for instructions on how to turn on the calibration tone and set its frequency and level.

D) Using the AO 100% button, set the desired analog output level corresponding to 100% modulation, using units of dBu (0 dBu = 0.775 Vrms).

The most accurate way to set this control is by observing a modulation analyzer connected to your transmitter.

In the United States, F.C.C. Rules permit you to add 0.5% modulation for every 1% increase in subcarrier injection. For example, if your subcarrier injection totals 20%, you can set the total modulation to 110% (±82.5 kHz deviation). This implies that you must set the 5518's composite out-

put level for the equivalent of 90% modulation, not counting the subcarriers. (90% + 20% = 110%.) The pilot injection will thus be about 8% modulation instead of the desired 9%. Adjust the *Setup* > STEREO ENCODER > *Next* > PILOT LVL control as necessary to produce 9% modulation (±6.75 kHz deviation). This will ordinarily require you to set the PILOT LVL parameter to "10%."

7. Set digital output and configuration level.

[Skip this step if you will not be using the digital output.]

[See the notes in step 6 immediately above.]

A) Navigate to *Setup* > I/O CALIB > DIG OUT CALIB.

B) Set the DO PRE-E control to PRE-E (for preemphasis), PRE+J17, J.17 or FLAT.

C) Set the DO RATE to 32, 44.1, 48, 88.2, or 96 kHz.

The 5518's fundamental sample rate is always 32 kHz, ensuring that the output bandwidth is always strictly limited to 16 kHz and that the processed signal can be passed through a 32 kHz uncompressed STL without addition of overshoot. However, the internal sample rate converter sets the rate at the 5518's digital output. This adjustment allows you to set the output sample rate to ensure compatibility with equipment requiring a fixed sample rate.

D) Set the PILOT SYNC.

The PILOT SYNC control determines the reference frequency source to which the 19 kHz pilot tone frequency is locked. (To do this, the DSP clock is locked to this frequency.) The choices are DIG IN (the AES3 or AES11 signal appearing at the 5518's digital input), REF IN (the 10 MHz or 1x wordclock applied to the 5518's REF IN BNC connector), or INTERNAL (the internal crystal-controlled DSP clock oscillator).

- If DIG IN is chosen and no valid signal is available at the unit's digital input, the 5518 automatically switches the sync source to the REF IN BNC connector. If there is no valid digital input signal at the reference input, the sync source defaults to the 5518's internal clock.
- If REF IN is chosen and there is no valid input signal at the REF IN BNC connector, the sync source defaults to the 5518's internal clock.

E) Press *Next*. Then set the DO SYNC.

You can choose PILOT SYNC (the DSP clock frequency reference as determined by the PILOT SYNC control) or DIG IN (the output sample rate is synchronized to the sample rate appearing at the 5518's AES3 input).

- If DIG IN is chosen and no valid signal is available at the unit's digital input, the 5518 automatically switches the sync source to the source determined by the PILOT SYNC control.

F) Set the desired output WORD LENGTH.

[14], [16], [18], [20], or [24], in bits

The largest valid word length in the 5518 is 24 bits

The 5518 can also truncate its output word length to 20, 18, 16 or 14 bits. The 5518 can add dither for input material that is insufficiently dithered for these lower word lengths (see the next step).

G) Adjust DITHER to IN or OUT, as desired.

[In] or [Out]

When set to In, the 5518 adds "highpass" dither before any truncation of the output word. The amount of dither automatically tracks the setting of the WORD LENGTH control. This is first-order noise shaped dither that considerably reduces added noise in the midrange by comparison to white PDF dither. However, unlike extreme noise shaping, it adds a maximum of 3 dB of excess total noise power when compared to white PDF dither. Thus, it is a good compromise between white PDF dither and extreme noise shaping.

If the source material has already been correctly dithered (as is true for virtually all commercially recorded material), you may set this control to OUT. However, particularly if you use the Noise Reduction feature, the processing can sometimes attenuate input dither so that it is insufficient to dither the output correctly. In this case, you should add dither within the 5518.

H) Set DIGITAL FORMAT to AES or SPDIF.

SPDIF is the standard consumer format; AES is almost always correct in professional facilities.

I) Set the DO SOURCE to FM, FM+DELAY, or MONITOR.

See the notes in step (6.B) in page 2-25.

J) Press the *Prev* button.

K) Using a modulation monitor or modulation analyzer, adjust the DO 100% control to make the modulation monitor read 100% modulation (usually ±75 kHz deviation).

See the notes in step (6.D) on page 2-25.

8. Customize your on-air preset for your transmission path.

Refer to steps 19 through 26 starting on page 2-16. Remember to save your work as a User Preset (step 26).

Automation Using the 5518's Internal Clock

1. If you have not already done so, set the system clock.

[You can also set the clock automatically via PC Remote or the Internet. See *Synchronizing 5518 to a Network Time Server* starting on page 2-45.]

A) Navigate to *Setup* > *Next* > TIME DATE AND ID > SET TIME.

a) Set hours and minutes.

b) Enter seconds slightly ahead of the correct time.

c) Wait until the entered time agrees with the correct time. Then press the ENTER TIME button to set the clock.

B) Press the SET DATE button.

a) Set today's date, using the days, month, and year buttons.

b) Press the ENTER DATE button.

C) Press the DAYLIGHT TIME button.

a) Using the Daylight Saving (DT MONTH and DT WEEK) buttons, set the month and week when Daylight Saving Time (Summer Time) begins, or OFF.

b) Using the Standard Time (ST MONTH and ST WEEK) buttons, set the month and week when Daylight Saving Time (Summer Time) ends.

Note that setting DT MONTH, DT WEEK, ST MONTH, or ST WEEK to OFF will defeat Daylight Time functionality.

c) Press the *Escape* key to back out of the daylight saving screen.

D) (Optional) Press the STATION ID button to specify your station's identifier (call sign or call letters).

a) Use the knob to select characters. Use the *Prev* and *Next* buttons to move the cursor.

b) When you are finished, press SAVE.

2. Navigate to Setup > Next > Automation.

If the AUTOMATION button reads DISABLED, hold it down and turn the knob to enable automation.

This button allows you to easily enable or disable all automation events without having to edit individual automation events.

3. To add an automation event:

A) Push the ADD EVENT button.

B) Choose whether you wish to program an event that occurs only once or an event that follows a daily or weekly schedule.

C) For events that occur only once:

a) Use the *Prev* and *Next* buttons to move the cursor over the word "DAILY:" and turn the knob so that is reads "DATE:" instead.

b) Use the *Prev* and *Next* buttons to move the cursor to the day, month, and year when the automation event will occur. Set the desired values with the knob.

c) Use the *Prev* and *Next* buttons to move the cursor set the hour, minute, and second (in 24-hour format) when the automation event is to occur. Set the desired values with the knob.

D) For events that occur on a daily or weekly schedule:

a) Use the *Prev* and *Next* buttons to move the cursor the each day of the week in turn, and use the rotary encoder to turn the day on or off.

You can program the event to occur on as many days of the week as you wish.

b) Use the *Prev* and *Next* buttons to move the cursor set the hour, minute, and second (in 24-hour format — e.g., 18:00:00 for 6:00 PM) when the automation event is to occur. Set the desired values with the knob.

Automation events have a "start" time but no "stop" time. The 5518 will indefinitely remain in the state specified by an existing automation event until its state is changed by another automation event or by another action (such as a user's interacting with the front panel or PC Remote software).

E) For all events:

a) Press the SELECT EVENT button.

b) Turn the knob to set the desired event. The available events are:

- Recall factory preset
- Recall user preset
- stereo mode
- mono-from-left-channel (MONO-L) mode
- mono-from right-channel (MONO-R) mode
- mono-from-sum-of-channels (MONO-SUM)
- compatible SSB/VSB mode (SSB).

See *SSB Stereo Encoder Operation* on page 3-6 for more information.

- bypass mode
- Independently activate and defeat the diversity delay applied to the analog, digital, and composite outputs.
- exit test (restores the operating preset that was on-air before a test mode was invoked)
- mod. reduction 1
- mod. reduction 2
- exit mod. reduction

F) When you have programmed an event to your satisfaction, press the SAVE EVENT button.

You will return to the automation menu.

4. To edit an existing event:

A) Press the VIEW/EDIT EVENT button.

B) Select *Next/Prev* to sort by either the event times or event tasks.

C) Turn the knob until you see the event you wish to edit.

D) Press the EDIT EVENT button.

E) Edit the event as desired. Use the same technique as adding an event.

See step 3 on page 2-28.

F) Press the SAVE EVENT button to store your edits.

5. To delete an event:

A) Press the DELETE EVENT button.

B) Select *Next/Prev* to sort by either the event times or event tasks.

C) Choose the event to delete with the knob.

You can search by date or by event (i.e., recalling a given preset). Use the *Next* button to navigate from one type of search to the other type.

D) When you have located the event you want to remove, press the DELETE EVENT button.

This action will immediately delete the event. There is no "are you sure" warning message. To abort the deletion, press the ESC button, not the DELETE EVENT button.

Security and Passcode Programming

[Skip this step if you do not plan to use PC Remote software or do not plan to lock out the front panel locally.]

The 5518 has several levels of security to prevent unauthorized people from changing its programming or operating state. Security controls access to the front panel and to anyone connecting to the 5518 through a direct serial connection, dial-up networking (through modems), or its Ethernet port.

The security levels are:

1. All Access (i.e., administrator level)
2. All Access except Security
3. All Access except Modify and Security
4. Recall, Modify and Automation
5. Recall Presets and Program Automation
6. Recall Presets

A single Level 1 (All Access) passcode, known only to the engineer responsible for the technical operation of the station, is usually appropriate for a 5518 installation.

Starting with version 1.2.1 software, there is a default All-Access passcode: `1234`. This allows PC Remote users to connect to the 5500 if they forgot to add a passcode from the 5500's front panel. *Like any other default passcode, it should be erased and replaced by a strong custom passcode as soon as possible.* See *To Delete a Passcode* on page 2-32 and *To Create a Passcode* below. Note that if you fail to create a custom passcode and merely delete the `1234` passcode, the `1234` passcode will be regenerated automatically the next time your Optimod is turned off and back on.

The 5518 secures User Presets by encrypting them (using the Advanced Encryption Standard algorithm with the session passcode as its key) when PC Remote fetches them. Hence, a packet sniffer cannot intercept User Presets in plaintext form. PC Remote then writes the fetched User Presets in encrypted form on your hard drive, where they remain for the duration of your PC Remote session.

> If PC Remote exits normally, it will erase these temporary User Preset files from your computer's hard disk. If it does not exit normally, these files will remain in encrypted form. However, the next time that PC Remote starts up, it will automatically clean up any orphaned files.

To Create a Passcode:

A) Navigate to *Setup* > SECURITY > ADD PASSCODES.

> If the front panel is already password protected, you can only access this screen by entering a passcode with All Access privileges.

B) Use the four soft buttons, labeled"1," "2," "3," and "4," to create a passcode.

> Passcodes can be up to eight characters long but can only contain the characters "1," "2," "3," and "4." This limitation makes it easy to enter a passcode using the four available soft buttons.

C) When you have finished entering your new passcode, write it down so you do not forget it. Then press the *Next* button.

> If you wish to discard the passcode you just entered, press the ESC button instead. Then return to step (B).

D) The PERMISSIONS screen appears. Turn the knob to choose the permission level for the passcode you just created.

> If you wish to discard the passcode you just entered, press the PREV button to return to the Enter Passcode screen or ESC to return to the Security screen.

E) Press the *Next* button to save your new passcode.

To Edit a Passcode:

A) Navigate to *Setup* > SECURITY > VIEW-EDIT PASSCODES.

If the front panel is already password protected, you can only access this screen by entering a passcode with ALL ACCESS privileges.

B) Turn the knob until you see the passcode you want to edit.

C) Press the *Next* button. The Permissions screen appears.

D) Turn the knob to set the desired permission level for the passcode you are editing.

E) Press the *Next* button to confirm your choice.

Your new permission level is stored and the Security menu appears.

To Delete a Passcode:

A) Navigate to *SETUP* > SECURITY > DELETE PASSCODES.

If the front panel is already password protected, you can only access this screen by entering a passcode with All Access privileges.

B) Turn the knob until you see the passcode you want to delete.

C) Press the *Next* button. The Confirm Delete screen appears.

D) Press the YES soft button to delete the passcode. Press the NO or *ESCAPE* buttons to abort deleting the passcode.

To Lock the Front Panel Immediately:

After you have adjusted the processor, to maximize security you will often want to lock it immediately without waiting for the timeout. To do so:

A) Press the *Setup* button.

B) Press the LOCK NOW soft button.

To Program local lockout:

A) Navigate to *Setup* > SECURITY.

If the front panel is already password protected, you can only access this screen by entering a passcode with ALL ACCESS privileges.

B) Hold down the AUTOLOCK soft button and turn the knob to set the desired lockout time (if any).

You can program the lockout delay time (in hours:minutes) from 15 minutes to 8 hours, or OFF. This is the time delay between the last access to a local front panel control and when the front panel automatically locks itself out, requiring that you enter a passcode to regain front panel control of the 5518.

Autolock can only be turned on if at least one passcode exists with ALL ACCESS privileges because an ALL ACCESS passcode is required to fully unlock the panel or to turn off the Autolock function.

C) Press the *Escape* button to leave the Security menu.

To Unlock the Front Panel:

A) On the 5518 front panel, operate any button or the knob.

The PASSCODE screen will appear.

B) Enter a passcode using the four soft buttons.

The 5518 functionality that you can access depends on the security level of the passcode that you entered.

After you have finished working, the panel will automatically re-lock after the time delay you set in *Setup* > SECURITY > AUTOLOCK. (You can set a new delay at any time if you have an ALL ACCESS passcode.)

Dial-up Networking and the Passcode

When you make a Windows Dial-up Networking connection, Windows will ask you for your passcode. To allow the connection to occur, enter any passcode that you set at the 5518's front panel. Once your PC is connected to the 5518, you will be able to access the 5518 functionality corresponding to the security level of your passcode.

If you have not set a passcode, leave the Windows dialog box blank.

If You Have Forgotten Your Passcode

You can reset factory defaults and wipe out security passcodes (in case you forgot your ALL ACCESS passcode).

A) Remove power from the 5518.

B) While pressing both the *Escape* and *Setup* buttons, restore power.

The Restore Defaults screen appears.

C) To gain access to the 5518, press the ERASE ALL PASSCODES soft button.

D) Reprogram passcodes as necessary; see *To Create a Passcode* on page 2-31.

The RESTORE DEFAULTS button (in the Restore Defaults screen) restores all System Setup and Input/Output parameters to their factory default settings. It also erases all passcodes. You should never need to use this button in an existing installation, although it is a convenient way to make the 5518 "factory fresh" if it is being installed in a different facility.

The RESTORE DEFAULTS button takes you to a screen that allows you to keep or erase any user presets that exist in your unit.

Administering the 5518 through its Serial Port or Ethernet

Connecting to the 5518's Ethernet Port or Serial Port via a Terminal Program on a PC

You can connect a terminal emulation application to the 5518's Ethernet or Serial ports via TCP/IP, port 23 (which is the standard Telnet port and the 5518 factory default). When connected like this, you can:

- recall presets (step 1 on page 2-37)
- turn the diversity delay on and off for a specified output (step 2 on page 2-38)
- trim the diversity delay (step 3 on page 2-38)
- Select the analog or digital input as the audio source (step 4 on page 2-39)
- Fetch real-time operational status information from the Optimod (step 5 on page 2-39)
- Fetch information about the active processing preset (step 6 on page 2-40)
- Fetch diagnostic information from the 5518 (step 7 on page 2-40)

This interface can be used to allow custom third-party applications (including automation systems) to recall presets, view status and set the controls listed above. However, you cannot restore defaults, set security passcodes and change networking controls via Ethernet or the serial port. You can set those controls by using 5518 PC Remote software. (See *Installing 5518 PC Remote Control Software* on page 2-47.)

- The serial port connection uses the PPP protocol.
- To set a different port number:

  A) From the main menu, navigate to *Setup* > NETWORK&REMOTE > NETWORK.

  B) Press the TERMINAL PORT soft button.

  The current setting of the Terminal Port appears.

  If the TERMINAL PORT soft button is not visible, press the *Next/Prev* buttons until it is.

  a) Use the *Next* and *Prev* keys to move the cursor in turn to each digit in the terminal port number. Use the knob to set the digit to the desired value. Repeat until you have selected all the numbers in the IP address assigned by your network administrator

  b) Press the SAVE soft button to confirm your setting.

- The IP address for this Ethernet connection is the same as the IP address set in step (1.B) on page 2-42 and is visible in the *Setup* > NETWORK&REMOTE > NETWORK

screen. A serial connection uses a fixed IP address: 192.168.168.101.

To control the 5518 directly through its Serial or Ethernet port, you can use the freeware terminal emulation application PuTTY. If you wish to automate control, download Plink. Both of these applications are available for free download. Search "PuTTY" with Google to find a download site.

> Note that Windows 7 does not install a Telnet Client by default, so you must do this manually if you wish to initiate a Telnet connection between a Windows 7 machine and your Optimod. Refer to: http://technet.microsoft.com/en-us/library/cc771275(WS.10).aspx

Direct Control Using PuTTY

A) If you are using a serial connection, establish a Direct Serial Connection between your computer and the Optimod. See *Appendix: Setting Up Serial Communications* starting on page 2-51.

> A connection through the serial port uses a fixed IP address: 192.168.168.101

B) Start PuTTY.

The SESSION window appears.

C) Click the RAW button, and set the Port to 23, or whatever terminal port you have set at the Optimod.

> The Terminal Port is visible in the Optimod's SYSTEM SETUP > NETWORK REMOTE > NETWORK screen.

D) In the TERMINAL category, check "Implicit CR in every LF."

You should not have to change any other PuTTY Terminal, Window, or Connection defaults

E) Specify the host name or IP address:

- If you are connecting through the serial port, type 192.168.168.101 into the "Host Name (or IP address)" field.
- If you are connecting through the 5518's Ethernet interface, type the 5518's IP address into the "Host Name (or IP address)" field.

> The IP address for this connection is the same as the IP address set in step (1.B) on page 2-42 and is visible in the SYSTEM SETUP > NETWORK REMOTE > NETWORK screen.

F) Name and save the Session if you wish.

G) Click OPEN.

H) Activate the CAPS LOCK on your computer to ensure that you type in uppercase.

You can now perform the operations described in steps 1 through 7 starting on page 2-37.

To automate control of the 5518 externally, establish a Telnet/SSH connection and issue commands and parameters, either by typing them directly into a Telnet/SSH cli-

ent or by placing them within batch files. Then process them with a scriptable Telnet/SSH client that supports this operation, such as PuTTY, along with its companion command-line interpreter, Plink. You can also use netcat.exe. Below, we provide instructions for both PuTTY/Plink and Netcat.

Custom third party applications can be developed to use this protocol. Additionally, you can include this protocol in an existing application by using small subsets of the standards-based Telnet/SSH protocols directly, or for simplicity, by using scripting or by calling batch files with a Telnet/SSH client such as PuTTY along with its companion command-line interpreter, Plink.

Automating control changes is possible using the Windows Task Scheduler to launch batch files at the desired time.

> **CAUTION**: Because of the powerful features and potential security risks of Netcat, many virus programs may detect this software as a threat. If Netcat is detected as such, configure virus software to allow, and use the software with the normal security precautions. The outbound configurations shown here do not provide any security risks. Inbound connections, if used for other applications, require careful security configuration.

In the examples below, replace "123.45.67.89" with the IP address of the 5518 you are controlling. Replace "23" with the terminal port you specified using the method described on page 2-34. Port 23 is the factory default.

Automated Control Using PuTTY/Plink

This method is scripted with a .cmd file and calls a .txt file. Via plink.exe, the .cmd file calls putty.exe, which then makes the network connection between the computer executing putty.exe and 5518, and specifies the .txt file to use.

The .txt file contains the 5518 commands.

The following two examples recall the presets JAZZ and ROCK-OPEN respectively.

The file "5518_P1_Jazz.cmd" contains:

```
plink -raw -P 23 123.45.67.89 < 5518_P1_JAZZ.txt
```

The file "5518_P1_JAZZ.txt" contains:

```
RP JAZZ [PASSWORD]
disconnect
```

The file "5518_P2_Rock-Open.cmd" contains:

```
plink -raw -P 23 123.45.67.89 < 5518_P2_ROCK-OPEN.txt
```

The file "5518_P2_Rock-Open.txt" contains

```
RP ROCK-OPEN [PASSWORD]
disconnect
```

Automated Control Using Netcat

Only one utility is required to use this method: netcat.exe. This is available as a free download. Google "netcat."

This method is scripted with a .cmd file and calls a .txt file.

- The .cmd file calls netcat.exe to make the network connection between the computer executing netcat.exe and 5518, and specifies the .txt file to use.
- The .txt file contains the 5518 commands.

The following two examples recall the presets JAZZ and ROCK-OPEN respectively.

The file "5518_P1_JAZZ.cmd" contains:

```
nc.exe -v -n -w 1 123.45.67.89 23 < 5518_P1_JAZZ.txt
```

The file "5518_P1_JAZZ.txt" contains:

```
RP JAZZ [PASSWORD]
disconnect
```

The file "5518_P2_ROCK-OPEN.cmd" contains:

```
nc.exe -v -n -w 1 123.45.67.89 23 < 5518_P2_ROCK-OPEN.txt
```

The file "5518_P2_GreggOpen.txt" contains:

```
RP ROCK-OPEN [PASSWORD]
disconnect
```

Administrative Operations Available via the Serial Port

In the following tables of commands and responses:

- Text that the user enters appears in **MONOSPACED BOLD**.
- Responses that the 5518 transmits appear in monospaced normal.
- The symbol "↵" means CR (for received commands) and CR+LF (for transmitted responses from 5518).

Available Commands

1. **To recall a preset:**

Command	Response
RP XXXXXXX[PASSCODE]↵	(valid passcode and preset name) ON AIR: XXXXXXX (invalid passcode)

	[no error message is issued]

In the above table: **XXXXXXX** = the preset name;
PASSCODE = any valid passcode.

- If a non-existent control value and/or an invalid passcode is entered, the 5518 will ignore the command. If a non-existent preset name is entered, your Optimod will return an error message to indicate that the preset you entered does not exist.
- You can apply this command anytime after the 5518 boots up.
- This command is useful in interfacing automation systems to the 5518.

2. To turn the analog diversity delay on or off for a given output:

Command	Response
DE XXX[PASSCODE]	(valid passcode and argument) DIVERSITY DELAY: [ON,OFF] (for each output) (invalid passcode) [no error message is issued]

In the above table: **XXX = ANALOG_ON, ANALOG_OFF, DIGITAL1_ON, DIGITAL1_OFF, COMPOSITE_ON, COMPOSITE_OFF,** or **?**

PASSCODE = ANY VALID PASSCODE.

- If a non-existent control value and/or an invalid passcode is entered, the 5518 will ignore the command.
- You can apply this command anytime after the 5518 boots up. The 30-minute timeout does not apply.

3. To set the analog diversity delay:

Command	Response
TR X.XXXXXXXXX[PASSCODE]	(valid passcode and argument) DELAY: X.XXXXXXXXX (invalid passcode) [no error message is issued]

In the above table: **X.XXXXXXXXX** = the delay time. Acceptable values are 0.000015625 to 8.192 for the 8-second board and 0.000015625 to 16.384 for the 16-second board (10 total digits) in increments of 0.000015625

PASSCODE = ANY VALID PASSCODE.

- This command is useful when a station has two transmission chains (typically main and backup) that require different diversity delay settings. We recommend first using 5518 PC Remote to set the correct delays for the main and backup chains. When you have found the correct delay for each transmission chain, write down the delay times that PC Remote displays. Then program these into "main" and "standby" batch files that, when executed, send the appropriate TR command to the 5518 when the on-air transmission chain is swapped.
- If a non-existent control value, and/or an invalid passcode is entered, the 5518 will ignore the command.

4. To select the analog or digital input as the audio source:

Note: When the input is set to DIGITAL and no valid digital signal is present at the input, the setting of the DI ANALOG FALLBACK control will determine whether the Optimod automatically switches to its analog input. See step 27 on page 2-20.

Command	Response

IN X[PASSCODE]	(valid passcode and argument)
	`INPUT: [ANALOG, DIGITAL, DIGITAL J17] (for each output)`
	(invalid passcode)
	`[no error message is issued]`

IN [PASSCODE]?↵	`Returns active Input.`

In the above table: **X = A, D, J17**
where A = analog input, D = digital input, and J17 = Digital J.17.

PASSCODE = ANY VALID PASSCODE.

- ? returns the active input setting.
- If a non-existent control value and/or an invalid passcode is entered, the 5518 will ignore the command.

5. To fetch real-time operational status information from the Optimod:

This provides a real-time status report including the following information:

Command	Response

RT [PASSCODE]↵	`5518 Status:`
	`digital input 1 lock [active][inactive]`
	`remote contact closure 1 [active][inactive]`

	remote contact closure 2 [active][inactive] remote contact closure 3 [active][inactive] remote contact closure 4 [active][inactive] remote contact closure 5 [active][inactive] remote contact closure 6 [active][inactive] remote contact closure 7 [active][inactive] remote contact closure 8 [active][inactive] tally out 1 [active][inactive] tally out 2 [active][inactive]

6. To fetch information about the active processing preset:

Command	Response
AP [PASSCODE]?↵	Returns active processing preset name
AP [PASSCODE]??↵	Returns active processing preset control settings
LP [PASSCODE] ↵	Returns a list of all available processing presets

7. To fetch diagnostic information from the 5518:

This provides a status report indicating technical parameters:

Command	Response
ST [PASSCODE]↵	5518 Status: 5518 V 1.2.4.156 Station Name: XXXX Access Level: 0: all access Bootup: Thu Nov 21 23:17:40 2013 MAC Address: 00-0E-EC-E8-0B-99 Memory Available: 11086976 Available Space: 8578 Kbytes i/o board version: 5.00 SNMP active

8. To set the security timeout of the terminal connection:

Sets the delay (minutes) between when the last terminal command is received and when the Optimod disconnects automatically. Default is 15 minutes. The timeout reverts to the default each new connection; if you change the timeout for one connection, it is not retained for the next one.

Command	Response
TIMEOUT [PASSCODE]↵	Delay (minutes) between when the last command is received and when the Optimod disconnects automatically.

Remote Control Interface Programming

[Skip this step if you do not wish to program the GPI (contact closure) remote control interface.]

1. **Navigate to *Setup* > *Next* > NETWORK & REMOTE > REMOTE INTERFACE.**

2. **Program one or more remote control interfaces.**

   A) Navigate to the desired Remote Interface button (1 through 8) by repeatedly pressing the *Next* button.

   B) Hold down the button while turning the knob to select the desired function for the interface.

   Use either button below the appropriate graphics; both work the same.

   A momentary pulse of voltage will switch most functions except as noted.

   - **Preset Name**: switches the named preset on the air. The control interface can recall any factory or user preset.
   - **Input**: **Analog**: selects the analog inputs.
   - **Input**: **Digital**: selects the digital input and but does not apply deemphasis to it.
   - **Input**: **Digital+J.17**: selects the digital input and applies J.17 deemphasis to it.
   - Independently activate and defeat the **diversity delay** applied to the analog, digital, and composite outputs.
   - **Bypass**: switches the Bypass Test Mode on the air.
   - **Tone**: switches the Tone Test Mode preset on the air.

- **Exit Test**: If a test preset is presently on the air, EXIT TEST reverts to the previous processing preset.
- **Stereo**: Determines the operating mode of the audio processing (STEREO, MONO-FROM-LEFT, MONO-FROM-RIGHT, MONO-FROM-SUM, or SSB.)
- **Mono from Left, Mono from Right, or Mono from Sum**: switches the 5518's stereo encoder off, using the Left, Right, or Sum (L+R) respectively as the program source. This also determines the feed to the entire processing chain so that facilities that do not use the 5518's stereo encoder can change stereo/mono mode and select the source when in mono mode.

- **SSB**: switches the 5518 to its experimental compatible SSB/VSB mode. See *SSB Stereo Encoder Operation* on page 3-6 for more information.
- **Mod Reduction 1, or Mod Reduction 2**: reduces the program modulation by the percentage programmed in SETUP > NEXT > MODULATION REDUCTION (see step 17 on page 2-15). When voltage is removed, these functions are deactivated.
- **Reset Clock To Hour**: resets the internal clock to the nearest hour. For example, 3:03:10 would be reset to 3:00:00, while 3:53:40 would be reset to 4:00:00. Use this function to periodically re-sync the 5518's internal clock to your station's master clock.
- **Reset Clock to Midnight**: Resets the clock to 0:00:00. You can use this function to periodically re-sync the 5518's internal clock to your station's master clock.
    - **No Function**: remote input is disabled.

3. End remote control interface programming.

When you are finished programming the remote control interface, press the Escape button to return to higher menu levels.

Networking and Remote Control

[Skip this step if you do not wish to connect to your 5518 remotely, either for downloading software upgrades or for PC Remote Control.]

The 5518 has a built-in Ethernet connector that can be used with 10 Mbps or 100 Mbps ports using the TCP/IP protocol. You can also connect a PC to the 5518 through the 5518's RS-232 serial port, either by modem or directly through a null modem cable.

1. Prepare the 5518 for an Ethernet network connection:

[Skip this step if you will not be using an Ethernet connection.]

See your network administrator to get the data required in the following procedure.

Note that if you wish to do this from the 5518 PC Remote software, then you must first be able to connect to the 5518. Therefore, you will usually perform this procedure from the 5518's front panel to prepare it for connection.

A) Navigate to *Setup* > NETWORK & REMOTE > *Next*.

B) Press the SET IP ADDRESS soft button.

The IP Address Screen appears.

a) Use the *Next* and *Prev* keys to move the cursor in turn to each digit in the IP address. Use the knob to set the digit to the desired value. Repeat until you have selected all the numbers in the IP address assigned by your network administrator

b) Press the SAVE soft button to confirm your setting.

C) Set the Subnet Mask assigned by your network administrator if necessary:

a) Press the SET SUBNET MASK soft button.

b) Use the *Next* and *Prev* keys to move the cursor in turn to each digit in the subnet mask. Use the knob to set the digit to the desired value. Repeat until you have selected all the numbers in the subnet mask assigned by your network administrator

c) Press the SAVE soft button to confirm your setting.

D) Set the Gateway Address assigned by your network administrator if necessary:

a) Press the GATEWAY ADDRESS soft button.

b) Use the *Next* and *Prev* keys to move the cursor in turn to each digit in the gateway address. Use the knob to set the digit to the desired value. Repeat until you have selected all the numbers in the gateway address assigned by your network administrator

c) Press the SAVE soft button to confirm your setting.

E) Set the IP Port assigned by your network administrator if necessary:

a) Press the IP PORT soft button.

b) Use the *Next* and *Prev* keys to move the cursor in turn to each digit in the IP port. Use the knob to set the digit to the desired value. Repeat until you have selected all the numbers in the IP port assigned by your network administrator

c) Press the SAVE soft button to confirm your setting.

F) Connect your Ethernet network to the RJ45 jack on the rear panel of your 5518.

- If you are connecting to a hub or router, use a standard Ethernet cable.
- If you are connecting directly to the Ethernet jack on a computer, use a "crossover" or "reverse" Ethernet cable.

G) Press the *Next* button.

2. Prepare the 5518 for modem connection through the serial port:

[Skip this step if you will not be using a modem connection.]

A) Navigate to *Setup* > NETWORK & REMOTE.

B) Hold down the PC CONNECT soft button and turn the knob until you see MODEM on the display.

C) Press the MODEM INIT soft button.

D) If the string that appears in the display is S0=4, this is correct. Press the *Escape* button and skip steps (E) and (F) below.

> S0=4 is the 5518 default setting. This activates auto-answer functionality in the modem.

E) Set the INIT STRING to S0=4. Use the *Next* and *Prev* KEYs to move the cursor in turn to each character in the modem initialization string. Use the knob to set the character to the desired value. Repeat until you have set all the characters in the initialization string.

F) Press the SAVE soft button to confirm your setting.

3. Modem setup:

You will need two modems and two available phone lines, one of each for your PC and your 5518. Orban Customer Service supports only the 3Com/U.S. Robotics® 56kbps fax modem EXT on the 5518 side of your connection, although other 56kbps modems will often work OK.

You can use either an internal or an external modem with your PC.

A) Connect the telephone line from the wall phone jack to the wall connection icon on the back of the modem (modem in).

B) Connect the modem to the 5518's serial port with a standard (not null) modem cable.

> The cable provided with your 5518 is a null modem cable and will not work.

C) Set the modem to AUTO ANSWER and turn it on.

> For 3Com/U.S. Robotics® 56kbps fax modem EXT, set dipswitches 3, 5, and 8 in the down position to activate the AUTO ANSWER setting. All other dipswitches should be set to the up position.

4. Prepare the 5518 for direct serial connection through the serial port:

[Skip this step if you will not be using a modem connection.]

A) Navigate to *Setup* > NETWORK & REMOTE.

B) Hold down the PC CONNECT soft button and turn the knob until you see DIRECT on the display.

You are now ready to connect your computer to your 5518 through a null modem cable connected to your computer's serial port. Refer to *Installing 5518 PC Remote Control Software on page 2-47*.

Synchronizing 5518 to a Network Time Server

[Skip this section if you do not wish to automatically synchronize your 5518's internal clock to a network timeserver, which may be part of your local network or located on the Internet.]

1. Navigate to SETUP > NEXT > TIME DATE AND ID > NEXT > TIME SYNC.

A) Use the PROTOCOL control to choose either TIME PROT or SNTP.

- Select TIME PROT if the 5518 is behind a firewall that does not pass UPD packets. TIME PROT selects the Time Protocol as described in the standard RFC868. This method uses TCP on port 37.
- Select SNTP if your network timeserver supports the Simple Network Time Protocol as described in standard RFC1769. This method uses UDP on port 123.

Ask your network administrator which protocols are available. SNTP is slightly more accurate.

B) Using SYNC PERIOD, choose how often your 5518 will automatically update its internal clock to the timeserver you selected.

The choices are OFF, 8 HOURS, and 24 HOURS.

> If the connection to the timeserver fails (due to network overload or other problems), your 5518 will try once per hour to synchronize until it is successful.

C) Set the OFFSET to the difference (in hours) between your time zone and Universal Time (UTC).

UTC is also known as GMT, or Greenwich Mean Time.

- The value can range between –12 and +12 hours in increments of 30 minutes. If this value is set to 0, your 5518's time will be the same as UTC.
- You can empirically adjust this value until the correct time for your location is displayed after you synchronize your 5518 to a timeserver.

2. Choose a timeserver.

http://tf.nist.gov/tf-cgi/servers.cgi# provides a current list of timeservers available on the Internet. You network may also have a local timeserver; ask your network administrator.

3. Press the NEXT button to set up timeserver parameters.

The TIME SERVER button is located on the second page of the TIME SYNC functions. (You can access this function from anywhere in the 5518 menu tree by navigating to *Setup* > *Next* > TIME DATE AND ID > *Next* > TIME SYNC > *Next*.)

You can specify the timeserver either from your 5518's front panel or from its PC Remote software. From the front panel, you can only enter the timeserver's IP address (for example, 192.43.244.18). If you specify the timeserver from PC Remote, you can specify either its named address (for example, time.nist.gov) or its IP address. The PC Remote method is easier.

4. Specify the time sync parameters from your 5518's front panel:

[Skip this step if you wish to specify the timeserver and time sync parameters from your Windows XP computer.]

A) Press the TIME SERVER button.

The timeserver IP Address Screen appears.

a) Use the *Next* and *Prev* keys to move the cursor in turn to each digit in the IP address. Use the knob to set the digit to the desired value. Repeat until you have selected all the numbers in the desired IP address.

b) Press the SAVE soft button to confirm your setting.

B) Press the SYNC NOW soft button to test your settings. Your 5518's display should indicate that it is connecting to the IP address that you specified. When the connection is successful, the 5518's clock will automatically synchronize to the timeserver.

- If the connection is not successful within five seconds, the display will indicate that the connection failed. This means either that the timeserver is too busy or that your setup cannot connect to the timeserver. Double-check the IP address. If you are behind a firewall, make sure that port 123 is open.

- If your connection failed, the gateway address might not be set correctly on your 5518. The gateway address for the timeserver connection is the same gateway address that you set in step (1.D) on page 2-43. If you do not know the correct gateway address, you can often discover it by connecting a Windows computer to the same Ethernet cable that is ordinarily plugged into your 5518. Ascertain that the computer can connect to the Internet. At the command prompt, type `ipconfig`. The computer will return the "Default Gateway."

5. Specify the time sync from the 5518 PC Remote software:

[Skip this step if you wish to specify the timeserver and time sync parameters from your 5518's front panel.]

5518 PC Remote software can automatically set your 5518's local time, OFFSET, and TIME SERVER to reflect the Windows settings in the machine running PC Remote software.

> If you are running Windows 2000, you cannot specify the timeserver from your computer. However, you can still set your 5518's clock and offset.

A) In Windows, navigate to the CONTROL PANEL > DATE AND TIME > TIME ZONE tab.

B) Set time zone to correspond to your local time zone.

C) In Windows, navigate to the CONTROL PANEL > DATE AND TIME > INTERNET TIME tab.

D) If you are running Windows XP:

a) Check "Automatically synchronize with an Internet time server" to set your 5518's SYNC PERIOD to "24."

b) Set "Server" to the desired timeserver.

c) Click the "Update Now" button to synchronize your computer's clock to the selected timeserver. If this is successful, this means that you can connect to the selected timeserver over your network.

- The INTERNET TIME tab is not available in Windows 2000. If you are running 5518 PC Remote on Windows 2000, you must enter the timeserver from your 5518's front panel as an IP address (step 4 on page 2-46).
- If the timeserver you selected in Windows is a named address, not an IP address, the 5518 will resolve it correctly but the IP address that appears in your 5518's display will be 0.0.0.0.
- To use PC Remote to turn off your 5518's automatic synchronization, uncheck "Automatically synchronize with an Internet time server" on your PC. Then click the "Update Now" button on PC Remote.

E) Navigate to 5518 PC Remote's SETUP > UTILITY tab and click the SET 5518 CLOCK button.

- If you are running Windows XP, PC Remote will download your computer's currently specified timeserver into your 5518.
- PC Remote will adjust your 5518's OFFSET setting to correspond to your computer's time zone setting.
- PC Remote will synchronize your 5518's clock with your computer's clock.

F) It is wise to disconnect from PC Remote and then to press the SYNC NOW button on your 5518 [step (4.B) on page 2-46]. This is to test the ability of your 5518 to synchronize to the selected timeserver and to ensure that your 5518's clock is set accurately.

NOTE: Manually setting your 5518's clock via Set Time, Set Date, Daylight Time, and the remote contact closure Reset to Hour and Reset to Midnight will not work when the automatic synchronization function is active. To inactivate this function (thereby permitting manual setting to work), set the SYNC PERIOD to OFF.

Installing 5518 PC Remote Control Software

This section briefly summarizes the procedure for installing 5518 PC Remote software on existing 5518s. If required, you will find more detailed instructions in the

.pdf file automatically installed on your computer by Orban's installer program, `Setup5518_x.x.x.x.exe`, where "x.x.x.x" represents the software version you are installing. (For example, for version 1.0 software, this would be 1.0.0.0.)

The PC Remote software is supplied on a CD shipped with your 5518. You can also download it from `ftp.orban.com/5518/Software`.

Instructions for using the PC Remote software begin on page 3-8.

Installing the Necessary Windows Services

The 5518 PC Remote application uses Windows' built-in communications and networking services to deal with the low-level details necessary to communicate with the 5518's serial port. (These services are also used to upgrade your 5518's firmware when updates are available from Orban.) The exact process will vary, depending on how you wish to set up the communications. That is:

If you want to communicate through a local PC, you will need to establish a connection between a serial (COM) port of the PC and the COM port of your 5518 through a null modem cable (supplied with your 5518). You will then use Windows Direct Serial Connect to make the basic connection.

If you want to communicate through a pair of modems, you will use the Windows Dial-Up networking service to make the connection.

You must install the appropriate communications services in Windows (if they are not already installed) before you can run 5518 Remote software. *You may therefore need to have access to the Windows install disk(s) — or have their image copied onto your computer's hard drive — before you attempt to use the 5518 PC Remote application*.

> In all cases, regardless of whether your PC communicates to the 5518 through its serial port or Ethernet connector, it uses the ppp and the TCP/IP protocols to communicate with the 5518.

Check Hardware Requirements

To connect your PC to your 5518, regardless of the method you choose, you will need the following:

Orban 5518.

If connecting by serial cable: a null modem cable (also called a "reverse" cable). This cable has DB9 female connectors at both ends for connecting the 5518 to the serial port on your computer. If your computer has a DB25 connector, you will need to obtain an adapter.

If connecting by modem: a 3Com/U.S. Robotics® 56kbps fax modem EXT and normal (not null) modem cable for the 5518 side of the connection. Note that Orban Customer Service does not support any other type of modem for connecting to the 5518.

If connecting by network: a standard Ethernet cable (with RJ45 connectors) to connect to a network hub or router, or a crossover Ethernet cable to connect directly to your PC's Ethernet jack.

PC running Windows 2000 (SP3 or higher)/XP/Vista/7.

5518 PC Remote will not run on older Windows versions.

Recommended Components

Computer	Pentium II or higher
Available Disk Space	25MB
RAM	Depends on your computer's OS
Display	SVGA or higher
Microsoft Windows	2000 (SP3 or higher)/XP/Vista/7
COM Port	16550 (or compatible) UART

WARNING!

When connecting your 5518, use shielded cable to protect the pins in the RS-232 connector from electrostatic discharge.

The following subsections provide steps for connecting to your 5518 software using the Windows 2000/XP Direct Cable Connect or via modem connection.

Running the Orban Installer Program

Insert the installer CD into your computer's CD drive.

The installer should start up and ask you if you wish to install the PC Remote application on your computer. If it fails to do so, navigate to Start \ Run on your computer, and type `X:setup` (where "X" is the drive letter of your CD drive).

Follow the prompts on your screen to install the PC Remote software automatically on your computer.

- You might have obtained the automatic installer application from some other source than Orban's CD, like Orban's ftp site or another computer on your network. If so, just run the application and follow the on-screen instructions.
- This program installs the necessary files and adds an Orban/5518 folder to your computer's Start Menu. This folder contains shortcuts to the PC Remote application and to the documentation. If you accepted the option during installation, there is also a shortcut to the PC Remote application on your desktop.

You have now installed all files necessary to use the PC Remote software. If you are using a direct serial or a modem connection, the next step is to install and configure the Windows communications services that allow your computer to communicate with your 5518. *Appendix: Setting Up Serial Communications* on page 2-51 provides details.

Setting Up Ethernet, LAN, and VPN Connections

If you are using an Ethernet connection and your computer can successfully connect to the Internet through its Ethernet port, it already has the correct (TCP/IP) networking set up to communicate with the 5518. In most cases, all you need is your 5518's IP address, Port, and Gateway number, as set in step 1 on page 2-42. You will enter these when you create a "connection" to your 5518 from the 5518 PC Remote application — see step (E) on page 3-9. If your computer does not have a working Ethernet port, you will need to add one and then following the instructions provided by Microsoft to set it up to enable TCP/IP networking.

If you wish to connect to your 5518 through your LAN or VPN (through a WAN or the Internet), consult your network administrator. Note that to cross subnets, you must specify a gateway. If the PC and 5518 are on the same subnet, then it is unnecessary to specify a gateway.

If you are behind a firewall, you must open the port you specified in step (1.E) on page 2-43. If the gateway, port, and firewall (if used) are configured correctly, it is possible to connect 5518 PC Remote to a 5518 via a VPN.

Conclusion

By carefully following the instructions in the Appendix, you should have successfully installed the necessary Windows services and connected to your 5518. However, if you experience any problems with this process, or have any other 5518 questions, please contact Orban Customer Service:

Phone +1 856.719.9900

email: custserv@orban.com

For details on your new 5518 software, from new features to operational suggestions, refer to our FTP site (ftp.orban.com/5518).

Appendix: Setting Up Serial Communications

This appendix provides instructions for setting up both direct serial and modem connections from your 5518 to your PC. You must do this when you define a new connection from the 5518 PC Remote application. The appendix provides procedures for both the Windows 2000 and Windows XP operating systems and can be readily extended by analogy for Windows Vista and 7, although we recommend using Ethernet connections with Vista or 7. Note that the screen shots were prepared using Orban's Optimod-FM 8300 but apply equally well to the 5518.

Preparing for Communication through Null Modem Cable

1. **Configure your 5518.**

   A) On your 5518's front panel, navigate to *Setup* > NETWORK & REMOTE.

   B) Hold down the PC CONNECT soft button and turn the knob until you see DIRECT on the display.

2. **Connect the cable.**

   A) Connect one end of the null modem cable that we supplied with your 5518 to the DB9 serial connector on the 5518's rear panel.

   Be sure to use a null modem cable. A normal serial cable will not work.

   B) Connect the other end of the cable to your computer's COM port.

Connecting Using Windows 2000 Direct Serial Connection:

Ordinarily, a direct serial connection through a null modem cable is used only when you are controlling one 5518 per available COM port on your computer. If you wish to control multiple local 5518s, it is better to use an Ethernet network connection. However, in principle you could control multiple 5518s serially from one COM port, using a hardware serial switch to select the 5518 you wish to control. In this case, you should set up a separate 5518 "connection" for each 5518 to be controlled, following the instructions below. All connections should reference the same COM port.

This connection is used both for upgrading your 5518 and for connecting the 5518 PC Remote application to your 5518.

Important: The Direct Serial Connection must have exclusive access to the PC COM port that connects to your 5518. Make sure than any software that monitors this COM port (such as HotSync manager, etc) is disabled before running Direct Serial Connection.

If you have already configured your direct serial cable connection, skip to step 2 on page 2-56.

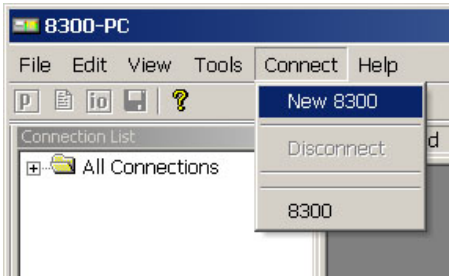
If you cannot access the Internet after making a Direct or Modem connection, you will have to reconfigure certain networking parameters in Windows. Please see *You Cannot Access the Internet After Making a Direct or Modem Connection of the 5518* on page 5-6.

1. Add and configure a Direct Connection for Windows 2000:

A) Create a New Windows 2000 Direct Connection:

a) Launch 5518 PC Remote.

b) Choose "Connect > New 5518"

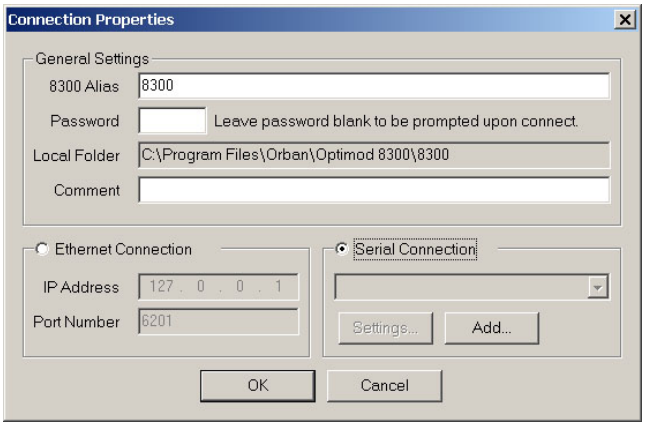


c) Give your 5518 a name (e.g., "KABC") by entering this name in the "5518 Alias" field.

d) If you wish to have 5518 PC Remote remember the password for this Optimod, enter the pass-word in the "Password" field.

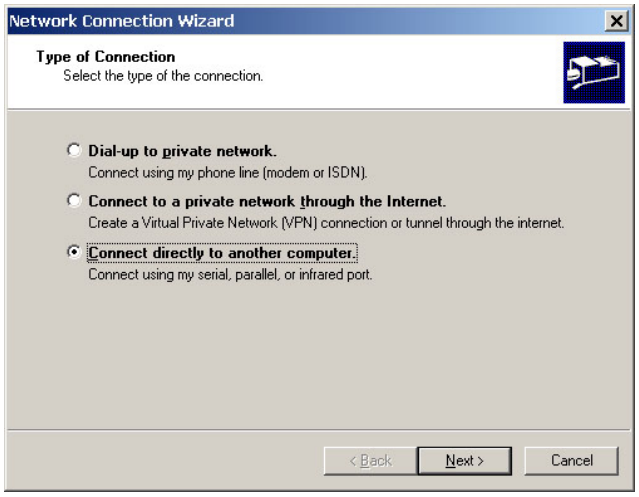
e) Select "Serial Connection."

f) Click "Add."



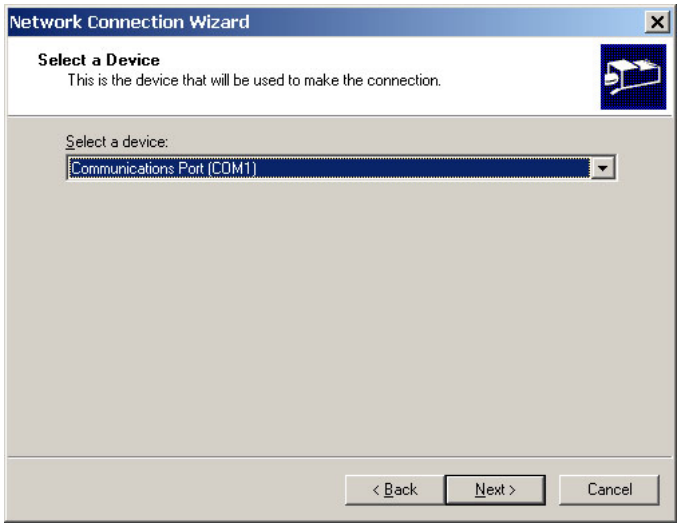
g) Select "Connect Directly to another computer."

h) Click "Next."



i) In the drop-down box, select the serial port you will be using to make the connection.

j) Click "Next."

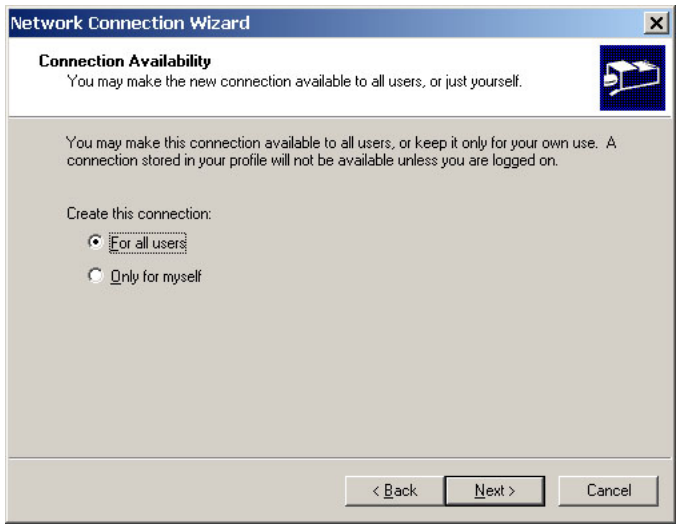


k) Select either "For all users" or "Only for myself."

The correct setting depends on how your network and security are configured.

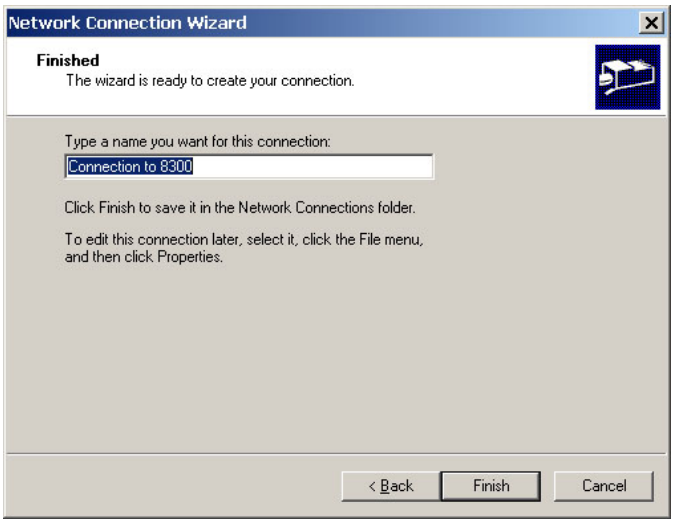
Your wizard may not display this field if your computer is set up for a single user only.

l) Click "Next."

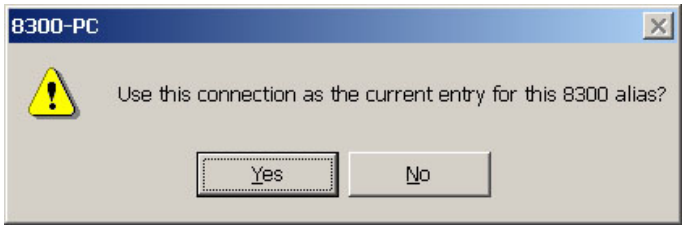


m) Enter a name for your Connection such as: "Connection to 5518."

n) Click "Finish."

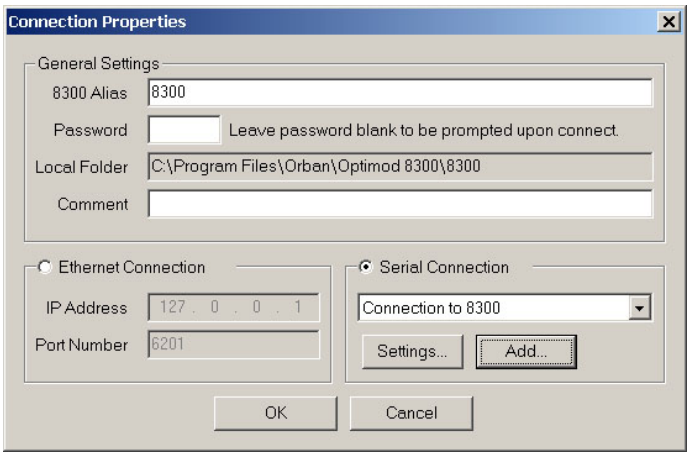


o) Click “Yes.”



B) Edit your new Direct Connection properties:

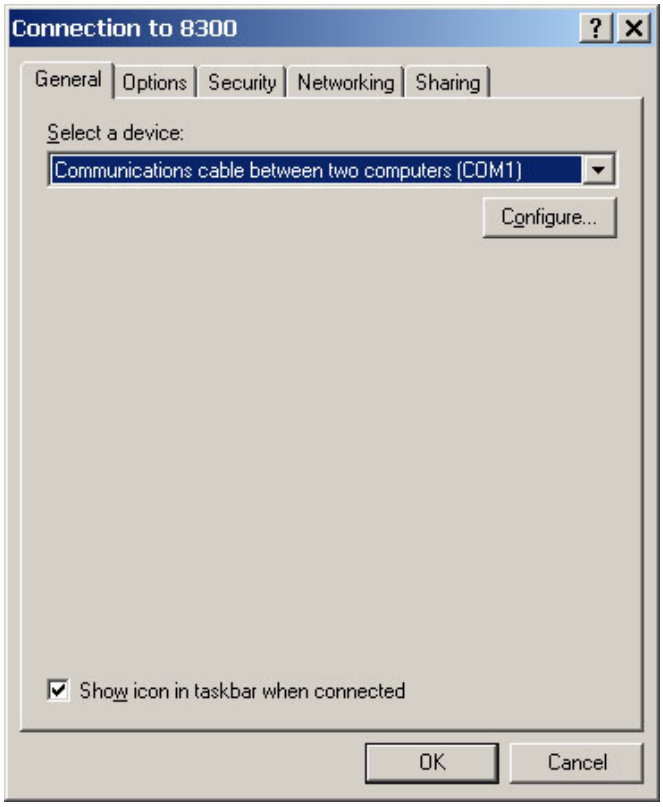
a) Click “Settings.”



b) Click the “General” tab.

c) Select the device you set up in step (i) on page 2-53. This will usually be “Communications cable between two computers (COM1).”

d) Click “Configure.”

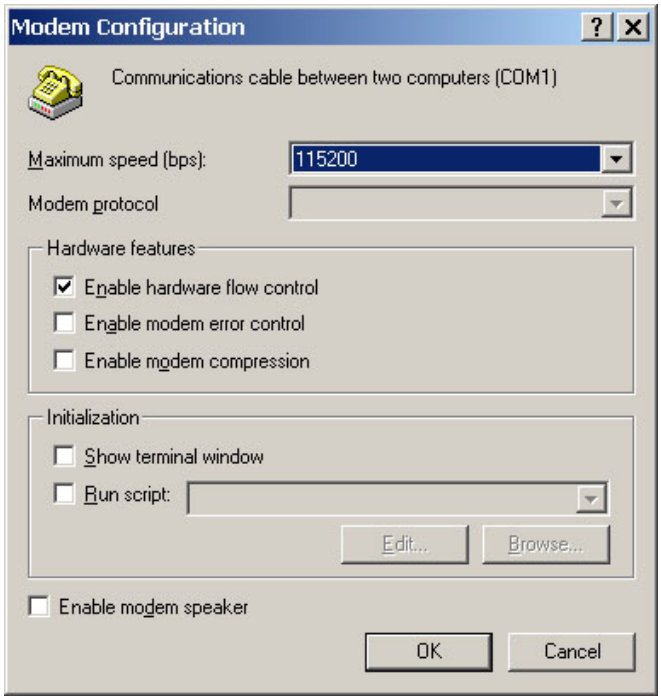


e) Set "Maximum speed (bps)" to "115200."

f) Check "Enable hardware flow control."

g) Make sure that all other boxes are not checked.

h) Click "OK."



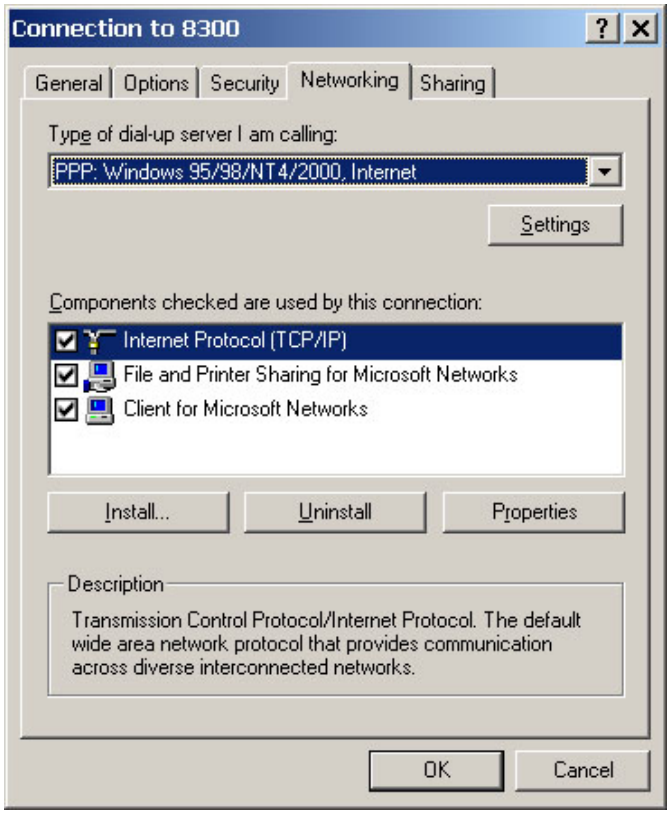
i) Select the Networking tab.

j) Make sure that "PPP: Windows 95/98/NT 4/2000, Internet" appears in the "Type of dial-up server I am calling" field.

k) Make sure that "Internet Protocol (TCP/IP) is checked.

You may leave "File and Printer Sharing for Microsoft Networks" and "Client for Microsoft Networks" checked if you like.

l) Click "OK."



When the "Connection properties" window appears, click "OK."

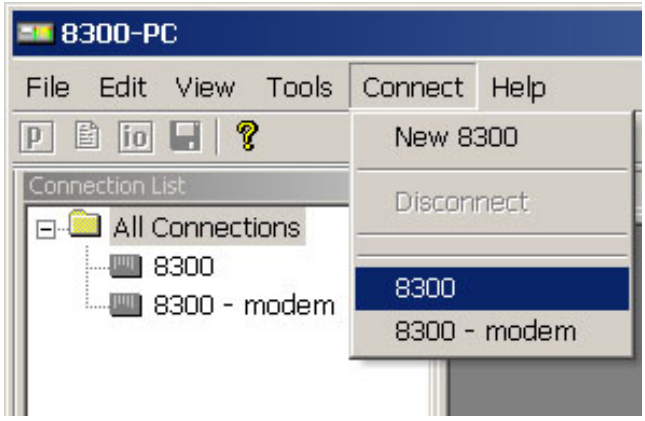
2. Launch an existing Windows 2000 Direct connection.

Once you have set up a "connection" specifying Direct Connect in the 5518 PC Remote application (see *To set up a new connection* on page 3-9), choosing this connection from 5518 PC Remote automatically opens a Windows Direct Connection to your 5518.

You can connect by selecting the desired connection from the drop-down list in the CONNECT menu.

You can also connect by double-clicking the connection in the "Connection List" window.

A dialog bubble will appear on the bottom right hand corner of the screen verifying your connection if the connection is successful.



If you have trouble making a connection, refer to *OS Specific Troubleshooting Advice: Troubleshooting Windows 2000 Direct Connect* on page 5-6. If you have trouble the first time after creating a connection according to the instructions above, try restarting your computer to clear its serial port.

3. To change the properties of an existing connection:

Right-click the connection in the "connection List" window and choose "Properties." The "Connection properties" window opens (see page 2-52).

Connecting Using Windows XP Direct Serial Connection

If you have already configured your direct serial cable connection, skip to step 2 on page 2-60.

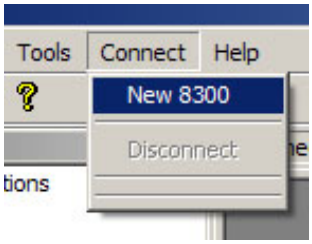
If you cannot access the Internet after making a Direct or Modem connection, you will have to reconfigure certain networking parameters in Windows. Please see *You Cannot Access the Internet After Making a Direct or Modem Connection to the 5518* on page 5-6.

1. Add and configure a Direct Connection for Windows XP:

A) Create a New Windows XP Direct Connection:

a) Launch 5518 PC Remote.

b) Choose "Connect > New 5518"

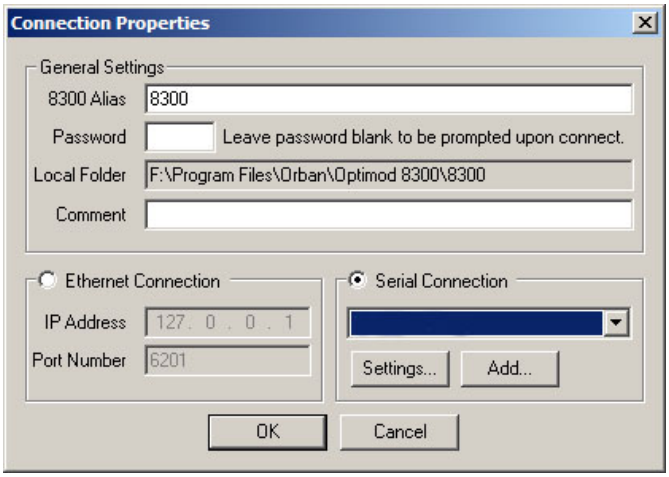


c) Give your 5518 a name (e.g., "KABC") by entering this name in the "5518 Alias" field.

d) If you wish to have 5518 PC Remote remember the password for this Optimod, enter the password in the "Password" field.

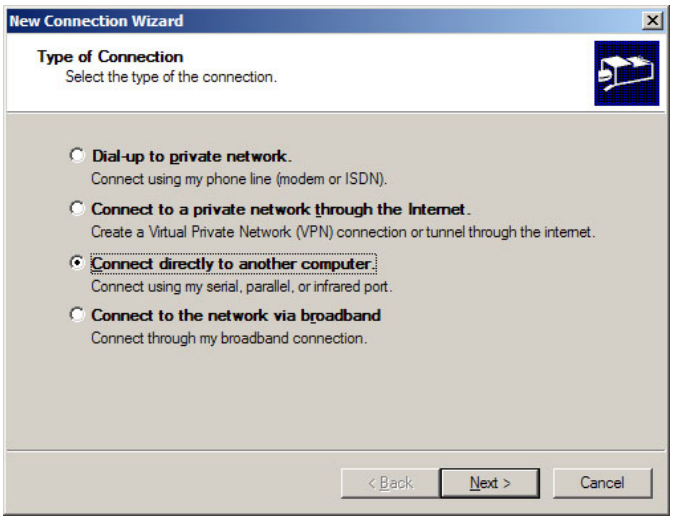
e) Select "Serial Connection."

f) Click the "Add" button.



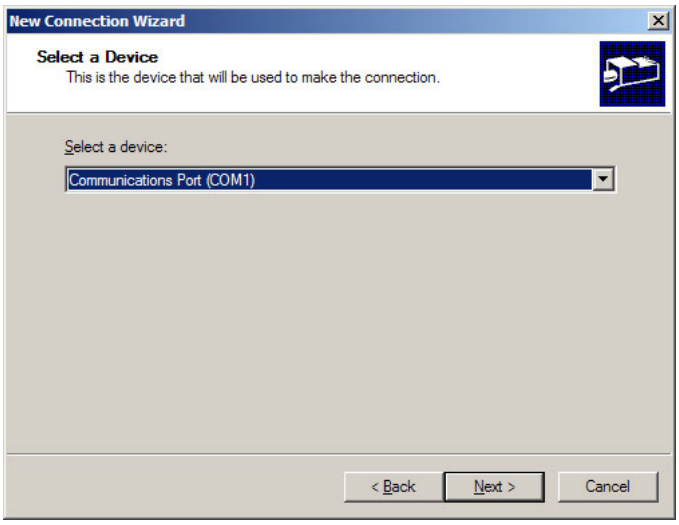
g) Choose "Connect directly to another computer."

h) Click "Next."



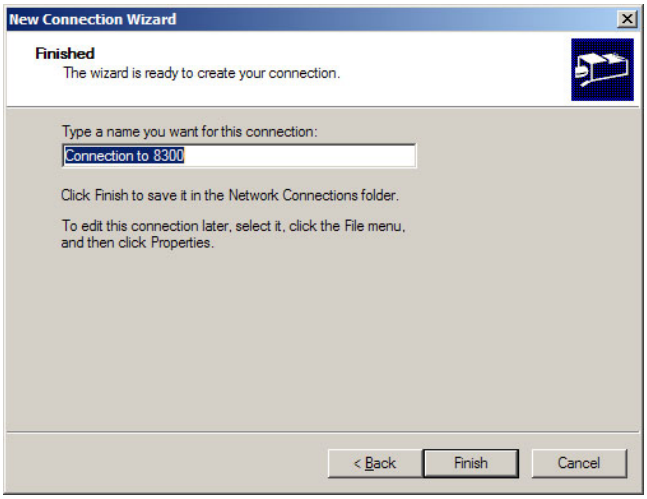
i) In the drop-down box, select the serial port you will be using to make the connection.

j) Click "Next."

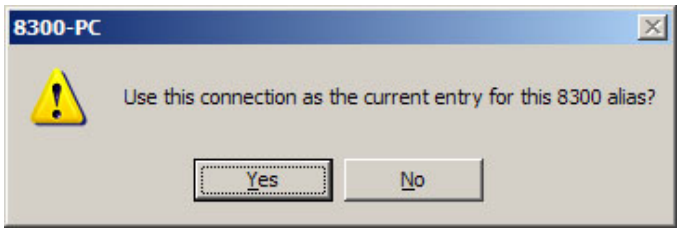


k) Type in a name for your Connection such as: "Connection to 5518."

l) Click "Finish."

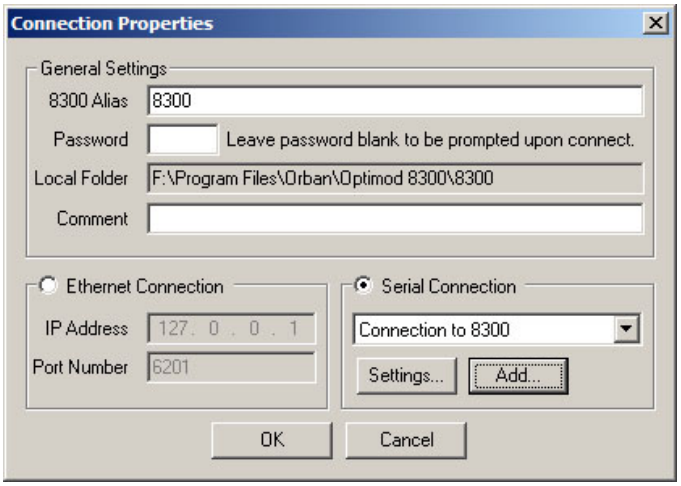


m)Click "Yes."



B) Edit your new Direct Connection properties:

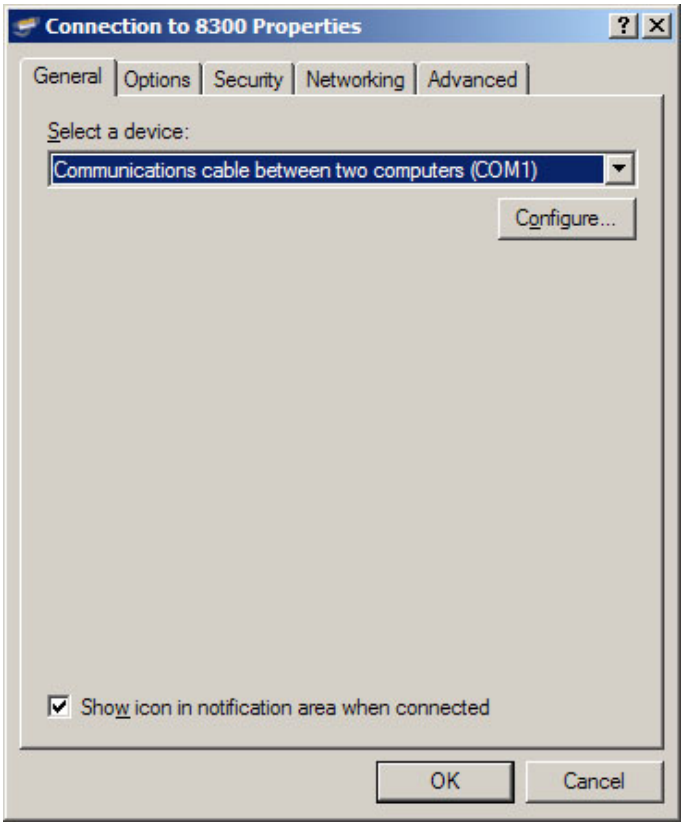
a) Click "Settings."



b) Click the "General" tab.

c) Select the device you set up in step (i) on page 2-57. This will usually be "Communications cable between two computers (COM1)."

d) Click "Configure."

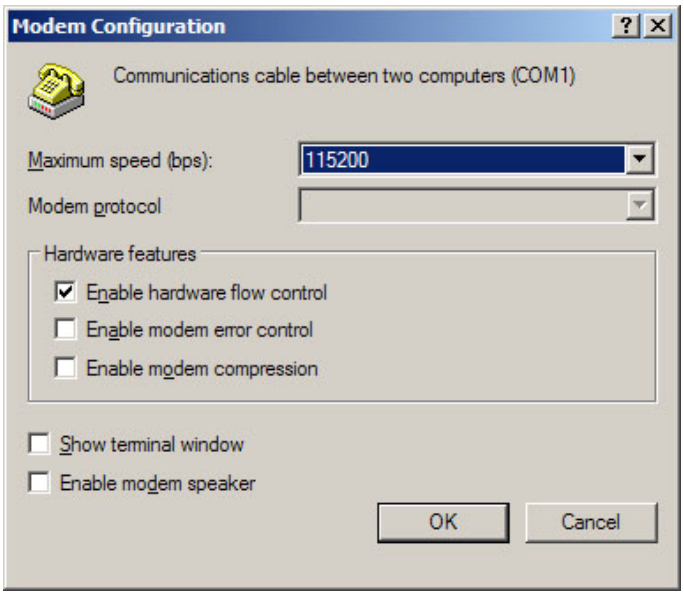


e) Set the "Maximum Speed (bps)" to 115200.

f) Check "Enable hardware flow control."

g) Make sure all other hardware features are unchecked.

h) Click "OK."



i) Select the Networking tab.

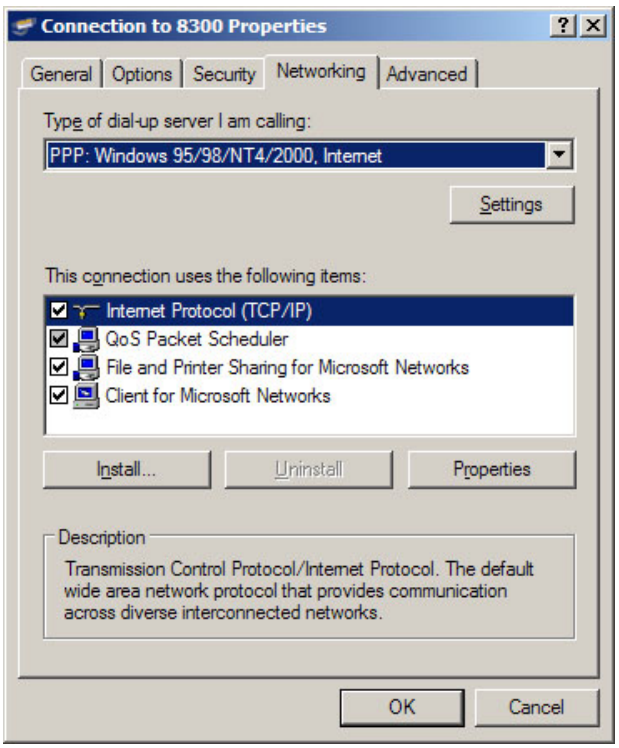
j) Make sure that "PPP: Windows 95/98/NT 4/2000, Internet" appears in the "Type of dial-up server I am calling" field.

k) Make sure that "Internet Protocol (TCP/IP) is checked.

You may leave "File and Printer Sharing for Microsoft Networks" and "Client for Microsoft Networks" checked if you like

l) Click "OK."

m) When the "Connection properties" window appears, click "OK."



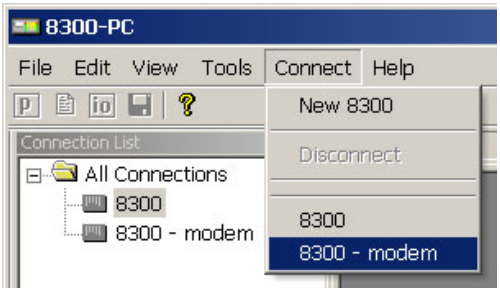
2. Launch an existing Windows XP Direct connection.

Once you have set up a "connection" specifying Direct Connect in the 5518 PC Remote application (see *To set up a new connection* on page 3-9), choosing this connection from 5518 PC Remote automatically opens a Windows Direct Connection to your 5518.

You can connect by selecting the desired connection from the drop-down list in the CONNECT menu.

You can also connect by double-clicking the connection in the "Connection List" window.

A dialog bubble will appear on the bottom right hand corner of the screen verifying your connection if the connection is successful.



If you have trouble making a connection, refer to *Troubleshooting Windows XP Direct Connect* on page 5-9. If you have trouble the first time after creating a connection according to the instructions above, try restarting your computer to clear its serial port.

3. **To change the properties of an existing connection:**

   Right-click the connection in the “connection List” window and choose “Properties.” The “Connection properties” window opens (see page 2-52).

Connecting Using Windows 7 Direct Serial Connection:

You must install the Windows 7 direct serial connection as a modem device using the Modem setup procedures as shown in the steps below.

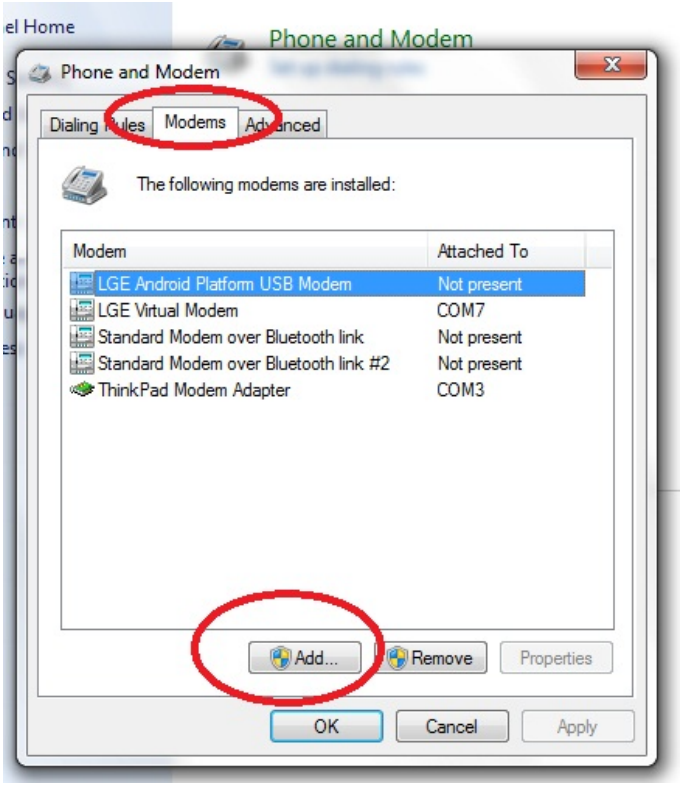
1. **Add and configure a Direct Connection for Windows 7.**

   A) Go to the Control Panel. Find the Modem applet. This is normally under the Phone and Modem section.

   Click on it to start the Phone and Modem applet.

B) In the Phone and Modem applet, click on the Modems tab and click "Add."

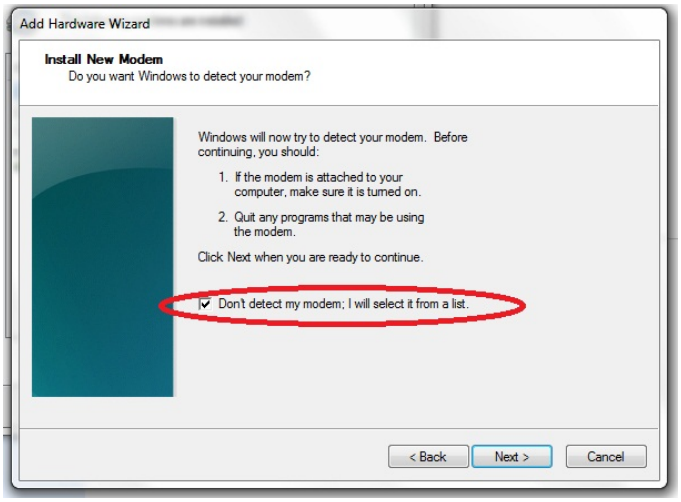
You need administrator's rights to do this. If UAC comes up, provide the relevant credentials and proceed.



C) The Add Hardware Wizard will appear.

a) Tick "Don't detect my modem; I will select it from a list."

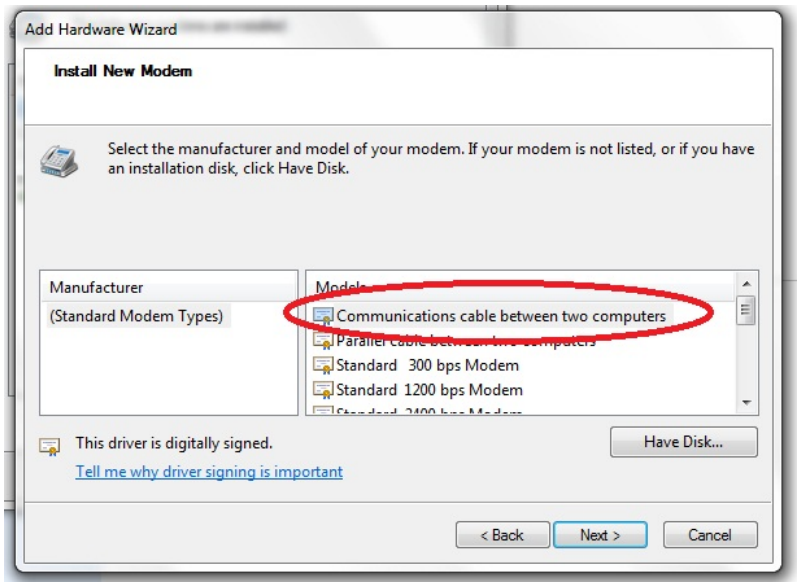
b) Proceed to next step by clicking on the NEXT button.



D) The *Install New Modem* window will appear.

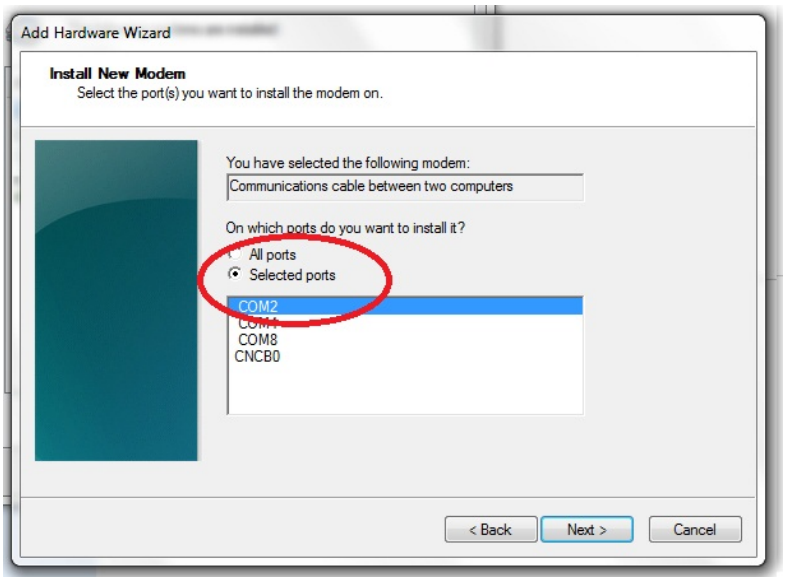
a) Select Communications cable between two computers.

b) Proceed to next step by clicking on the NEXT button.

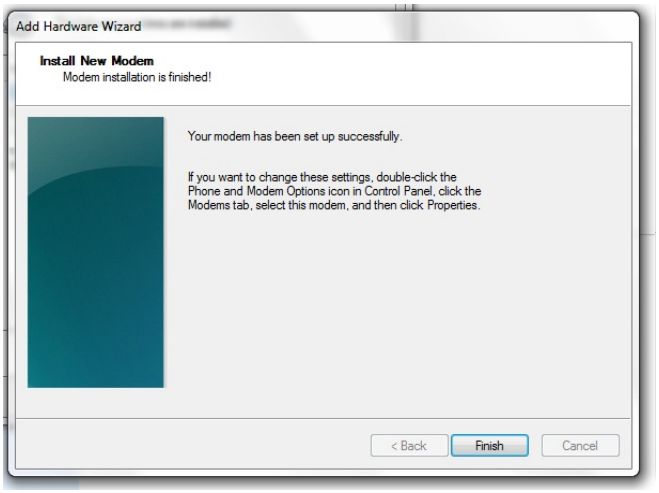


E) Select the Serial com port to which the NULL cable is connected.

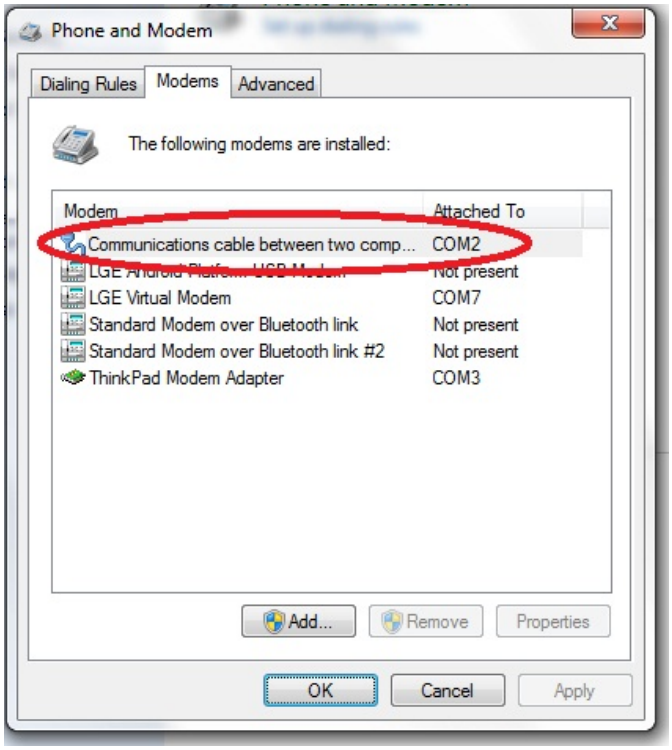
Proceed to next step by clicking on the NEXT button.



F) At the *Modem installation is finished* window, click FINISH to complete the installation.



G) Once you are back at the *Phone and Modem* window, you will see your newly installed communication cable attached to the serial com port that you specified earlier.



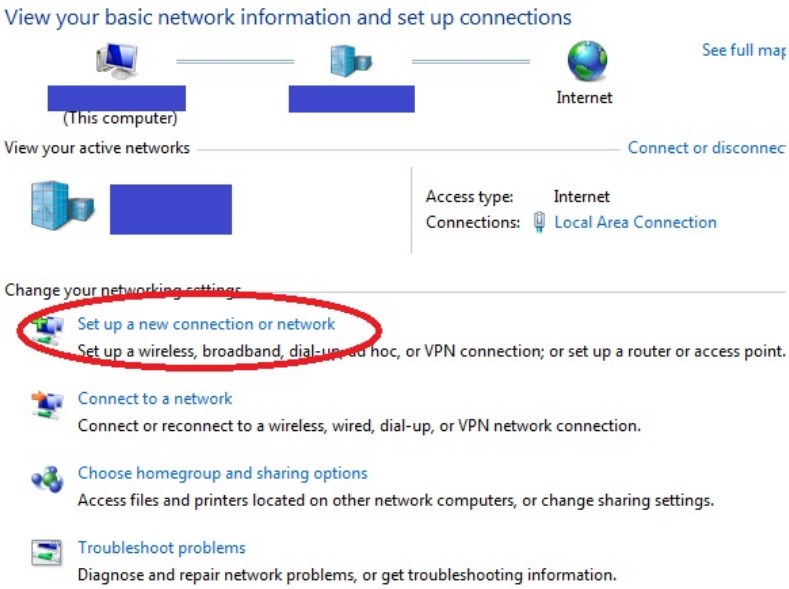
This completes the installation of the device driver for the device "Communications cable between two computers." This configuration is also commonly known as "Direct Cable Communications."

2. Set up the Network for the Direct Cable Connection.

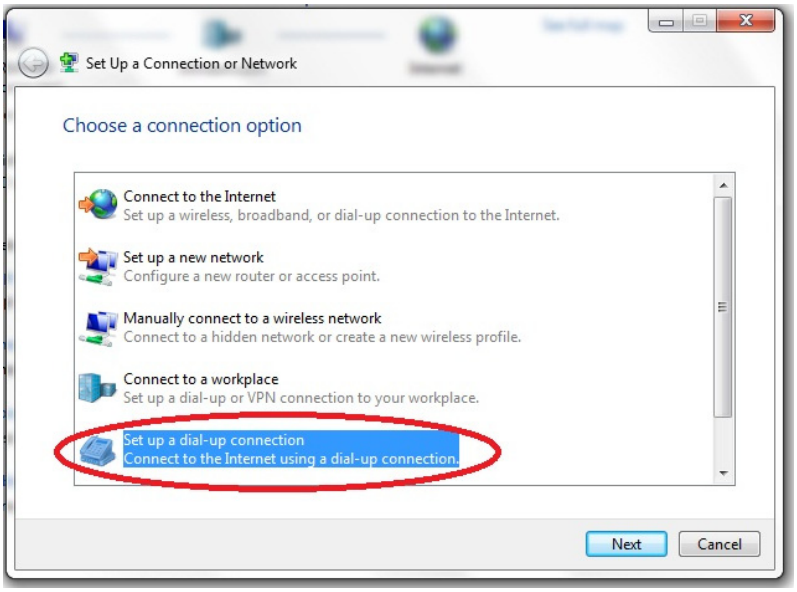
You must next bind the Direct Cable Connection driver to a particular Network. This is where Microsoft will make this connection using the PPP protocol.

It will do this for you automatically. Previous Windows version requires you to install the PPP protocol separately.

A) Go to the Network and Sharing Center and click on Set up a new connection or network link.

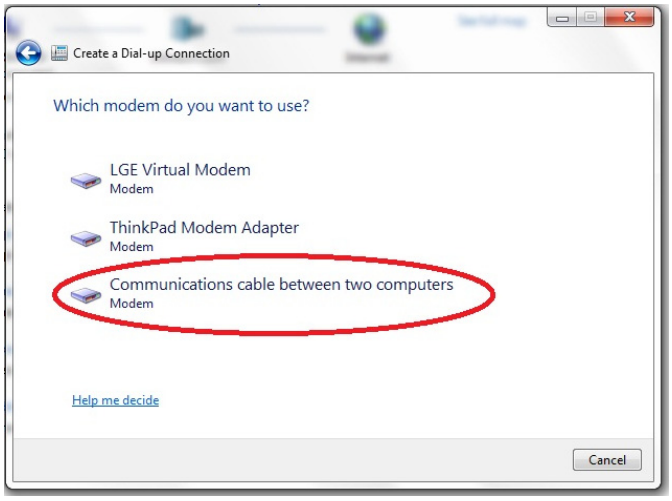


B) In the Choose a connection option window, select Set up a dial-up connection.



C) If you are asked Which modem do you want to use?, select Communications cable between two computers/modem.

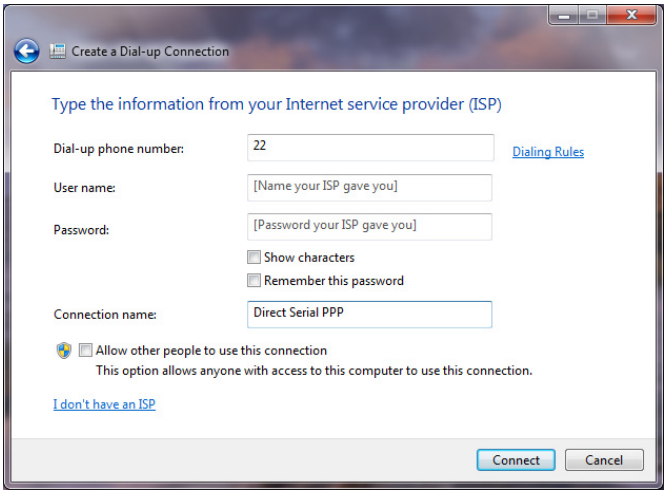
This only query will open appear if you have configured more than one modem device.



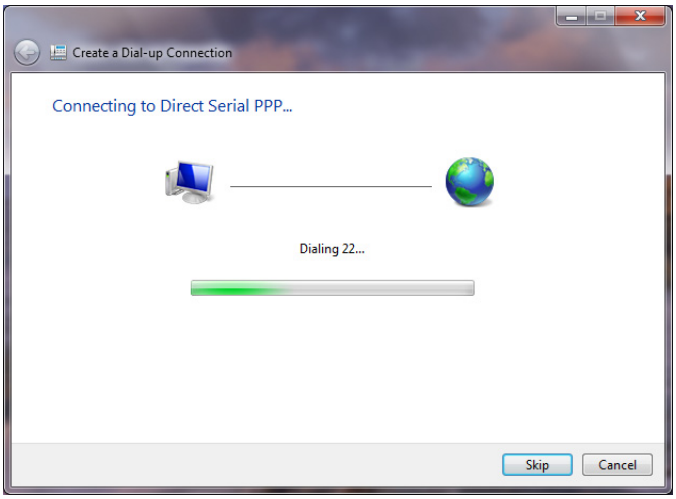
D) When prompted to "Type the information from your Internet Service Provider," enter a dummy number to the phone number field; Windows will not use it.

E) Choose a name for your connection and enter it into the *Connection name:* box. Choose a name that will remind you that this is a PPP connection, such as "Direct Serial PPP."

F) Proceed to next step by clicking on the CONNECT button.

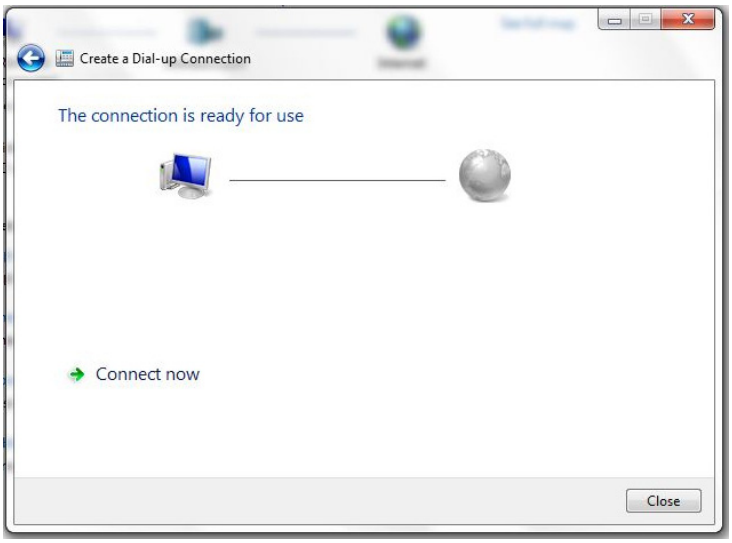


G) Click the SKIP button.



Windows will emit a message stating *The connection is ready for use*. However, you must to configure some of the PPP settings before you can make a connection to your Optimod

Although you did not specifically install anything that states "PPP," the PPP protocol has nevertheless been installed.



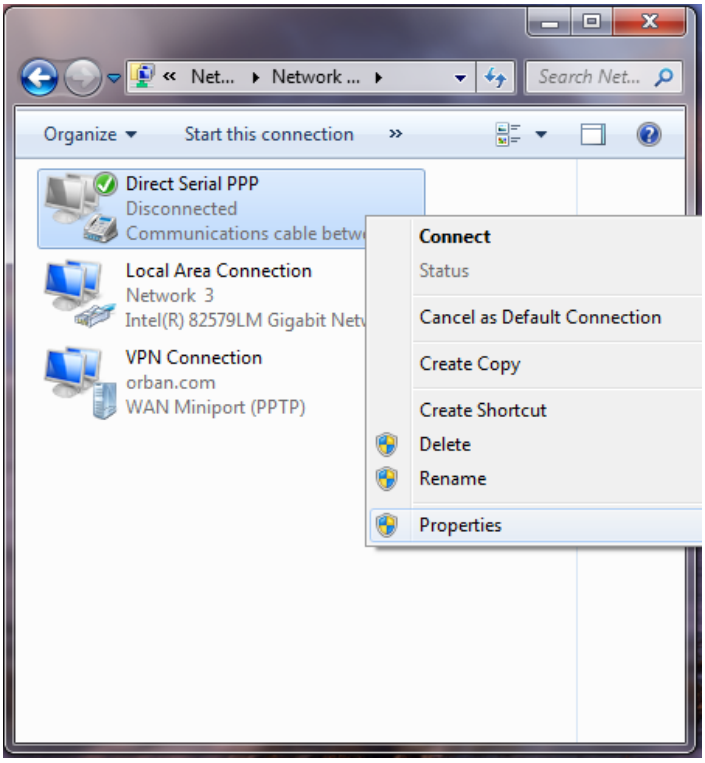
3. Configure the Direct Cable Connection adapter.

In this step, you will customize the PPP settings on Windows 7 so that it can talk to your Optimod.

A) Go to the Windows 7 Network and Sharing Center and click the *change adapter settings* link. This is on the left side of the window.

B) In the *Network adapter* window, right-click the *Direct Serial PPP* icon and click on the properties.

You need administrator rights to proceed from here. If UAC comes up, provide the relevant credentials and continue.



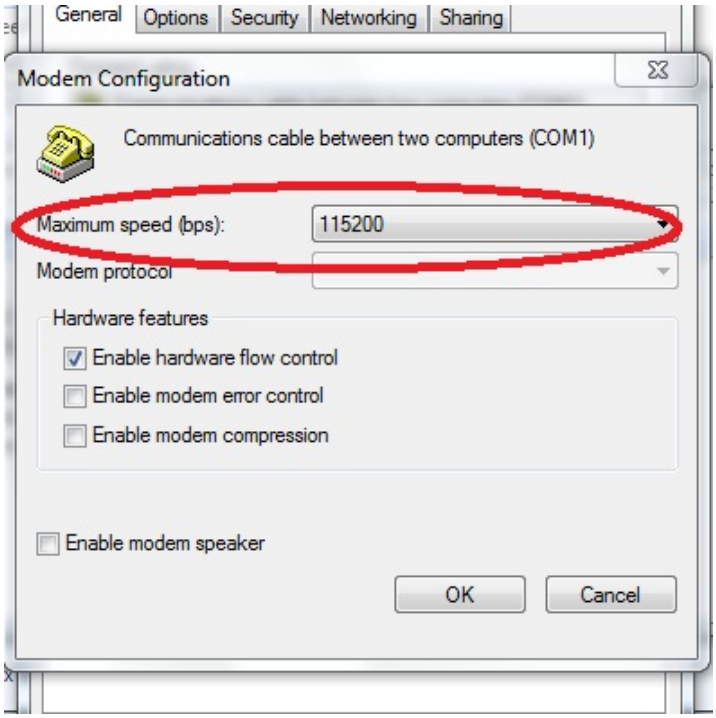
C) In the Direct Serial PPP Properties window, select the General tab.

D) Click the Configure button and select 115200 bps.

E) Click OK to close the window.

F) Make sure your bps settings saves correctly:

a) Dismiss the Direct Serial PPP Properties window by selecting OK.



b) Reopen the Properties window and select the General tab again. If your bps setting is correct, the value has saved and you may skip to step (G) below.

c) If it is not correct, reset it to 115200 bps.

d) Click OK to close the window.

e) Click OK to dismiss the Properties window.

f) Restart your computer.

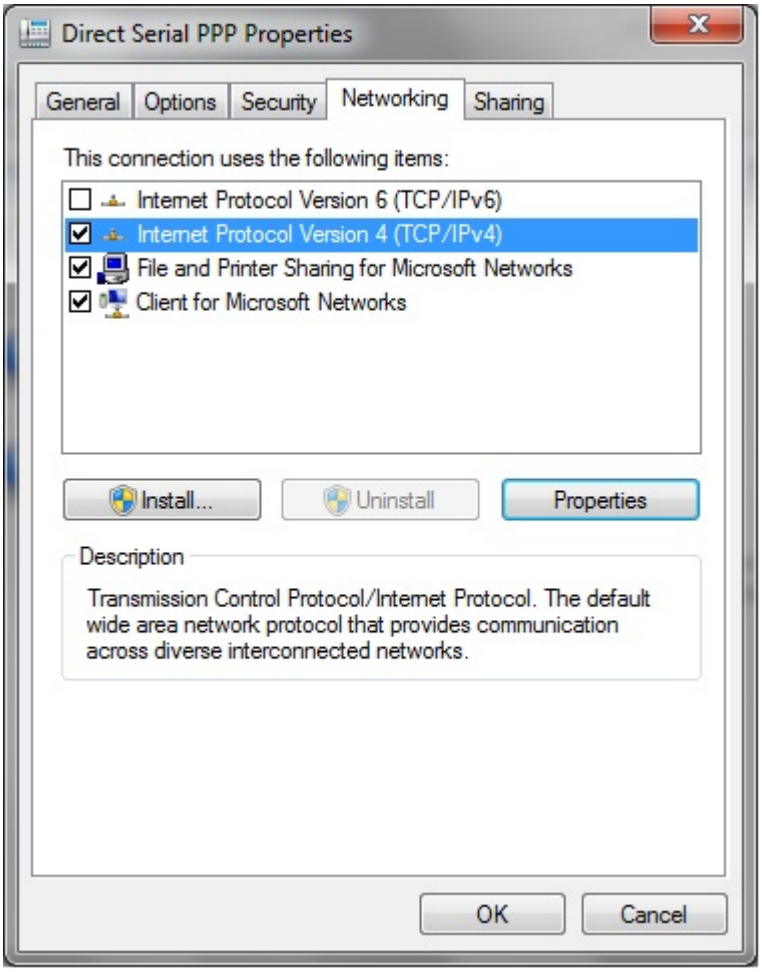
Restarting should ensure that the bps setting is saved.

G) Select the Networking tab.

a) Unselect the Internet Protocol Version 6.

b) Click on the Internet Protocol Version 4.

c) Click the *Properties* button.



H) In the *Advance TCP/IP Settings* window, click on the *Advance* button.

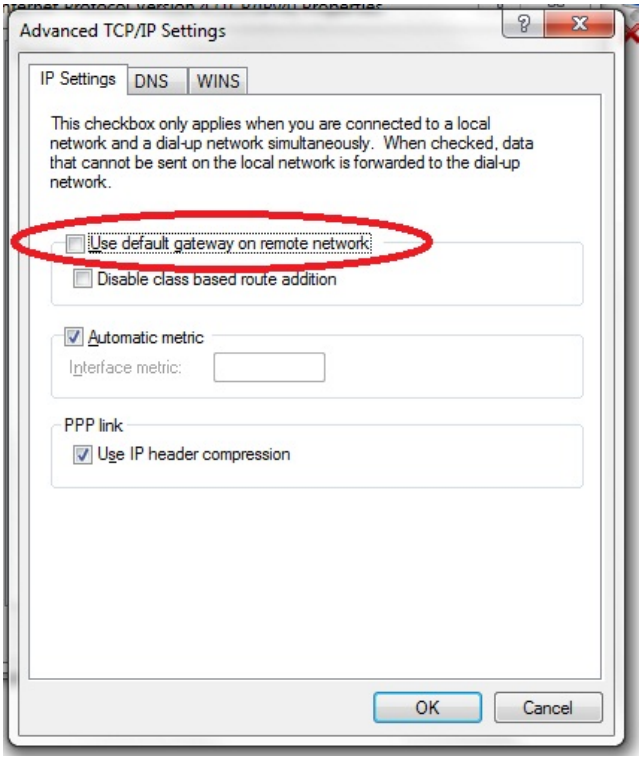
a) Unselect Use default gateway on remote network.

b) Click OK to close this window.

This prevents Windows 7 from routing all networking requests to your Optimod.

c) Click OK to close the Internet Protocol version 4 Properties window.

d) Click OK at the *Direct Serial PPP Properties* window to save the *Direct Serial PPP* settings.



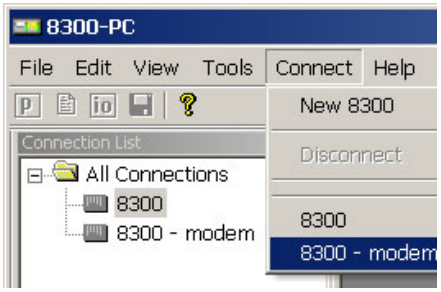
4. Launch an existing Windows 7 Direct connection.

Once you have set up a "connection" specifying Direct Connect in the 5518 PC Remote application (see *To set up a new connection* on page 3-9), choosing this connection from 5518 PC Remote automatically opens a Windows Direct Connection to your 5518.

You can connect by selecting the desired connection from the drop-down list in the CONNECT menu.

You can also connect by double-clicking the connection in the "Connection List" window.

A dialog bubble will appear on the bottom right hand corner of the screen verifying your connection if the connection is successful.



If you have trouble making a connection, double-check step (3.F) on page 2-68. If you have trouble the first time after creating a connection according to the instructions above, try restarting your computer to clear its serial port.

5. To change the properties of an existing connection:

Right-click the connection in the "connection List" window and choose "Properties." The "Connection properties" window opens (see page 2-52).

Preparing for Communication through Modems

1. **Prepare your 5518 for a modem connection through the serial port.**

   See step 2 on page 2-43.

2. **If you have not already done so, create an 5518 passcode.**

   See *To Create a Passcode* on page 2-31.

3. **Modem setup:**

You will need two modems and two available phone lines, one of each for your PC and your 5518.

> Reminder: Orban supports only the 3Com / U.S. Robotics® 56kbps fax modem EXT on the 5518 side (although other 56kbps modems will often work OK).

Connect the modem to the 5518's serial port with a standard (not null) modem cable. The cable provided with your 5518 is a null modem cable and will not work.

You can use either an internal or an external modem with your PC.

A) Connect the telephone line from the wall phone jack to the wall connection icon on the back of the modem (modem in).

B) Connect the modem cable from the modem to the serial port of the 5518.

C) Set the modem to AUTO ANSWER and turn it on.

> For 3Com / U.S. Robotics® 56kbps fax modem EXT, set dipswitches 3, 5, and 8 in the down position to activate the AUTO ANSWER setting. All other dipswitches should be set to the up position.

Connecting Using Windows 2000 Modem Connection

This connection is used both for upgrading your 5518 and for connecting the 5518 PC Remote application to your 5518.

1. **Add and configure modem for Windows 2000:**

If your modem is already installed, skip to Launch a Windows 2000 Modem connection *on page 2-76.*

A) Install Windows 2000 modem:

Use either an internal modem or external modem with your computer.

a) If you are using an external modem, connect the modem to a serial port on your PC and make sure the modem is connected to a working phone line.

b) On your PC, click "Start / Settings / Control Panel / Phone and Modem Options."

c) Click the "Modems" tab.

d) Verify that your modem appears in the list available under "The following Modems are installed."

e) Verify that your modem is "Attached to" the correct port.

If your modem is unavailable or not attached to the correct port, you will need to Add it. See your Windows documentation.

f) If your modem is available in the list available under "The following Modems are installed" and it is attached to the correct port, then click "Properties" for that modem.

g) Make sure the port speed is set at 115200.

h) Click "OK."

B) Create a New Windows 2000 Dial-Up Connection:

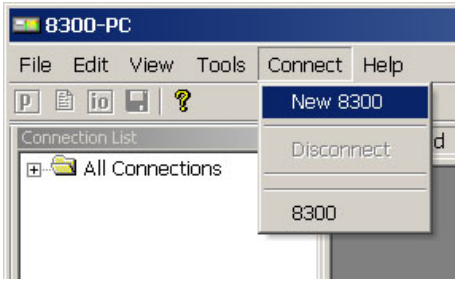
a) Click "Start / Settings / Network and Dial-up Connections / Make New Connection."

b) Once the New Connection Wizard has opened, Click "Next."

C) Create a New Windows 2000 Direct Connection:

a) Launch 5518 PC Remote.

b) Choose "Connect / New 5518"

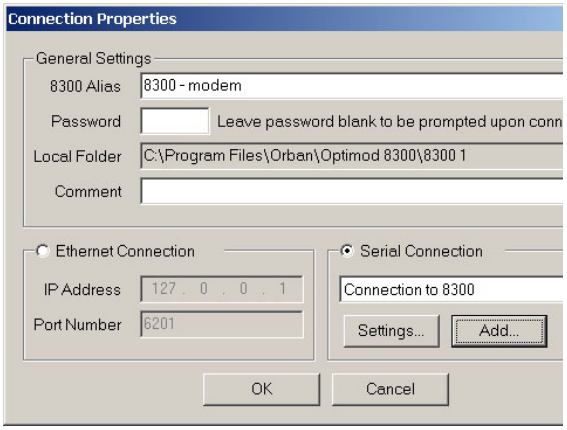


c) Give your 5518 a name (e.g., "KABC") by entering this name in the "5518 Alias" field.

d) If you wish to have 5518 PC Remote remember the password for this Optimod, enter the password in the "Password" field.

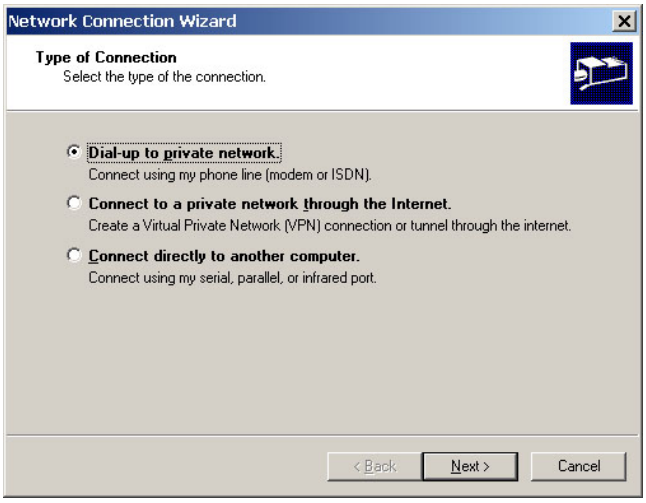
e) Select "Serial Connection."

f) Click the "Add" button.



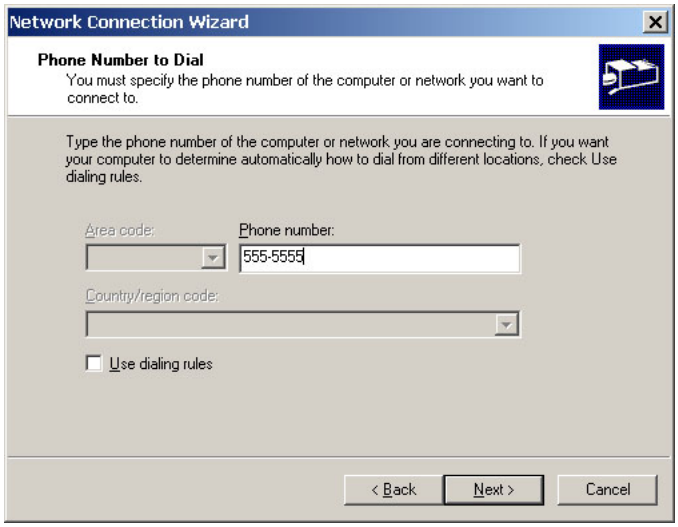
g) Select “Dial-up to private network.”

h) Click “Next.”



i) Enter the phone number of the modem connected to the 5518 that you are setting up.

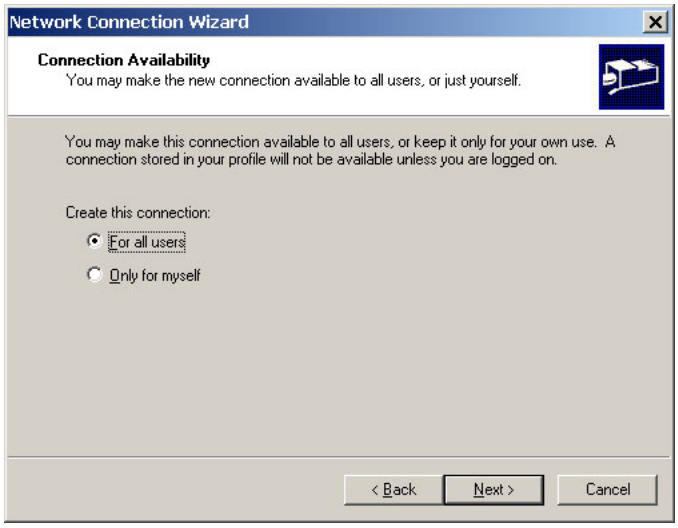
j) Click the “Next” button.



k) Select either “For all users” or “Only for myself.”

The correct setting depends on how your network and security are configured.

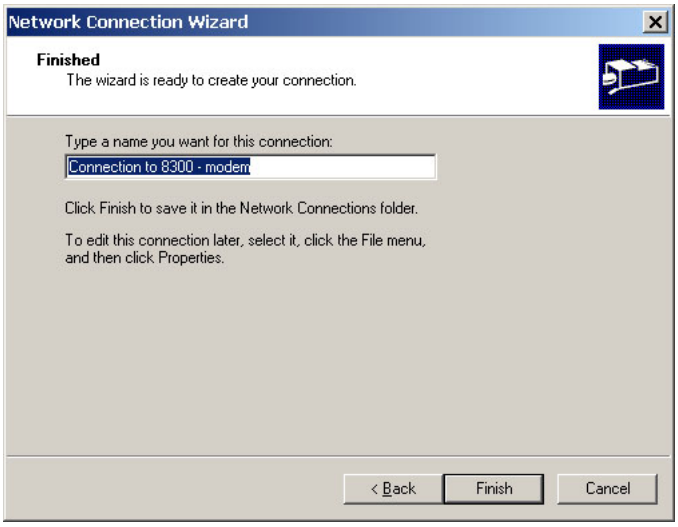
l) This screen may not appear in computers set up for single users.



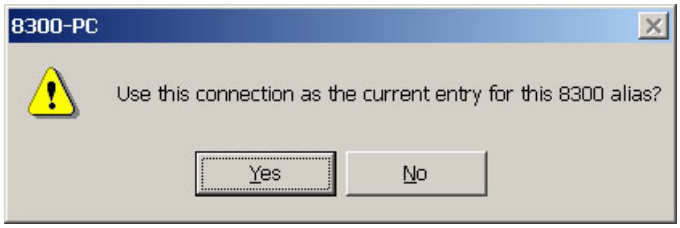
m) Click the "Next" button.

n) Type in a name for your Connection such as: "Connection to 5518 – Modem."

o) Click the "Finish" button.

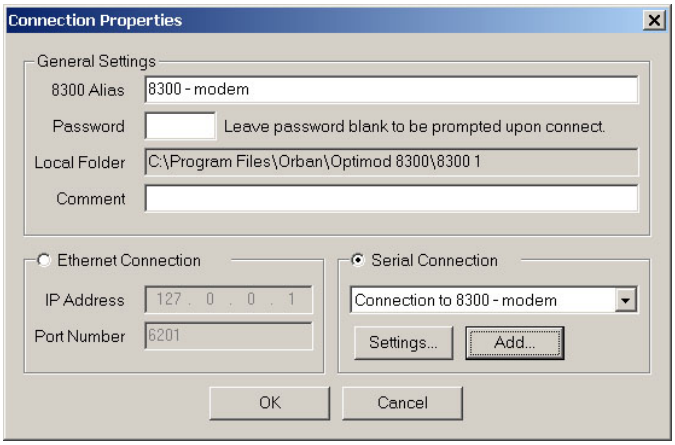


p) Click "Yes."



D) Edit your new Direct Connection properties:

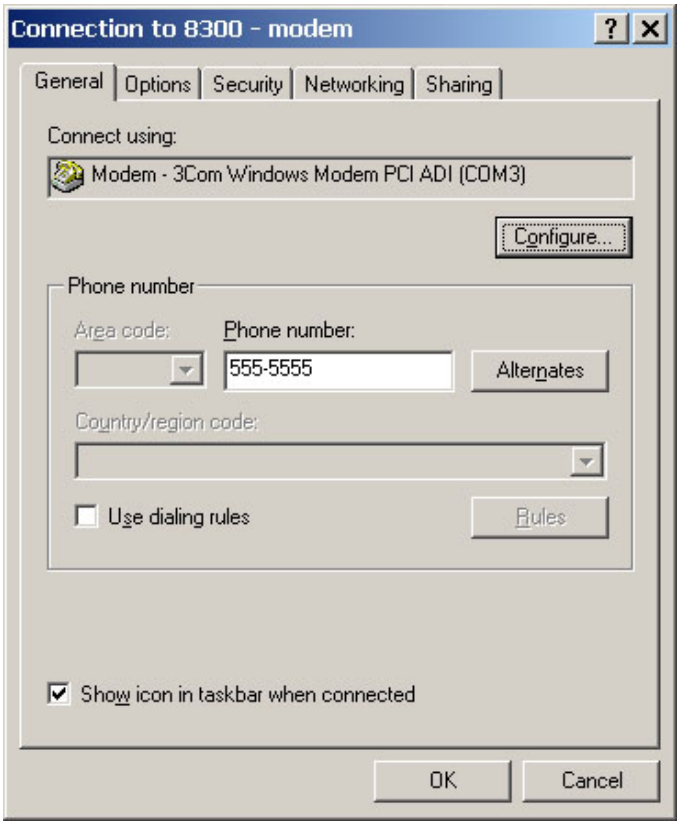
a) Click "Settings."



b) Click the “General” tab.

c) In the “Connect using” field, select the modem you will be using to make the connection on the PC side.

d) Click “Configure.”



e) Set “Maximum speed (bps)” to “115200.”

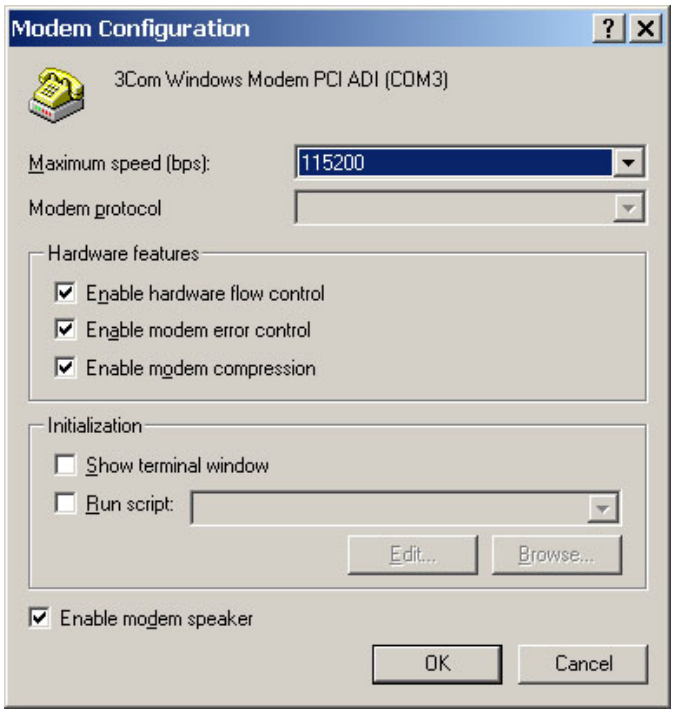
f) Check “Enable hard-ware flow control.”

g) Check “Enable modem error control.”

h) Check “Enable modem compression.”

i) Make sure that all other boxes are not checked.

j) Click “OK.”



k) Select the Networking tab.

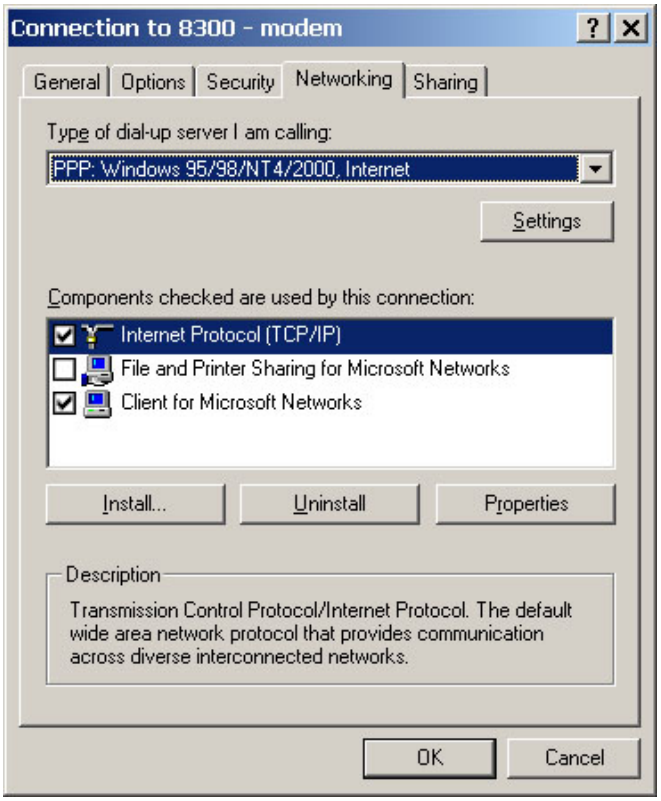
l) Make sure that "PPP: Windows 95 / 98 / NT 4 / 2000, Internet" appears in the "Type of dial-up server I am calling" field.

m) Make sure that "Internet Protocol (TCP/IP) is checked.

You may leave "Client for Microsoft Networks" checked if you like.

n) Click "OK."

o) When the "Connection properties" window appears, click "OK."



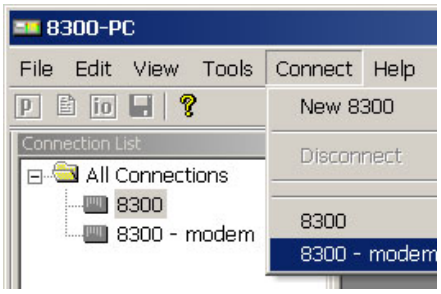
2. Launch a Windows 2000 Modem connection.

Once you have set up a "connection" specifying a modem connection in the 5518 PC Remote application (see *To set up a new connection* on page 3-9), choosing this connection from 5518 PC Remote automatically opens a Windows modem connection to your 5518.

You can connect by selecting the desired connection from the drop-down list in the CONNECT menu.

You can also connect by double-clicking the connection in the "Connection List" window.

If the connection is successful, a dialog bubble will appear on the bottom right hand corner of the screen verifying your connection.



If you have trouble making a connection, refer to *OS Specific Troubleshooting Advice: Troubleshooting Windows 2000 Modem Connect* on page 5-8. If you have trouble the first time after creating a connection according to the instructions above, try restarting your computer to clear its serial port.

3. **To change the properties of an existing connection:**

   Right-click the connection in the "connection List" window and choose "Properties." The "Connection properties" window opens (see page 2-72).

Connecting using Windows XP Modem Connection

1. **Add and configure modem for Windows XP:**

   Skip this step if your modem is already configured and working.

   A) Configure the Windows XP PC ports:

   Use either an internal modem or external modem with your computer.

   a) If you are using an external modem, connect the modem to a serial port on your PC.

   b) Make sure the modem is connected to a working phone line.

   c) Click "Start / Control Panel / Systems."

   d) Go to the "Hardware" tab and click "Device Manager."

   e) In the Device Manager dialog box click the "+" next to the "Ports (COM and LPT)" icon.

   A list will branch off, showing your available ports.

   f) Double-click "Communications Port (COM1) or (COM2)," depending on how you set up your system.

   The "Communications Port (Comx) Properties" dialog box opens.

   Not all PCs have a COM2.

   IMPORTANT: The COM port you choose at this point *must* match the COM port to which you connected your modem.

   g) From the tabs at the top, choose "Port Settings" and configure the settings to match your PC modem.

   If you are using a U.S. Robotics® external modem, the settings will be: Bits per second= 115200, Data bits = 8, Parity = None, Stop bits = 1, Flow Control = None.

   h) When you are finished, click the OK button to close the "Communications Port (Comx) Properties" dialog box.

   i) Click the OK button in the "Systems Properties" dialog window.

   j) Close the "Control Panel" window.

If your modem is already installed, skip to Launch an existing Windows XP modem connection *on page 2-81.*

   B) Install the Windows XP modem:

   a) Use either an internal modem or external modem with your computer.

If you are using an external modem, connect the modem to a serial port on your PC and make sure the modem is connected to a working phone line.

b) On your PC, click "Start / Settings / Control Panel / Phone and Modem Options."

c) Click the "Modems" tab.

d) Verify that your modem appears in the list available under "The following Modems are installed."

e) Verify that your modem is "Attached to" the correct port.

If your modem is unavailable or not attached to the correct port, you will need to Add it. See your Windows documentation.

f) If your modem is available in the list available under "The following Modems are installed" and it is attached to the correct port, then click "Properties" for that modem.

g) Make sure the port speed is set at 115200.

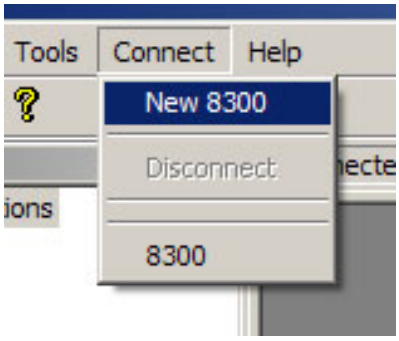
h) Click "OK."

C) Create a new Windows XP modem connection:

a) Launch 5518 PC Remote.

b) Choose "Connect / New 5518."

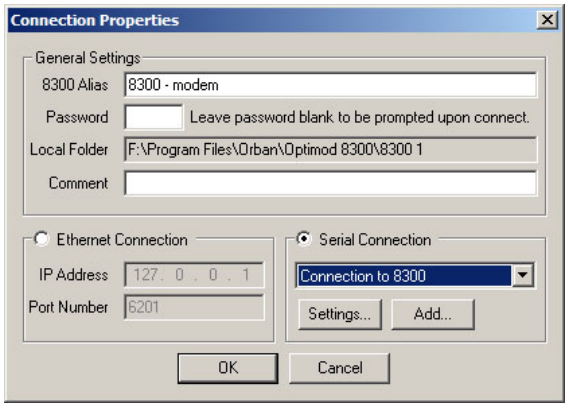
The Connection Properties window opens.



c) Give your 5518 a name (e.g., "KABC") by entering this name in the "5518 Alias" field.

d) If you wish to have 5518 PC Remote remember the password for this Optimod, enter the password in the "Password" field.

You must enter a valid password to connect. This means that at least one 5518 passcode must have been assigned via the 5518's front panel. (See *To Create a Passcode* on page 2-31.)



e) Click “Add.”

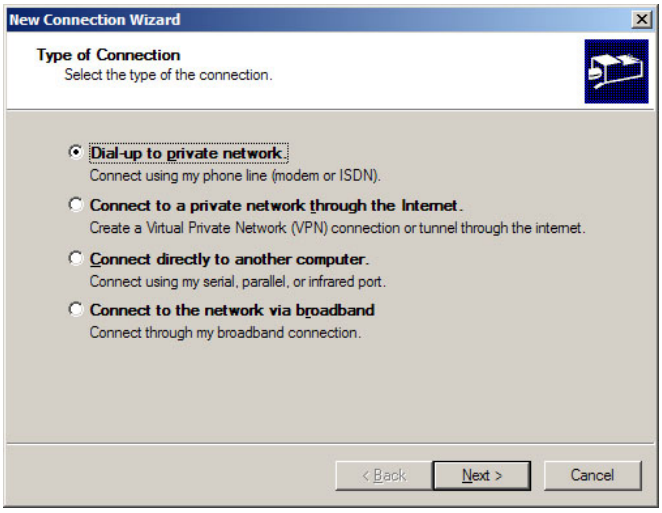
The Windows New Connection Wizard starts up.

f) Select “Serial Connection.”

g) Click the “Add” button.

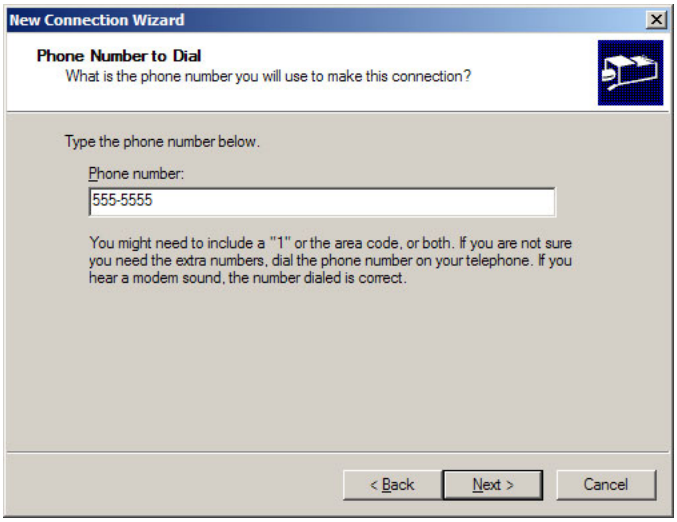
h) Select “Dial-up to private network.”

i) Click “Next.”



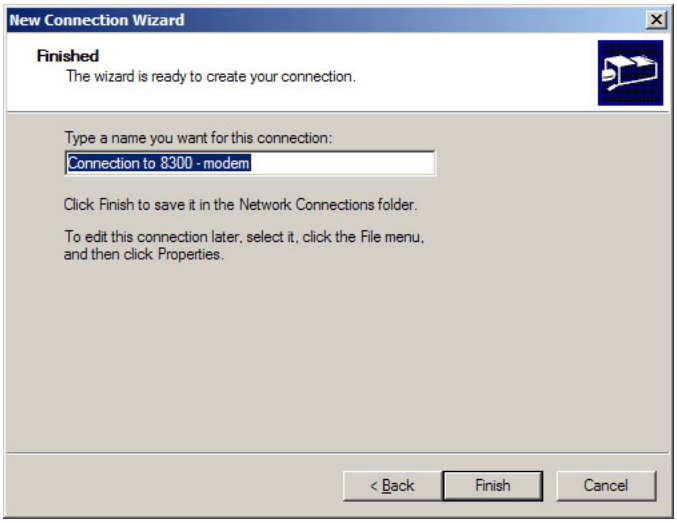
j) Enter the phone number of the modem connected to the 5518 you are setting up.

k) Click “Next.”

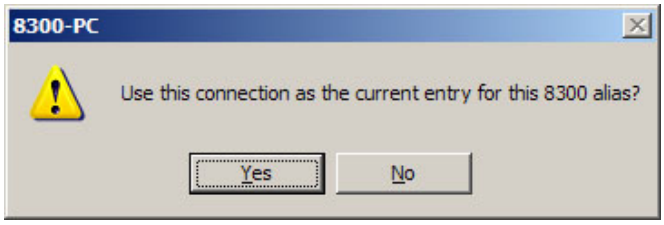


l) Type in a name for your Connection such as: “Connection to 5518 – Modem”

m)Click the “Finish” button.

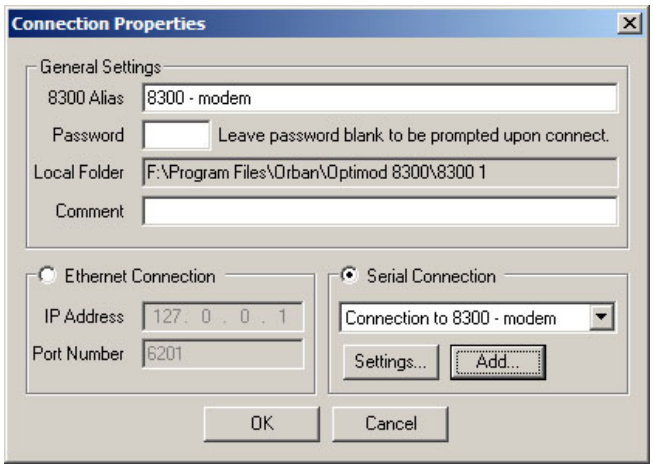


n) Click "Yes."



D) Edit your new Direct Connection properties:

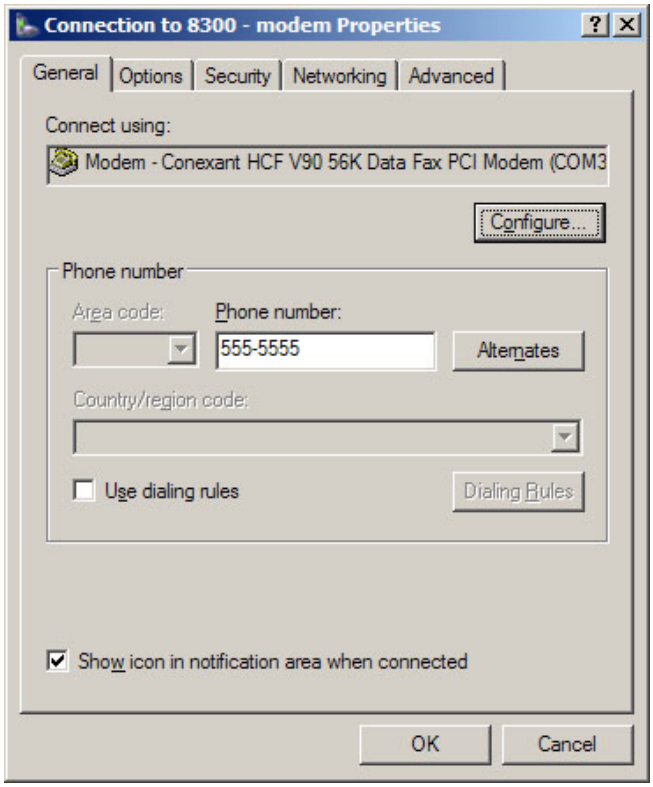
a) Click "Settings."



b) Click the "General" tab.

c) Select the modem you will be using to make the connection on the PC side.

d) Click "Configure."



e) Set "Maximum speed (bps)" to "115200."

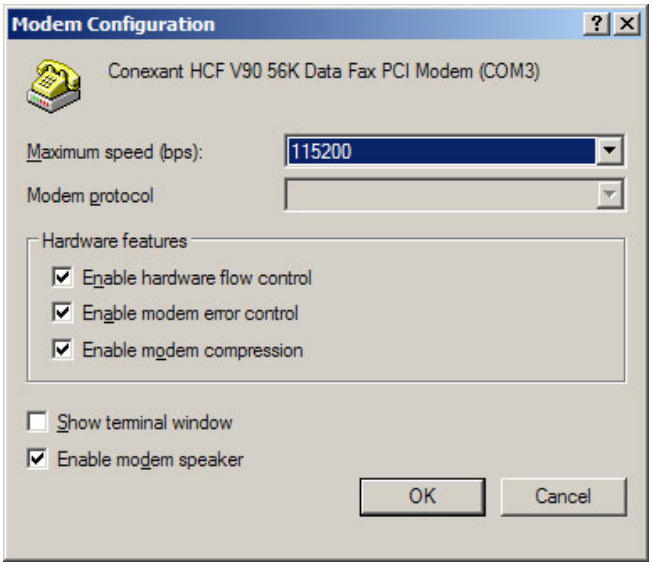
f) Check "Enable hardware flow control."

g) Check "Enable modem error control."

h) Check "Enable modem compression."

i) Make sure that no other box is checked.

j) Click "OK."



k) Select the Networking tab.

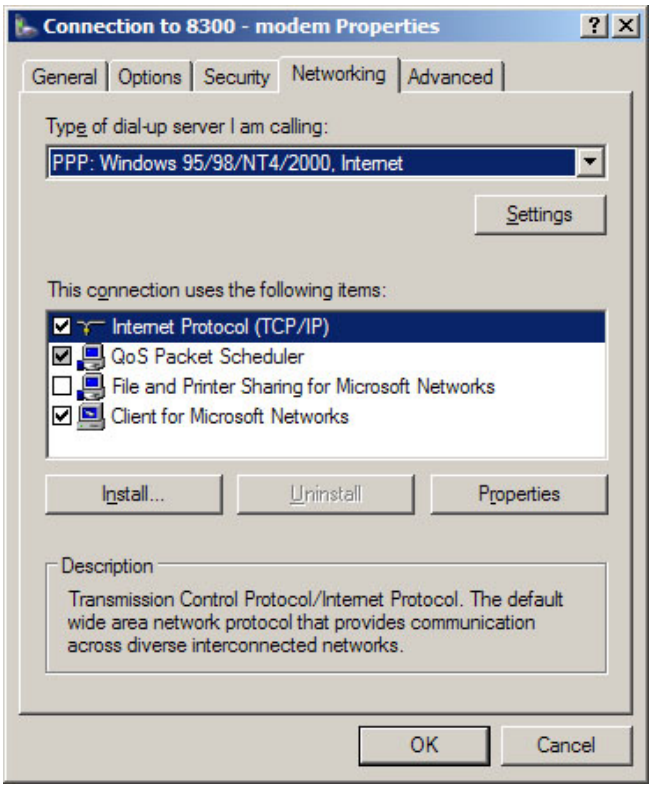
l) Make sure that "PPP: Windows 95 / 98 / NT4 / 2000, Internet" ap–pears in the "Type of dial-up server I am calling" field.

m) Make sure that "Internet Protocol (TCP/IP) is checked.

You may leave "Client for Microsoft Networks" checked if you like.

n) Click "OK."

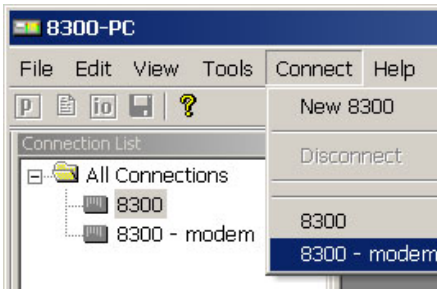
o) When the "Connection properties" window ap-pears, click "OK."



2. Launch an existing Windows XP modem connection.

Once you have set up a "connection" specifying a modem connection in the 5518 PC Remote application (see *To set up a new connection* on page 3-9), choosing this connection from 5518 PC Remote automatically opens a Windows modem connection to your 5518.

You can connect by selecting the desired connection from the drop-down list in the CONNECT menu.



You can also connect by double-clicking the connection in the "Connection List" window.

If the connection is successful, a dialog bubble will appear on the bottom right hand corner of the screen verifying your connection.

If you have trouble making a connection, refer to *Troubleshooting Windows XP Modem Connect* on page 5-10. If you have trouble the first time after creating a connection according to the instructions above, try restarting your computer to clear its serial port.

3. **To change the properties of an existing connection:**

   Right-click the connection in the "connection List" window and choose "Properties." The "Connection properties" window opens (see page 2-72).

Updating your 5518's Software

The software version number of PC Remote must be the same as the version number of the software running within your 5518. If the software version of PC Remote is higher than the version running in your 5518, PC Remote will automatically detect this and will offer to update your 5518's software automatically.

1. **If you have not already done so, prepare your computer and the 5518 for a direct serial, modem, or Ethernet connection.**

   See *Networking and Remote Control* starting on page 2-42.

2. **Install the latest version of 5518 PC Remote software on your computer.**

   This is available from

   ftp://orban.com/5518/Software

   See *Installing* 5518 PC Remote Control Software on page 2-47.

   See the readme5518_x.x.x.x.htm file (where x.x.x.x is the version number) for details about the upgrade not given in this manual. The PC Remote installer will install this file on your computer's hard drive.

3. **If you have not previously done so, start 5518 PC Remote and set up a "connection" to the 5518 you will be updating.**

   See *To set up a new connection* on page 3-9.

4. Update your 5518.

A) Attempt to initiate communication to your 5518 via your connection.

See

To initiate communication on page 3-10.

5518 PC Remote will automatically detect that the 5518 software version on your 5518 is not the same as the version of 5518 PC Remote. PC Remote will then offer to update your 5518 automatically.

This procedure will only work for a connection using an "all-access" (administrator) passcode.

B) Choose YES and wait for the update to complete. Note that this will cause an interruption in the audio of approximately 3 seconds when your 5518 automatically reboots after the update is complete. If you cannot tolerate such an interruption, choose NO or CANCEL to abort the update.

Please be patient; this will take several minutes. (The exact time will depend on whether the 5518 has to do any "housekeeping" to its flash memory as part of the update.)

Completion will be indicated by the updater's command-line window's closing automatically and your 5518's rebooting.

Your 5518 will continue to pass audio normally while the update is occurring. *However, the audio will be interrupted for approximately 3 seconds when your 5518 reboots.*

Do not interrupt power to your 5518 or your computer, close PC Remote or the update application's command-line window, or reboot your computer during this time. While doing any of these things is unlikely to damage your 5518 (because of extensive backup and error-checking provisions in your 5518), they will certainly cause the update to fail. We recommend powering the 5518 from a UPS during an update.

C) When the 5518 screen display returns after its automatic reboot, the 5518 will be running with the updated software.

If the update fails for some reason, try repeating the procedure in steps (A) through (C) again.

D) If the 5518 screen remains blank for more than one minute after the update has completed, manually reboot the 5518 by removing AC power from the 5518 for at least ten seconds and then powering the 5518 back up.

E) The 5518 software update is now complete. You should now be able to connect to your 5518 via PC Remote.

NOTE: If you cannot make a serial connection after a software upgrade, manually reboot the 5518 with a normal "power-off/power-on" sequence.

SNMP Support

The SNMP (Simple Network Management Protocol) features allow you to monitor your Optimod's status and to send Alarm notifications via your Optimod's Ethernet connection to your network. It is beyond the scope of this manual to provide a general explanation of how SNMP works. The text below provides sufficient information to use your Optimod in your specific SNMP setup if you are already familiar with the general principles of setting up SNMP.

SNMP Network Setup

- **SNMP** (Enable/Disable): enables or disables the SNMP feature. Select "enable" and disconnect from the PC remote to update the unit and allow SNMP access.

  If you wish to disable SNMP access after it has been enabled, select "disable" and then reboot your Optimod.

  F) From the main menu, navigate to *Setup* > NETWORK&REMOTE > NETWORK > SNMP ENABLE.

  If the SNMP ENABLE soft button is not visible, press the *Next/Prev* buttons until it is.

  G) While holding down the SNMP ENABLE soft button, turn the knob to set the SNMP ENABLE field to YES.

The controls below are only available from Optimod PC Remote.

In the I/O menu, select the NETWORK tab to access the SNMP configuration controls.

- **Primary Manager Address**: (255.255.255.255) sets the address of the Primary SNMP Manager.
- **Primary Manager Port**: (162) sets the port of the Primary SNMP Manager.
- **Secondary Manger Address**: (255.255.255.255) sets the address of a Secondary SNMP Manager.
- **Secondary Manger Port**: (162) sets the address of a Secondary SNMP Port.

SNMP Mib file

The orban5500.mib file is in the location where you installed your PC Remote application.

The default 5518 install location is:

`Program Files\Orban\Optimod 5518 PC Remote`
or
`Program Files(x86)\Orban\Optimod 5518 PC Remote`

SNMP Default Settings

- **SNMP Agent**: Disabled
- **Primary Manager(Alarm) Address**: 255.255.255.255
- **Primary Manager (Alarm) Port**: 162
- **Secondary Manger (Alarm) Address**: 255.255.255.255
- **Secondary Manger (Alarm) Port**: 162

SNMP Features

Get/Query:

- Station Name
- System Diagnostics Orban (walks through all of the "get" commands and displays their status.)
- Primary and Secondary Manager IP
- Primary and Secondary Manager Port
- Analog Input Silent
- Analog Input Active (The analog input is selected as the input source)
- AES Input Silent
- AES Error
- Digital Input Active (The digital input is selected as the input source)
- Current value of diversity delay
- mpxModulationLevel (MPX Modulation Level)
- pilotInjectionLevel (19 kHz Pilot Injection Level)
- rdsSubcarrierLevel (RDS Subcarrier Level)
- mpxPowerdBr (MPX Power Level)
- mpxPowerGr (MPX Power Gain Reduction)
- analogInputLevel (Analog Input Level)

- digitalInputLevel (Digital Input Level)

Set/Control:

- Primary and Secondary Manager IP
- Primary and Secondary Manager Port
- Station Name
- Diversity Delay

Traps/Alert:

- Analog Input Silent
- Analog Input Active (selected as input source)
- AES Input Silent
- AES Error
- Digital Input Active (The digital input is selected as the input source)

Figure 2-4: SNMP Settings

SNMP Community String:

The "SNMP Community string" is like a user id or password that allows access to a router's or other device's statistics. It is set at Optimod PC Remote to implement SNMP security. PRTG sends the community string along with all SNMP requests. If the community string is correct, the device responds with the requested information. If the community string is incorrect, the device simply discards the request and does not respond.

- **Read String** allows users to set a password for SNMP to retrieve information from the Optimod. Default is PUBLIC.
- **Write String** allows users to set a password for SNMP to write (set) information from the Optimod. Default is PRIVATE.

RDS/RBDS Generator

Your Optimod includes a full-featured RDS/RBDS generator that supports dynamic PS. We presume that you are already familiar with the basics of RDS and you wish to implement RDS via your Optimod. See the *References* on page 2-98 for more about RBS and RBDS.

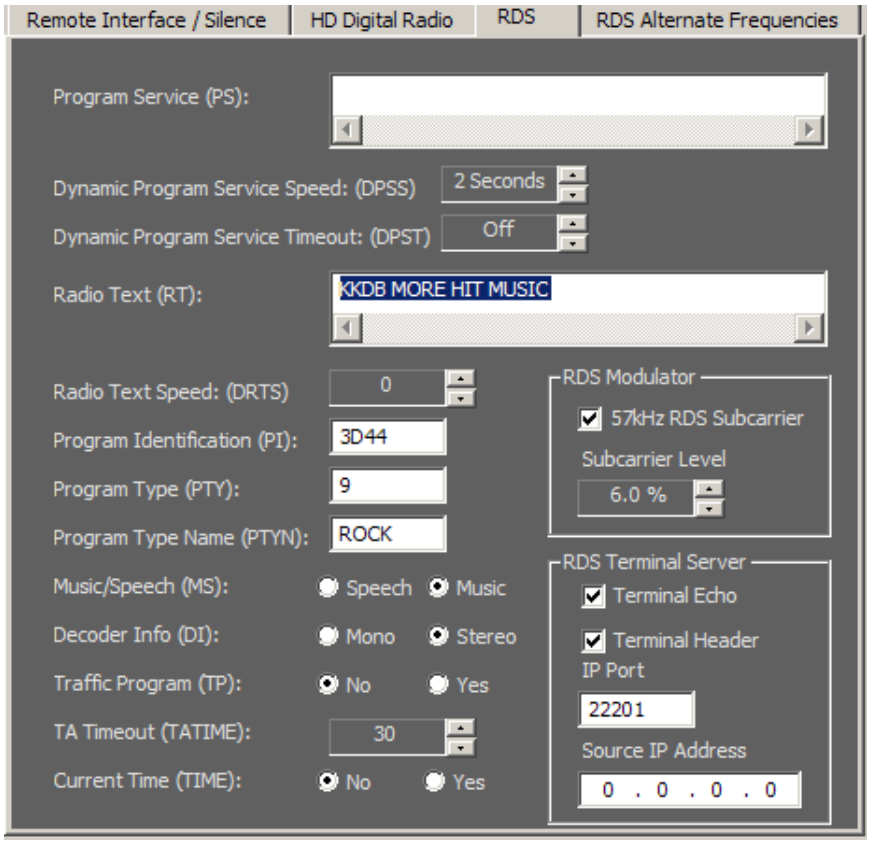
There are three ways to control RDS generation from your Optimod:

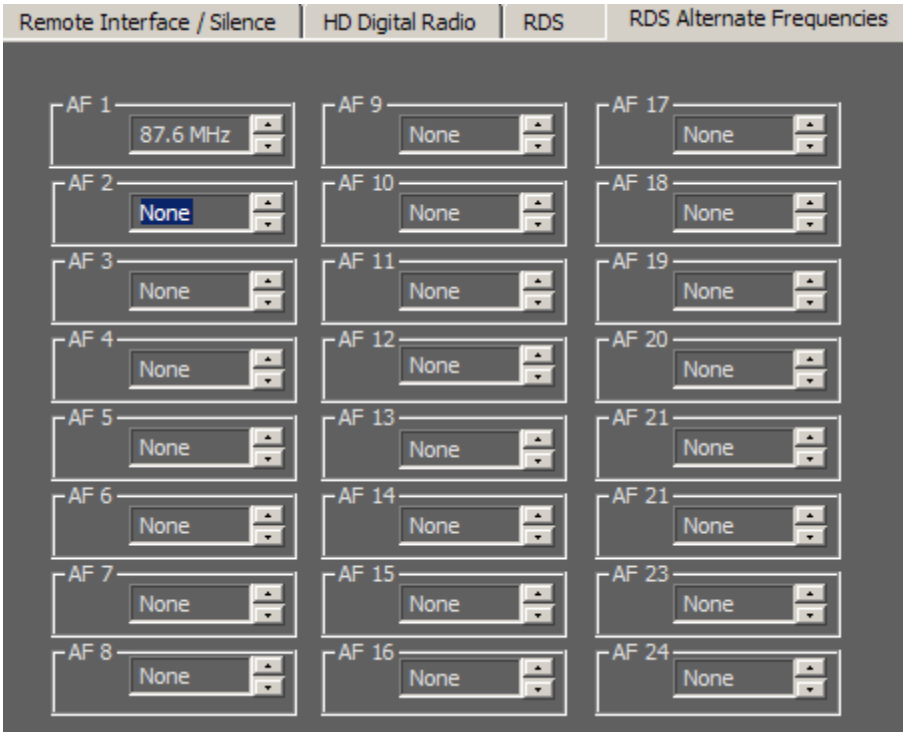
- Use the **System I/O** [the default] to set up the RDS to generate static RDS.
- Change the RDS data dynamically by using **processing presets**.
- Change the RDS data dynamically by using **terminal control**.

You can use both User Presets and the RDS terminal control to change the RDS dynamically. For example, if you are running a mixed format where part of the broadcast day is devoted to news and part to jazz, you may want the RDS Program Type to change when you recall a preset appropriate for the format that is currently on-air.

Using System I/O

RDS Setup via System I/O is available only from PC Remote software.





RDS	
Program Service (PS= / DPS=)	Default: undefined
Radio Text (RT= / TEXT=)	Default: undefined
Radio Text Speed (DRTS=)	Default: Off
Program Identification (PI=)	Default: undefined
Program Type (PTY=)	Default: undefined
Program Name (PTYN=)	Default: undefined
Music/Speech (MS=)	Default: Music
Decoder Info (DI=)	Default: Stereo
Traffic Program (TP=)	Default: 0
TA Timeout (TATIME)	Default: 30
57kHz RDS Subcarrier (RDS=)	Default: Off
Subcarrier Level (RDSLEVEL=)	Default: 6%
Terminal Echo (ECHO=)	Default: yes
IP Address	Default: 0.0.0.0
RDS Terminal Port (PORT1=)	Default: 22201
Current Time (TIME=)	Default: No
Alternate Frequency 1-24 (AF=)	Default: None

Table 2-1: System I/O RDS controls and defaults

In the **System I/O** RDS tab, turn on the RDS generator by setting 57 kHz RDS control to YES. You can also set up the Modulation level and all other RDS I/O controls in the System I/O RDS screens per the screenshot above. Table 2-1 shows a list of RDS controls available in System I/O.

When you open I/O RDS screen in the PC remote when the System RDS controls are active, the Optimod will update the RDS output when a control is changed or if you select the DONE button.

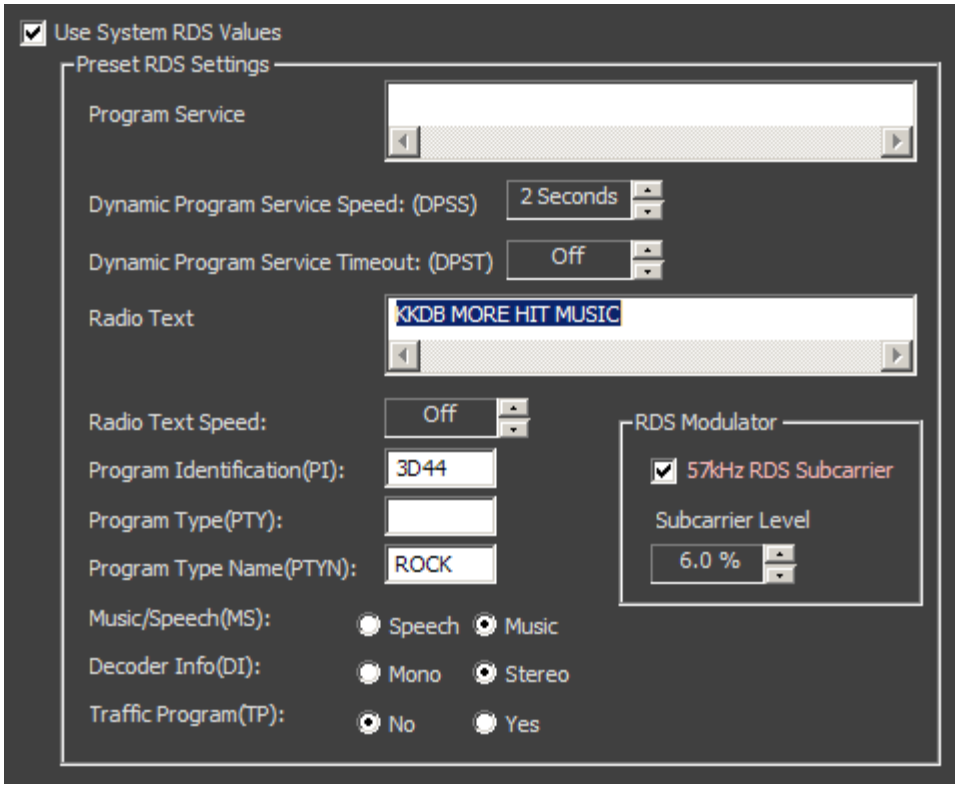
Using Processing Presets

RDS adjustment via processing presets are available only from PC Remote.

To use **processing presets**, edit your on-air preset with the RDS checkbox USE SYSTEM RDS VALUES deselected. Then set the RDS preset controls as required and save the result as a new user preset. It is possible to make as many user presets as you want whose audio processing controls are set identically, but the RDS controls are set differently.

These controls are located in the processing preset's RDS tab in PC remote.

Note that because of buffering to ensure reliable RDS encoding, there is a delay of about four seconds between when you change a control and when your Optimod puts it on-air.



Using the Terminal Server

The **terminal server** is another way to change RDS dynamically. Your Optimod will update the outgoing RDS to whatever RDS control value it receives via the terminal, overwriting the system and preset RDS values. The terminal connects via TCP/IP, using the IP address and port specified in SETUP > RDS.

The values received via the terminal only persist until overwritten by a change in the system or processing preset. When you change a value in a System I/O RDS control at the Optimod front panel or via PC Remote, or if you recall a preset that has RDS activated, the new system/preset will overwrite whatever the Optimod last received from the terminal.

Although the terminal RDS will override the RDS settings in the active system or processing preset, it will not overwrite the RDS setting for the I/O or preset. For example, if you are using a processing preset to generate RDS with the ***PS 1234,*** then you send the terminal command ***PS ABCD***, the RDS will generate **ABCD,** but if you recall the processing preset again, the RDS generator will revert to transmitting ***1234*** because the terminal settings are not saved.

The `INIT` command clears any values previously sent from the Terminal connection and causes the RDS to revert to the System values.

By using the SAVE command, you can rewrite the SYSTEM RDS settings from the terminal server. For security, this command requires you to include a currently active password (see *Security and Passcode Programming* on page 2-30).

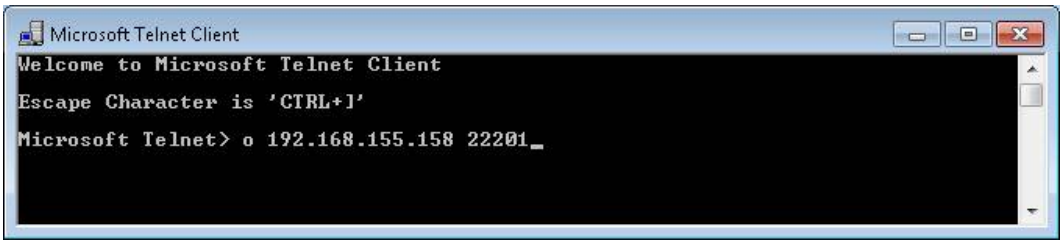
Using Telnet to Control the Terminal Server

Although the terminal server is usually used to accept commands from an automation system, batch file, or application like Modulation Index's PAD::bridge, you can also control RDS from Windows directly via the Windows Telnet command line utility or the free utility PuTTY.

A) Open the Windows Telnet client by typing `telnet` into the Windows Run box in the Start menu and hitting the Enter key on your keyboard.

> In Windows 7 and higher, you must enable the Telnet client; it is not enabled by default. If you do not know how, use a search engine to find out. The general idea is to navigate to CONTROL PANEL > PROGRAMS > TURN WINDOWS FEATURES ON OR OFF and check "Telnet."

B) Connect the Telnet client to the Optimod by typing `open [IP address] [IP Port]`, where `[IP address]` is the IP address of the Optimod and `[IP Port]` is the IP Port you assigned to the Optimod RDS terminal server in System .



C) You may now type any of the terminal commands in the chart of RDS Terminal Commands below.

> If you have checked the Optimod's TERMINAL ECHO box, when you type a command, the Optimod will return a status line relevant to the command to the Telnet client, which will write it to the screen.

The returned information will look similar to the following:

```
?
PS=undefined
DPS=undefined
DPSS=2 Seconds
DPST=Off
RT=KKDB MORE HIT MUSIC
DRTS=Off
PI=3D44
PTY=9
PTYN=ROCK
MS=Music
DI=Stereo
TP=No
TA=No
TATIME=30
TIME=No
RDS=Yes
RDSLEVEL= 6.0 %
AF 1=87.7 MHz
AF 2=0
AF 3=0
AF 4=0
AF 5=0
AF 6=0
AF 7=0
AF 8=0
AF 9=0
AF 10=0
AF 11=0
AF 12=0
AF 13=0
AF 14=0
AF 15=0
AF 16=0
AF 17=0
AF 18=0
AF 19=0
AF 20=0
AF 21=0
AF 22=0
AF 23=0
AF 24=0
```

Security

In the System I/O RDS control screen, you can set the RDS *Terminal control security* by specifying an RDS IP address from which to accept commands. Once set, this IP will be the only IP that can connect to the unit to update RDS. The 8500S will default to 0.0.0.0, which will allow any IP to connect to the RDS terminal control.

To prevent the Optimod from disconnecting and being unable to reconnect if the terminal connection drops out temporarily, set the TIMEOUT value (as shown in Table 2-1) to the maximum expected duration of the dropout (in minutes). Default is 4 minutes. Note that the timeout reverts to the default each new connection; if you change the timeout for one connection, it is not retained for the next one.

RDS Terminal Commands

Table 2-2 lists the terminal commands.

Note that you can fetch the status of the RDS generator as follows:

[command] ? returns current value
ST *returns current value of all controls*
HELP *returns a list of the RDS terminal commands*
↵ = CR/LF in Table 2-2

COMMAND	PARAMETER	INFORMATION	EXAMPLE
PS= / DPS=	Dynamic PS	256 (max) characters for scrolling messages in the PS field	DPS=Artist Goes Here :: Title Goes Here↵
DPSS=	DPS Dynamic Program Service Speed	OFF = Default PS Option Disabled 2 - 9 = wait time in seconds between receipt of last incoming DPS and transmission of DPS Default. Default is the DPS control value as designated in the I/O Setup.	DPSS = 2
DPST=	DPS Dynamic Program Timeout	0 = Default PS Option Disabled 1 - 7 = wait time in minutes between receipt of last incoming DPS and transmission of DPS Default. Default is the DPS control value as designated in the I/O Setup.	DPSTIMEOUT=0
RT=	Radio Text	128 (max) character message to be displayed by the receiver if so equipped	RT=KRD :: (800) 111-1111 :: www.domain.com↵

COMMAND	PARAMETER	INFORMATION	EXAMPLE
DRTS=	RadioText Speed	0 = RadioText OFF 0,5,10,…45 (steps of 5) = Refresh rate for RadioText message transmission (15 recommended for text messaging, higher values for RT+ applications)	DRTS=15
PI=	Program Identification	**4-digit HEX number**[1] corresponding to the Station Call Letters — RDS North America ONLY	PI=3D44↵ (for KRDS)
PTY=	Program Type (Format)	1 or 2 digit number from PTY list describing the station broadcast format — RDS & RBDS are DIFFERENT	PTY=9↵ (for North American "TOP 40")
PTYN=	Program Type Name	8-character refined format definition — RDS & RBDS are DIFFERENT	PTYN=TOP 40↵
MS=	Music/Speech Switch	0 = Music 1 = Speech	MS=0↵ (Music)
DI=	Decoder Information	0 = Mono 1 = Stereo	DI=1↵ (Stereo)
TP=	Traffic Program	0 = Station does not carry traffic info 1 = Station broadcasts routine traffic info	TP=0↵ (No Traffic)
TA=	Traffic Alert ON-AIR NOW	0 = Flag Off 1 = Flag On (Flag valid only when TP=1)	TA=0↵ (No Traffic Alert)
TATIME=	TA Timeout	0 = Timer Off 1 - 255 = seconds between start of TA flag and automatic reset to OFF; 30 is recommended	TATIME=30↵ (Display TA for 30 Seconds)
AFxx=	Alternative Frequency List	Enter each AF in MHz 0 = Clear	AF1=88.1↵ AF1=0↵ (Clear AF1)
ECHO=	Terminal Echo	0 = no echo of sent data 1 = sent data echoed to Terminal window	ECHO=1↵ (Default Terminal Echo Characters)
HEAD=	Head Mode	0 = No Head 1 = Head This takes effect upon disconnect from terminal.	HEAD=1↵ (Default with Head)
TIME=	Time Data on RDS	Determines if time and date are transmitted in the RDS data stream; 0=No, 1=Yes.	TIME=0↵ (turn time transmission off))
RDS=	57kHz RDS Subcarrier	0 = RDS subcarrier On 1 = RDS subcarrier Off	RDS=1↵ (Default - Disabled)
RDSLEVEL=	Subcarrier Level	% Modulation (0…120) - 6% Default	RDSLEVEL=6.0↵ (Default - 6%)

[1] See section D.7 of the NRSC-4-B Standard and section 5.1 of the NRSC-G300-B RBDS Usage Guidelines.

COMMAND	PARAMETER	INFORMATION	EXAMPLE
TIMEOUT=	RDS terminal connection time-out	Timeout (in minutes) between last transmitted command and when the Optimod disconnects automatically. Use it to allow the Optimod to reconnect automatically if the terminal connection is lost temporarily. *This command only affects the current connection; you must reissue it each time you connect.*	TIMEOUT=15↲ (current connection stays up for 15 minutes) TIMEOUT=0↲ (no auto-disconnect occurs)
VER↲	RDS Welcome Header	{ 0=No, 1=Yes } Sets whether the RSD welcome header is sent to the Network client upon connection..	VER 0↲
INIT↲	Use System RDS parameters	Use RDS parameters from System.	INIT↲
SAVE↲	Save RDS parameters	saves the current RDS parameters to the currently active RDS control set (either the System Settings or the User Preset group) NOTE: Any changes will not appear in the PC application if it is open. You must reconnect to see the saved values.	SAVE↲

QUERIES		
[command] ↲	Any command and '?' returns the status of the encoder memory for that specific command..	PS?↲
ST↲	Returns all settings in encoder memory.	ST↲
HELP↲	Reports a list of available commands	HELP↲
TI↲	Returns the current time, as read from the Optimod's real-time clock.	TIME=20:15:36 DATE=Jan. 1, 2015

RESPONSES		
(Return Echo)	The command received was properly formatted and was received and executed by the encoder.	TATIME=30
Invalid Data Entered	Incoming data is not properly formatted and hence was not accepted and executed by the encoder.	Invalid Data Entered
(none)	Data that has been sent either has not reached the encoder or the encoder has no response for that command.	(none)

Table 2-2: Preset/Terminal RDS controls and defaults

Alternative Frequency Channel Numbers

MHz	CHAN	MHz	CHAN	MHz	CHAN	MHz	CHAN
87.6	1	92.7	52	97.8	103	102.9	154

MHz	CHAN	MHz	CHAN	MHz	CHAN	MHz	CHAN
87.7	2	92.8	53	97.9	104	103.0	155
87.8	3	93.9	54	98.0	105	103.1	156
87.9	4	93.0	55	98.1	106	103.2	157
88.0	5	93.1	56	98.2	107	103.3	158
88.1	6	93.2	57	98.3	108	103.4	159
88.2	7	93.3	58	98.4	109	103.5	160
88.3	8	93.4	59	98.5	110	103.6	161
88.4	9	93.5	60	98.6	111	103.7	162
88.5	10	93.6	61	98.7	112	103.8	163
88.6	11	93.7	62	98.8	113	103.9	164
88.7	12	93.8	63	98.9	114	104.0	165
88.8	13	93.9	64	99.0	115	104.1	166
88.9	14	94.0	65	99.1	116	104.2	167
89.0	15	94.1	66	99.2	117	104.3	168
89.1	16	94.2	67	99.3	118	104.4	169
89.2	17	94.3	68	99.4	119	104.5	170
89.3	18	94.4	69	99.5	120	104.6	171
89.4	19	94.5	70	99.6	121	104.7	172
89.5	20	94.6	71	99.7	122	104.8	173
89.6	21	94.7	72	99.8	123	104.9	174
89.7	22	94.8	73	99.9	124	105.0	175
89.8	23	94.9	74	100.0	125	105.1	176
89.9	24	95.0	75	100.1	126	105.2	177
90.0	25	95.1	76	100.2	127	105.3	178
90.1	26	95.2	77	100.3	128	105.4	179
90.2	27	95.3	78	100.4	129	105.5	180
90.3	28	95.4	79	100.5	130	105.6	181
90.4	29	95.5	80	100.6	131	105.7	182
90.5	30	95.6	81	100.7	132	105.8	183
90.6	31	95.7	82	100.8	133	105.9	184
90.7	32	95.8	83	100.9	134	106.0	185
90.8	33	95.9	84	101.0	135	106.1	186
90.9	34	96.0	85	101.1	136	106.2	187
91.0	35	96.1	86	101.2	137	106.3	188
91.1	36	96.2	87	101.3	138	106.4	189
91.2	37	96.3	88	101.4	139	106.5	190
91.3	38	96.4	89	101.5	140	106.6	191
91.4	39	96.5	90	101.6	141	106.7	192
91.5	40	96.6	91	101.7	142	106.8	193
91.6	41	96.7	92	101.8	143	106.9	194
91.7	42	96.8	93	101.9	144	107.0	195
91.8	43	96.9	94	102.0	145	107.1	196
91.9	44	97.0	95	102.1	146	107.2	197
92.0	45	97.1	96	102.2	147	107.3	198
92.1	46	97.2	97	102.3	148	107.4	199
92.2	47	97.3	98	102.4	149	107.5	200
92.3	48	97.4	99	102.5	150	107.6	201
92.4	49	97.5	100	102.6	151	107.7	202
92.5	50	97.6	101	102.7	152	107.8	203
92.6	51	97.7	102	102.8	153	107.9	204

Table 2-3: Alternative Frequency Channel Numbers:

Program Type (PTY)

PTY	Program Type – US	Program Type – EU
0	None	None
1	News	News
2	Information	Current Affairs
3	Sports	Information
4	Talk	Sports
5	Rock	Education
6	Classic Rock	Drama
7	Adult Hit Music	Culture
8	Soft Rock Music	Science
9	Top 40 Music	Varied
10	Country Music	Pop Music
11	Oldies Music	Rock Music
12	Soft Music	Easy Listening Music
13	Nostalgia Music	Light Classics Music
14	Jazz	Serious Classics Music
15	Classical Music	Other Music
16	Rhythm and Blues Music	Weather
17	Soft R and B Music	Finance
18	Foreign Language	Children's Programs
19	Religious Music	Social Affairs
20	Religious Talk	Religion
21	Personality	Phone-In
22	Public Non-Commercial	Travel
23	College	Leisure
24	Spanish Talk	Jazz Music
25	Spanish Music	Country Music
26	Hip-Hop	National Music
27	(unassigned)	Oldies Music
28	(unassigned)	Folk Music
29	Weather	Documentary
30	Emergency Test	Alarm Test
31	Emergency!	Alarm!

Table 2-4: Program Type (PTY)

SCA/Subcarrier Phase Relationship

During stereo broadcast, the SCA subcarrier must be locked either in-phase or in quadrature to the third harmonic of the 19 kHz pilot tone. The tolerance of the phase angle is ±10° measured at the modulation input to the FM transmitter.

With no modulation other than the pilot tone, an oscilloscope trigged from the 19kHz pilot tone should display the following:

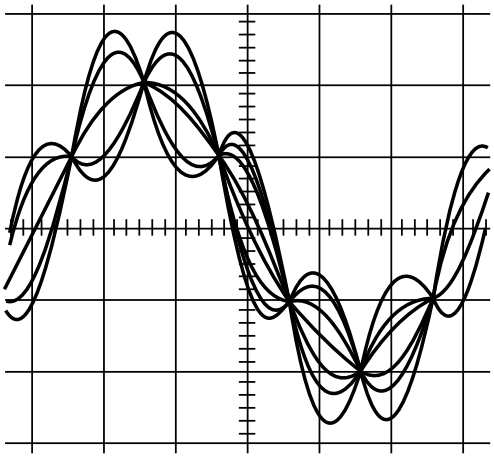


Figure 2-5: Pilot/SCA Phasing Scope Trace

To minimize the amount of peak level that the RDS subcarrier adds to the composite baseband, your Optimod's RDS generator is locked in quadrature with respect to the pilot tone, so Figure 2-5 is for reference only. If your transmission system is broadcasting stereo correctly, it will also correctly pass the phasing built into your Optimod's SCA generator.

References

- IEC 62016 Edition 2.0, 2009-07 (European RDS and most of North American RBDS)
- NRSC-4-B (ways in which the RBDS standard deviates from IEC 62016)
- NRSC-G300-B (guidelines for usage of RBDS)

Section 3
Operation

5518 Front Panel

- **Screen Display** labels the four soft buttons and provides control-setting information.

- Screen **Contrast** button adjusts the optimum viewing angle of the screen display.

- Four **Soft buttons** provide access to all 5518 functions and controls. The functions of the soft buttons change with each screen, according to the labels at the bottom of each screen.

- **Next** and **Prev** (← and →) buttons scroll the screen horizontally to accommodate menus that cannot fit in the available space. They also allow you to move from one character to the next when you enter data into your 5518.

  These flash when such a menu is in use. Otherwise, they are inactive.

- **Control Knob** is used to change the setting that is selected by the soft buttons. To change a value, you ordinarily have to hold down a soft button while you are turning the control knob.

- **Recall** button allows you recall a Factory or User Preset.

  Selecting the Recall button does not immediately recall a preset. See step (A) on page 1-5 for instructions on recalling a preset.

- **Modify** button brings you to list of controls that you can use to edit a Factory or User Preset. If you edit a Factory Preset, you must save it as a new User Preset to retain your edit.

- **Setup** button accesses the technical parameters necessary to match the 5518 to your transmission system.

- **Escape** button provides an escape from current screen and returns user to the next higher-level screen. Repeatedly pressing *Escape* will always return you to the Idle screen, which is at the top level of the screen hierarchy.

- **Input** meters show the peak input level applied to the 5518's analog or digital inputs with reference to 0 = digital full-scale. If the input meter's red segment lights up, you are overdriving the 5518's analog to digital converter, which is a very common cause of audible distortion.

- **Gain Reduction** meters show the gain reduction in the left/right overshoot limiter meters. Full scale is 5 dB gain reduction. If the overshoot limiter is turned off, these meters will stay dark.

- **Output** meters indicate the peak left and right channel drive levels to the stereo encoder modulator, which follows all lowpass filtering and overshoot limiting. They use the same scale as the COMPOSITE meter.

- **Composite** meter shows the output level of the stereo encoder before the composite output attenuators. The meter's reading is calibrated in percent modulation.

- **Multiplex Power** meter indicates the action of the ITU412 Multiplex Power controller. It shows how much the MPX Power Controller has reduced the clipper drive, thereby reducing the average power in the processed audio. It will show no gain reduction unless the MPX Power Controller is turned on.

- **Multiplex Power Level** meter indicates multiplex power according to the ITU-R BS.412 standard. Its calibration will be correct if the Optimod's output level control was adjusted using the tone method (see step 12and subsequent steps starting on page 2-14) and the transmission path following the Optimod has no overshoot. See *ITU-R Multiplex Power Controller* starting on page 3-4 for a full discussion of the Multiplex Power Gain Reduction and Level meters.

Signal Processing

The signal flows through the 5518 through the following blocks:

- **Input Conditioning**, including sample rate conversion to 64 kHz, defeatable 15, 16, or 17 kHz lowpass filtering, and the requisite preemphasis and deemphasis filters to allow the 5518 to accept, flat, preemphasized, or flat+J17 preemphasized audio.

- **Left/Right Overshoot Limiter.** This is intended to remove overshoots in studio/transmitter links caused by lossy digital audio compression (like MP2) or by unflat frequency response and group delay distortion. This is a very fast limiter using look-ahead and anti-aliased clipper technology. We recommend using no more than 3 dB of gain reduction.

- **DSP-derived Core Stereo Encoder** (stereo generator)

- **Composite Limiter/Clipper**.

To Create or Save a User Preset

Once you have edited a preset, you can save it as a user preset. The 5518 can store an indefinite number of user presets, limited only by available memory. However, most 5518 users will only require one user preset, which reflects the customization they did during initial setup. (See steps 19 through 26 starting on page 2-16.)

The 5518 will offer to save any edited, unsaved preset when the main screen is visible. To save a preset:

A) Press the ESC button repeatedly until you see the main screen, which shows the current time and the preset presently on air.

If there is an unsaved preset on air, the rightmost button will be labeled SAVE PRESET.

B) Press the SAVE PRESET button.

The Save Preset screen appears.

C) Choose a name for your preset.

Some non-alphanumeric characters (such as < and >) are reserved and cannot be used in preset names.

D) Use the knob to set the each character in the preset name. Use the *Next* and *Prev* buttons to control the cursor position.

E) Press the SAVE CHANGES button.

- You cannot give a user preset the same name as a factory preset. If the name that you have selected duplicates the name of a factory preset, the 5518 will suggest an alternate name.
- If the name you have selected duplicates the name of an existing user preset, the 5518 warns you that you are about to overwrite that preset. Answer YES if you wish to overwrite the preset and NO otherwise. If you answer NO, the 5518 will give you an opportunity to choose a new name for the preset you are saving.

You can save user presets from the 5518 PC Remote application. (See *Using the 5518 PC Remote Control Software* on page 3-8.) Please note that when you save presets from the PC Remote application, you save them in the 5518's memory (as if you had saved them from the 5518's front panel). The PC Remote application also allows you to *archive* presets to your computer's hard drive (or other storage device) and to restore them. However, archiving a preset is not the same as saving it. Archived presets reside on a storage medium supported by your computer, while saved presets reside in the 5518's local non-volatile memory. You cannot archive a preset until you have saved it. (See *To back up user presets, system files, and automation files onto your computer's hard drive* on page 3-11.)

Note that if, for some reason, you wish to save an unmodified preset (either Factory or User) under a new name, you must temporarily make an arbitrary edit to that preset in order to make the SAVE PRESET button ap-

pear. After you have saved the preset, reverse the edit and save the preset again.

ITU-R Multiplex Power Controller

The ITU-R recommends that the power in the composite baseband signal (including the pilot tone), integrated over any 60-second interval, not exceed the power in a sinewave that modulates the FM carrier to ±19 kHz (25.3% modulation re ±75 kHz deviation). Many European countries are now enforcing this recommendation.

The 5518 contains a patented, defeatable feedback multiplex power limiter that constantly monitors the multiplex power according to ITU-R 412 standards. The power controller automatically reduces the average modulation to ensure compliance. It allows you to set the "texture" of the processing freely, using any preset. If a given processing setting would otherwise exceed the multiplex power limit, the power controller automatically reduces the drive to the peak limiting system by increasing the amount of multiband compression. This action retains the processing texture but reduces distortion while controlling multiplex power.

The 5518 gives you control over the multiplex power threshold. This allows you to

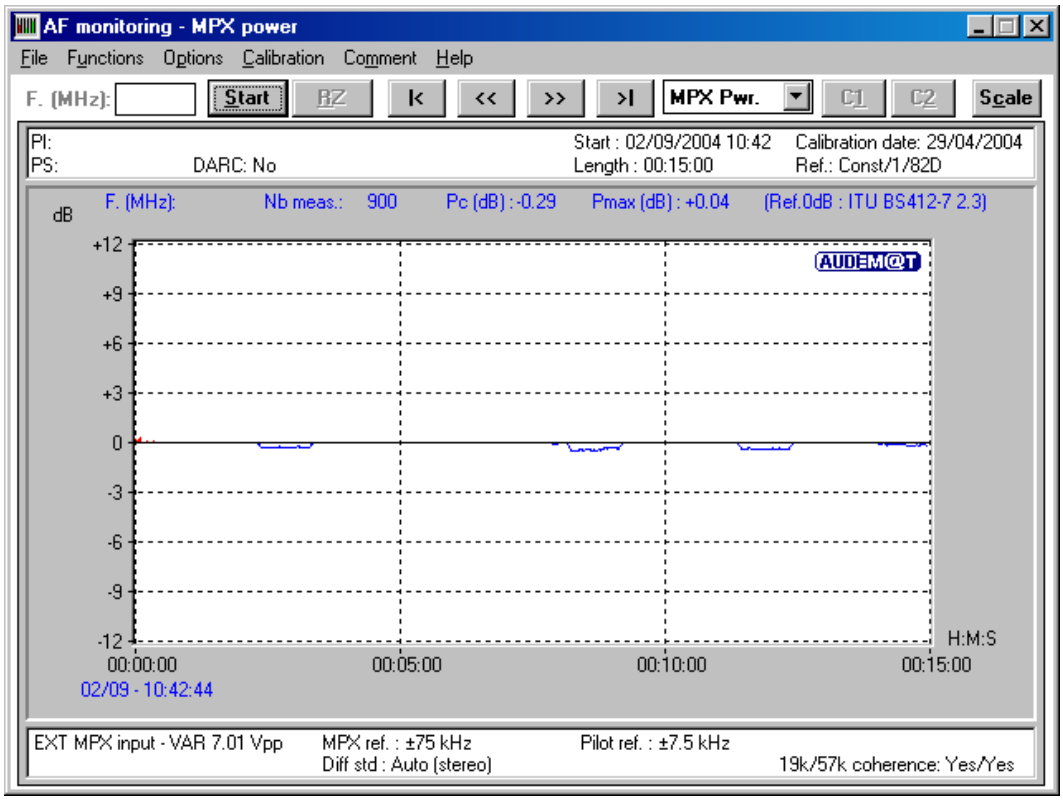


Figure 3-1: Multiplex Power over 15 Minute Observation Interval
with MPX Power Controller Active, measured at 5518's Composite Output

compensate for overshoots in the signal path upstream from the 5518, preventing excessive reduction of the multiplex power.

The ITU412 control is found in the MODIFY > STEREO ENCODER screen.

Power control is applied to all outputs, not just the composite output.

Multiplex Power Threshold

The 5518 provides a means to limit the integrated multiplex power to the ITU standard by a closed-loop technique. The multiplex power controller is adjusted via the ITU412-9 control (see step 29 on page 2-22). Set it OFF if your country does not enforce the standard.

If your country enforces the standard, you should set the control to complement the amount of peak overshoot in the transmission system following the 5518. Setting the control at "0" will correctly control the multiplex power when there is no overshoot after the 5518. This will typically be true when you are using your 5518's built-in stereo encoder to drive the transmitter directly.

Section 1 of this manual has an extensive discussion of overshoot in transmission paths. See page 1-11 and following pages.

Many paths have overshoot, and this forces you to reduce the average modulation to avoid overmodulating the transmitter. This would reduce the multiplex power by the same amount, forcing the multiplex power below the ITU requirement.

To compensate for this, match the ITU412-9 control to the peak overshoot of the transmission system following the 5518. For example, if RF peak deviation exceeds the peak deviation produced by the 5518's sinewave oscillator (set for 100% modulation) by 3 dB, set the MULTIPLEX POWER THRESHOLD to "+3."

The multiplex power controller does not operate in Test mode and will not prevent the 5518's test oscillator from producing illegal modulation. It is the responsibility of the operator to make sure that the test oscillator does not violate the ITU requirements. (To ensure this, never modulate the carrier with a single L+R tone that produces total carrier modulation, including pilot tone, of more than 24%.)

Setting up the Multiplex Power Control

We recommend setting up your transmission system to produce approximately 3 dB of average MPX power control. This avoids unnatural loudness variations.

To achieve this goal when an OPTIMOD-FM drives your 5518, reduce the drive into the 5518's peak limiters by turning down the MULTIBAND CLIPPING control in the on-air preset until the MPX Power gain reduction meter on the 5518 indicates an average of 3 dB of gain reduction. Save the result as a User Preset.

Do not reduce the drive level to the 5518 by turning down the driving 5518's output level control because this does not decrease distortion in the 5518's peak limiter, unlike turning down the MULTIBAND CLIPPING control.

SSB Stereo Encoder Operation

Starting with version 1.2.1, the 5518 allows its stereo encoder's stereo subchannel modulator to operate in an experimental compatible single sideband/vestigial sideband mode.

Please note that to control modulation peaks successfully in SSB/VSB mode, you must activate the 5518's composite limiter. This limiter is not activated in the factory default preset, so you must turn it on proactively if you wish to use SSB/VBS mode. We recommend setting the COMPOSITE LIMITER DRIVE control to 0.0 dB. You can access this control from the Intermediate Modify screens or from PC Remote.

SSB/VSB operation suppresses the upper sideband of the stereo subcarrier above 38,150 Hz, which reduces the occupied bandwidth of the FM-modulated RF signal. In SSB mode, the subchannel modulator acts as a pure SSB generator for L–R material in the frequency range of 150 Hz to 17 kHz and as a vestigial sideband generator below 150 Hz.

In normal operation, the stereo subchannel modulator produces a double sideband suppressed carrier signal with pairs of mirror image sidebands around 38 kHz. With respect to an L+R gain of 1, the gain of each sideband is 0.5. In SSB/VSB mode, the upper sideband is suppressed by at least 80 dB above a modulating frequency of 150 Hz and the gain of the lower sideband is 1.0. Below 150 Hz, the sum of the gains of the sideband pairs is 1.0. (The conventional DSB case is a limiting case of this, where the gains of the upper and lower sidebands are both 0.5 and sum to 1.) This "summation to 1" criterion is necessary to achieve compatibility with normal FM radios that use synchronous demodulation of the stereo subchannel. Almost every radio manufactured since 1973 works like this. We have verified that the 5518's SSB generator produces more than 60 dB of separation from 50 to 15,000 Hz when measured on a Belar FMSA-1 "Wizard" modulation monitor, which was originally designed for convention double sideband operation.

In SSB/VSB mode, the bandwidth of the 5518's composite output signal extends to 38,150 Hz when the 5518's composite limiter is not used. When the composite limiter is used, the limiting action will produce energy up to 55 kHz (as it does with normal DSB operation) but this energy will be much lower in level than the energy that would have been produced by normal DSB operation in the frequency range occupied by the upper sideband.

SSB operation causes irreducible, "laws of physics" composite peak modulation overshoots to occur with certain combinations of left and right channel signals that are independently peak limited to 100% modulation, which is the correct limiting technique for conventional double-sideband transmission. The worst-case irreducible SSB overshoot occurs when the left and right channels contain correlated signals whose phase difference is 90°.

Suboptimal system design can cause additional overshoots. To prevent this type of overshoot, the 5518's SSB/VSB generator uses constant-delay filters and its frequency response extends to DC (because of the VSB operation below 150 Hz).

The group delay of the phase-linear filters needed to create the SSB/VSB waveform and the audio delay in the look-ahead limiter together add approximately 12 ms to the delay of the stereo encoder. When diversity delay is applied to the 5518's composite output, the 5518 adjusts the delay automatically so that it is constant regardless of mode.

To control irreducible overshoots, the SSB generator includes a look-ahead overshoot limiter. To eliminate all overshoots, this limiter must be used together with the 5518's Half-Cosine Interpolation composite limiter, which is located after the look-ahead limiter in the system block diagram.

To activate SSB mode:

A) Navigate to *Setup* > STEREO ENCODER > MODE and select SSB.

SSB mode can also be activated via the 5518's GPI inputs and by PC Remote.

B) Check the setting of the MPX LIM DR control in the active processing preset (see page 2-25). If it is not set to 0.0 dB, set it to 0.0 dB and save the result as a user preset.

Because the composite limiter must work harder in SSB mode than in normal DSB mode to control peak levels, we recommend setting the MPX LIM DR control to 0.0 dB even if the preset has this control set higher than 0 dB when used in normal DSB mode. This will minimize any audible distortion caused by additional peak limiting when the composite limiter in SSB mode.

The look-ahead overshoot controller is always active in SSB mode, while the Half-Cosine Interpolation Composite Limiter is controlled by the active processing preset's COMP DRV control as usual.

Test Modes

The Test Modes screen allows you to switch between OPERATE, BYPASS, and TONE. When you switch to BYPASS or TONE, the preset you have on air is saved and will be restored when you switch back to OPERATE.

Table 3-1 shows the facilities available. Facilities are self-explanatory, except for the following:

- If you are using the composite output, a TONE LVL setting of 91% produces 100% modulation when the pilot tone is on and set to 9% injection. If you are using either the analog or digital outputs, a TONE LVL setting of 100% produces 100% modulation.
- In BYPASS mode, preemphasis is still applied to the signal path. The BYPASS GAIN control calibration allows enough internal headroom to make swept frequency response measurements without internal clipping. When the BYPASS GAIN control is set to 0.0 dB and the AI REF VU control is set to 0.0 dBu, you will observe a

gain of approximately –17 dB from the analog input to the analog output at 100 Hz. If the AO PRE-E control is set to PRE-E and the 5518 is configured for 75 µs preemphasis, the gain from analog input to analog output will be approximately 0 dB at 15 kHz.

While this calibration may seem unintuitive, experience has shown that it greatly reduces calls to Orban customer service complaining that the frequency response of the transmission path is not flat when in fact the measurement in question was causing undetected clipping at high frequencies due to preemphasis.

Setup: Test				
Parameter Labels	**Units**	**Default**	**Range (CCW to CW)**	**Step**
MODE	---	Operate	Operate, Bypass, Tone	---
BYPASS GAIN	dB	0.0	–18 … +25	1
TONE FREQ	Hz	400	16, 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000, 9500, 10000, 12500, 13586.76, 15000	LOG
TONE LVL	%	91	0 … 121	1
TONE CHAN	---	L+R	L+R, L–R, LEFT; RIGHT	---
PILOT	---	ON	ON, OFF	---

Table 3-1: Test Modes

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Using the 5518 PC Remote Control Software

5518 PC Remote control software allows you to access any 5518 control. The software also gives you the ability to backup user presets, system files, and automation files on your computer's storage devices (hard drives, floppy drives, etc.) and to restore them later to your 5518.

The 5518 PC Remote software can connect to your 5518 via modem, direct serial cable connection, or Ethernet network. It communicates with your 5518 via the TCP/IP protocol, regardless of how it is connected to your 5518.

PC Remote works best on displays of 1024x768 pel or higher. Scroll bars will appear when using lower resolutions.

Before running 5518 PC Remote, you must have installed the appropriate Windows communications services on your computer. By default, the installer installs a shortcut to 5518PC.exe on your desktop and in your Start Menu under Orban\5518.

5518 PC Remote can control only one 5518 at a time, but it can readily switch between several 5518s. 5518 PC Remote has a built-in "address book" that allows it to select and connect to:

- any 5518 on the same network as the PC,
- a 5518 that can be accessed through a modem connected to the PC via dial-up networking, and,
- a 5518 that is connected directly to the PC's serial port.

Before your PC can communicate with a given 5518, you must first set up a "connection," which is information that allows PC Remote to locate and communicate with the 5518.

To set up a new connection:

A) Launch 5518PC.exe.

B) Create a new 5518 connection by choosing NEW 5518 from the CONNECT file menu or by right-clicking on the ALL CONNECTIONS icon in the Connections List and selecting NEW 5518.

The Connection Properties dialog box opens.

C) Enter an Alias name for your 5518 (like "KABC").

D) Leave the password field blank to prompt the user to enter a password when initiating a connection.

Refer to *Security and Passcode Programming* on page 2-*30*.

Otherwise, enter a password to allow PC Remote to connect to your 5518 without requiring a password when the connection is initiated.

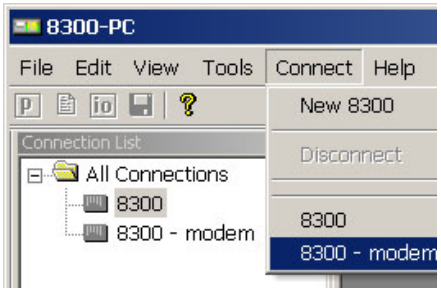
To initiate a successful connection, a password must have already been entered into your 5518 unit.

E) If you are communicating with your 5518 through a network, select the Ethernet radio button and enter the appropriate IP address, subnet mask, port, and gateway data. Note that these values must agree with the values that you set in your 5518 (see step 1 on page 2-42). See also *Setting Up Ethernet, LAN, and VPN Connections* on page 2-50.

If you are communicating via a direct serial cable connection or a modem connection, follow the appropriate procedure described in *Appendix: Setting up Serial Communications,* starting on page 2-51.

F) Click OK after entering all required information.

To initiate communication:



Initiate communication by double-clicking on the desired 5518 alias in the Connections List, or by selecting the desired 5518 alias from the CONNECT drop down menu.

If the connection is successful, a dialog bubble will appear on the bottom right hand corner of the screen verifying your connection.

- If a warning message appears stating: "No password is set at the 5518…" go to your 5518 unit and enter a passcode.
- If an Enter Passcode dialog box appears, enter a valid passcode and the 5518 PC Remote software will initiate a connection to the 5518 unit.

A window will appear saying, "Connecting to the 5518, please wait." A few moments later, a new message will appear: "Loading system files, please wait."

When run, the Orban PC Remote software installer makes copies of all 5518 factory preset files on your local hard drive. The PC Remote software reads these files to speed up its initialization. If any of these files have been deleted or damaged, the PC Remote software will refresh them by downloading them from the 5518. If the PC Remote software needs to do this, it can substantially increase the time required for the software to initialize, particularly through a slow modem connection.

When this download is finished, the main meters will appear.

- A wheel mouse is the quickest and easiest interface to use — you will rarely (if ever) have to use the keyboard.
- The help box at the bottom of the screen always presents a short help message for the function you have selected.

To modify a control setting:

A) Choose PROCESSING PARAMETERS from the EDIT menu.

B) Select menu tabs for Less-More, Stereo Enhancer, and EQ to access Basic Modify controls. All other menu tabs contain Full or Advanced Modify controls.

> You can reset any Basic Modify Control without losing LESS-MORE functionality; Full and Advanced modify control adjustments will cause LESS-MORE to be grayed-out.

To set a control, click it (it will become highlighted) and then adjust it by dragging it with the mouse or moving the wheel on the mouse.

You can also use the + and – keys on the numeric keypad to adjust any control.

To recall a preset:

A) Choose *Recall* PRESET from the FILE menu to bring up the OPEN PRESET FILE dialog box.

B) Click the desired preset within the dialog box to select it.

C) Double-click the desired preset or select it and click the *Recall* PRESET button to put it on-air.

Continually clicking the RECALL PRESET button will toggle between the current and previous on-air presets.

D) Click DONE to dismiss the OPEN PRESET FILE dialog box.

The folder on your hard drive containing the preset files (both Factory and User) is automatically synchronized to the contents of its associated 5518's memory each time 5518 PC Remote connects to that 5518. The 5518's memory is the "master." This means that if you delete a user preset from the 5518's memory (whether locally via its front panel or via 5518 PC Remote), 5518 PC Remote will automatically erase this preset from this folder on your computer. *To archive a preset permanently, you must use the Backup function.* (See page 3- 11.)

To save a user preset you have created:

A) Select SAVE PRESET AS from the FILE menu to bring up the SAVE AS Dialog Box. The current preset name will appear in the File Name field.

B) Click in the field, and edit it.

C) Click SAVE to save the preset to the 5518 as a User Preset.

If you have made edits to a previously existing user preset, you can select SAVE PRESET from the FILE menu to overwrite the pre-existing user preset automatically.

To back up User Presets, system files, and automation files onto your computer's hard drive:

A) Select BACKUP TO PC from the FILE Menu.

B) Click OK.

PC Remote will offer three options:

- Save User Presets, system files, and automation in plain text.

  This allows the presets and files to be read with any text editor program and to be readily exchanged between 5518 users.

- Save User Presets, system files, and automation files using the session passcode to encrypt them.

- Save User Presets, system files, and automation files using the password of your choice to encrypt them.

The encryption options prevent archived presets, system files, and automation files from being restored if the user does not have the password used for the encryption. *There is no "back door"— Orban cannot help you to decrypt a preset whose password is unknown.*

All User Preset, system, and automation files are copied from your 5518's internal memory to a folder called "backup" on your PC. This folder is a subfolder of the folder named the same as the alias of the 5518 that you are backing up.

This folder name ("backup") and location are hard-coded into the software. If you wish to move the backup files somewhere else later, use a file manager (like Explorer) on your computer.

To make more than one backup archive, rename the current backup folder (for example, to "Backup1"), 5518 PC Remote will create a new backup folder the next time you do a backup, leaving your renamed backup folder untouched. Later, you will be able to restore from any folder — the Restore dialog box allows you to choose the folder containing the files to be restored.

If you attempt to back up a preset with the same name as a preset existing in the Backup folder, but with a different date, 5518 PC Remote will warn you and will allow you to overwrite the preset in the Backup folder or to cancel the operation. If you wish to keep the existing archived preset, you can first use a file manager to move the existing user preset in the Backup folder to another folder and then repeat the backup operation.

To restore archived presets, system files, and automation files:

In addition to restoring an archived preset to its original 5518, you can also copy archived presets from one 5518 to another. The 5518 whose connection is active will receive the preset.

If the preset, system file, or automation file was encrypted when it was originally saved, PC Remote will request the password under which it was encrypted.

All User Presets are compatible with all 5518 software versions. If Orban adds new controls to a software version, the new software will assign a reasonable default value to any control missing in an old User Preset. If you archive such a User Preset after restoring it, the newly written archive file will now include the new controls (with the default values, unless you edit any of these values before you re-archive the preset).

A) Select RESTORE FROM PC from the FILE menu.

A standard Windows dialog box will open.

B) Select the type of files you want to restore using the FILES OF TYPE field at the bottom of the dialog box.

You can elect to restore 5518 user presets (*.orb5518user), system files (*.orb5518setup), and automation files (*.orb5518autom).

If you want to restore files from a different directory (i.e., that might have been created on a different 5518), navigate to that directory from within the dialog box.

C) To restore a single user preset:

a) Set the FILES OF TYPE field to a user preset file type (*.orb5518user).

b) Select the desired preset in the dialog box.

c) Click the RESTORE button.

D) To restore all the user presets from a specific location:

a) Set the FILES OF TYPE field to a user preset file type (*.orb5518user, *.orbu)

b) Highlight all the user presets in the dialog window

c) Click the RESTORE button.

E) To restore a system file:

a) Set the FILES OF TYPE field to the System Setup file type (*.orb5518setup).

b) Select the desired system file in the dialog box.

c) Click the RESTORE button.

F) To restore an automation file:

a) Set the FILES OF TYPE field to the Automation file type (*.orb5518autom)

b) Select the desired automation file in the dialog box

c) Click the RESTORE button.

G) Click DONE to dismiss the RESTORE dialog box.

To share an archived User Preset between 5518s:

A) Navigate to the directory containing the desired User Preset from within the RESTORE FROM PC dialog box

B) Click the RESTORE button.

This User Preset will be downloaded to the 5518 to which 5518 PC Remote is currently connected.

If the User Preset is encrypted, PC Remote will request its password.

To modify INPUT/OUTPUT and SYSTEM SETUP:

Choose SETUP from the TOOLS menu.

To set a control, click it (it will become highlighted) and then use the wheel on the mouse to adjust it. You can also use the + and – keys on the numeric keypad to adjust any control.

To modify AUTOMATION:

A) Choose AUTOMATION from the TOOLS menu.

An Automation Dialog box will open.

B) Click the NEW EVENT to create a new event

Controls to set the event type and time are available on the right hand side of the dialog box.

C) Check the ENABLE AUTOMATION check box at the top of the dialog box to enable automation.

To group multiple 5518s:

Right-click ALL CONNECTIONS in the Connections List and select NEW GROUP.

You can add multiple 5518 to a single group to help organize a network of 5518. However, only one 5518 from within a group can be connected to 5518 PC Remote at any one time.

Operation Using the Keyboard

As far as possible, PC Remote uses standard Windows conventions for navigation.

Navigate around the screens using the TAB key. Use CTRL-TAB to move to the next tabbed screen in PC Remote.

Use the + and – keys or the left and right arrow keys on the numeric keypad to adjust control settings.

To Quit the Program

Use standard Windows conventions: Press ALT-F4 on the keyboard, or click the X on the upper right corner with the mouse.

Also, please note the following behavior:

- If you close the PC Remote connection from the PC, you will be given the choice of staying connected through the ppp or disconnecting.
- If you close the connection from PC Remote but choose not to close the ppp connection, the END PC REMOTE button will remain displayed on the 5518's front panel. If you then select that button, the ppp connection will close.

  This behavior ensures that a user can tell from the 5518's front panel if a remote connection is active. A user can disconnect the PC connection at the 5518 if he or she wishes. This minimizes the likelihood of someone's leaving a connection open while someone else tries to access that 5518.

About Aliases created by 5518 PC Remote Software

When you ADD A NEW 5518 using 5518 PC Remote, your 5518 is automatically given a 5518 Alias name to differentiate it from other 5518s. You can change the name anytime in the 5518 Properties window inside 5518 PC Remote.

When you add a new 5518 or change the name of an existing 5518 Alias, an Alias folder is created in the same location as the executable for 5518 PC Remote (usually \Program Files\Orban\5518). The folder has the same name as the Alias name. Once you establish the initial connection to the 5518, all presets for that 5518 are automatically copied to the Alias folder; thus, the folder contains all the preset files for that 5518, both Factory and User. If you have backed up the 5518 using 5518 PC Remote, there will also be a "backup" subfolder located within the Alias folder.

> Archived user preset files saved without encryption are text files and can be opened in a text editor (like Notepad) if you want to examine their contents.

Alias folders and their associated backup subfolders are registered in your PC's Registry. This prevents folders from being accidentally deleted or moved. If you move or delete Alias folders from the PC, the Alias folders recreate themselves in the previous location and restore their contents by copying it from their associated 5518s when 5518 PC Remote connects to such a 5518.

Multiple Installations of 5518 PC Remote

Rarely, you may want to have more than one installation of 5518 PC Remote on your computer. There are a few extra things to know if you have multiple installations.

If you install a new version of the 5518 PC Remote software on your PC, any Alias folders and backup subfolders created in an earlier software version still remain in their original location on your PC (and in its registry).

The version of 5518 PC Remote must match the version of the software in the 5518 controlled by it. Therefore, you will only need multiple installations of PC Remote (having separate version numbers) if:

- you are controlling multiple 5518s, and
- not all of your 5518s are running the same version of 5518 software, and
- you do not want to upgrade at least one controlled 5518 to the latest version of 5518 PC Remote software.

Each version of 5518 PC Remote has its own top-level folder, normally under \Program Files\Orban. (The default folder is \Program Files\Orban\5518.) When you install a new version of 5518 PC Remote, the default behavior is to overwrite the old version, which is usually the desired behavior. To prevent the installer from overwriting the old version, you must specify a different installation folder when you install the new version (for example, \Program Files\Orban\5518v2).

Each version of 5518 PC Remote will display *all* 5518 Aliases, even those pointing to 5518s with incompatible version numbers. If you attempt to connect to an older version of 5518 from a newer version of 5518 PC Remote, 5518 PC Remote will offer to upgrade the software in the target 5518 so that it corresponds to the version of 5518 PC Remote that is active. If you attempt to connect to newer version of 5518

from an older version of 5518 PC Remote, it will refuse to connect and will emit an error message regarding incompatible versions.

If you decide to install the new software to a different location on your PC, new Aliases created using the new software will not be located in the same place as the old Aliases.

To Move Alias Folders:

Even though each version of 5518 PC Remote can see all aliases, you may wish to move the corresponding folders so they are under the folder corresponding to the highest version of 5518 PC Remote that is currently installed on your computer (although this is not required). If your Alias folders reside in different locations, you can move all the Alias folders to the same location by using the PC Remote software. *Do not use an external file manager to do this.* The old Alias folders need to be recreated under the 5518 PC Remote software you wish to use (so that the registry entries can be correctly updated). You can do this two different ways.

- **Rename the Alias** (preferred): Start the 5518 PC Remote executable you wish to use and rename your old Aliases with a slightly different name. A new Alias folder with the new name will be created in the same location as the 5518 PC Remote executable.

- **Delete and Recreate the Alias:** Start the 5518 PC Remote executable you wish to use. Delete the old 5518 Aliases and create new ones to replace them. New Alias folders will be created in the same location as the 5518 PC Remote executable.

  Important: The deletion process will automatically erase its associated folder, including the Backup directory. If you have anything in the Backup directory that you wish to keep, you should therefore move that directory elsewhere (or transfer the desired files to another, active backup directory). Use a Windows file manager like Windows Explorer to do this.

  The erasure process will usually move the Backup directory to your computer's Recycle Bin, so you can recover a Backup directory that you have accidentally deleted in this way.

Section 4
Maintenance

Routine Maintenance

The 5518 uses highly stable analog and digital circuitry throughout. Recommended routine maintenance is minimal.

1. **Periodically check audio level and gain reduction meter readings.**

   Become familiar with normal audio level meter readings, and with the normal performance of the G/R metering. If any meter reading is abnormal, see Section 5 for troubleshooting information.

2. **Listen to the 5518's output.**

   A good ear will pick up many faults. Familiarize yourself with the “sound” of the 5518 as you have set it up, and be sensitive to changes or deterioration. However, if problems arise, please do not jump to the conclusion that the 5518 is at fault. The troubleshooting information in Section 5 will help you determine if the problem is with the 5518 or is somewhere else in the station's equipment.

3. **Periodically check for corrosion.**

   Particularly in humid or salt-spray environments, check for corrosion at the input and output connectors and at those places where the 5518 chassis contacts the rack.

4. **Periodically check for loss of grounding.**

   Check for loss of grounding due to corrosion or loosening of rack mounting screws.

5. **Clean the front panel when it is soiled.**

   Wash the front panel with a mild household detergent and a damp cloth. Do not use stronger solvents; they may damage plastic parts, paint, or the silk-screened lettering. Do not use paper-based cleaning towels, or use cleaning agents containing ammonia, or alcohol. An acceptable cleaning product is “Glass Plus.” For best results when cleaning the lens, use a clean, lint-free cloth.

Subassembly Removal and Replacement

See page 6-27 for the *Circuit Board Locator and Basic Interconnections* diagram.

1. Removing the Top Cover:

To access any internal board (including the display assembly), you must remove the top cover.

A) Disconnect the 5518 and remove it from the rack.

Be sure power is disconnected before removing the cover.

Warning: Hazardous voltage is exposed with the unit open and connected to the AC line. Some of the metal parts in the switching power supply are connected to the AC line. These parts are shielded with insulating paper that has a warning printed on it.

B) Set the unit upright on a padded surface with the front panel facing you.

C) Remove all screws holding the top cover in place, and lift the top cover off.

Use a #1 Phillips screwdriver.

2. Removing the Front Panel Assembly:

A) Detach the cables that connect the display board assembly to the control board. Avoid bending or breaking the pins. Note the lead dress so you can reassemble the unit correctly.

B) Detach the front panel from the unit.

a) On each side of the chassis, remove the three screws close to the front panel.

b) Remove the front panel by sliding it out.

C) Set the front panel, face down, on a soft cloth to prevent scratches.

D) Using a 3/16-inch hex nut driver, remove the four hex nuts holding the two side brackets and central shield to the front panel. Remove the brackets and shield and set them aside.

E) Using a #1 Philips screwdriver, remove and reserve the eight screws and spacers that fasten the display board assembly to the front panel.

F) Lift the display board assembly off its supporting standoffs.

G) Separate the two boards in the display board assembly by carefully unplugging the top board from the bottom board. Note that there are four plugs and jacks.

3. Removing the Composite/SCA daughterboard.

A) Unplug the cable connecting the Composite/SCA daughterboard to the I/O-DSP board.

B) Using a deep hex nut driver (preferred), a small crescent wrench, or a pair of slip-joint pliers (in an emergency), remove the nuts and lockwashers holding the four BNC connectors to the chassis.

The Composite/SCA daughterboard can now be removed.

4. Removing the Control board:

A) If you have not yet done so, remove the top cover and Composite/SCA daughterboard (steps 1 and 3, above).

B) Using a 3/16-inch hex nut driver, remove the four hex nuts holding the DB-25 and DB-9 connectors to the rear panel of the chassis.

C) If you have yet not done so, remove the cables that connect the display assembly to the control board (step 2 on page 4-2).

D) Disconnect the ribbon cable connecting the control board to the I/O+DSP board.

E) Disconnect the short two-conductor cable that connects the control board to the I/O+DSP board.

F) Using a #1 Philips screwdriver, remove the four corner screws holding the control board to the chassis standoffs.

G) The control board is now free and can be removed from the chassis.

5. Removing the I/O+DSP (Input/Output+DSP) Board:

A) If you have not yet done so, remove the top cover (steps 1 above).

B) Unlock all XLR connectors: Using a jeweler's screwdriver, engage the locking mechanism (in the center of the triangle formed by the three contact pins) and turn counterclockwise until the XLR connector is no longer attached.

C) Using a deep hex nut driver (preferred), a small crescent wrench, or a pair of slip-joint pliers (in an emergency), remove the nut and lockwasher fastening the BNC connector to the chassis.

D) If you have not yet done so, disconnect the ribbon cable that connects the I/O+DSP board to the control board.

E) If you have not yet done so, disconnect the short two-conductor cable that connects the I/O+DSP board to the control board.

F) Disconnect the cable connecting the power supply to the I/O+DSP board. There are two connectors; unplug both. Note the lead dress so you can reassemble the unit correctly.

G) If you have not yet done so, disconnect the cable going to the Composite/SCA daughterboard.

H) Remove the thirteen #1 Phillips screws (and their washers) that connect the I/O+DSP board to the chassis.

I) Carefully pull the I/O+DSP board toward the front panel to clear the XLRs from their housings. Then lift the board out of the chassis.

6. Removing the Power Supply:

IMPORTANT: The power supply has no user serviceable components because replacing components with other than exact replacements could cause the supply to become unsafe and/or to generate unacceptable EMI that violates FCC and/or CE regulations. If the power supply fails, please contact Orban Customer Service (custserv@orban.com) to obtain an exact replacement.

Verify that the 5518 is disconnected from the AC line.

A) If you have not yet done so, remove the top cover (step 1, above).

B) Remove the screw holding the power supply's insulating cover and remove the cover. For safety, this cover must always be in place when the 5518 is connected to the AC line.

C) Remove the plug that connects the power supply to the AC line socket.

D) Unplug the cable connecting the output of the power supply to the I/O+DSP board.

E) Using a hex nutdriver, remove the threaded standoff that supports the power supply's insulating cover.

F) Remove the three Phillips screws holding the power supply to the main chassis.

G) Carefully lift the power supply up to remove it.

7. Reattaching the Power Supply:

A) Set power supply into main chassis, so that it aligns with its associated standoffs.

B) Thread, but do not tighten, the three Phillips screws that hold the power supply board to the main chassis.

C) Thread the long threaded standoff in the remaining mounting hole. Tighten it firmly.

D) Tighten the three Phillips screws that hold the power supply board to the main chassis.

E) Reattach the plug that connects the power supply to the AC line socket.

F) Reattach the cable that connects the power supply board to the I/O+DSP board.

G) Secure the insulating cover to the long standoff. **This cover must be replaced for safety.**

8. Replacing the Control board and I/O Board+DSP board:

Referring to steps 4 and 5, follow the instructions in reverse.

9. Replacing the Composite/SCA Daughterboard

Referring to step 3, follow the instructions in reverse.

10. Replacing the Front Panel Assembly:

A) Set the front panel, face down, on a soft cloth to prevent scratches.

B) Lightly reattach the bottom and top circuit boards by mating the four plugs and jacks. Use care to align the pins with the jacks so that all pins are correctly aligned and no pins are bent. Do not push the pins all the way into the jacks yet; leave room between the upper and lower boards for spacers.

C) Reattach the board assembly to the front panel using the eight #1 Philips-head screws and spacers removed in step (2.E) on page 4-2:

a) Thread each screw through a spacer placed between the upper and lower circuit boards.

b) Push down the top board until it rests on the spacers.

c) Align the screws with the threaded standoffs on the front panel.

d) Evenly tighten all eight screws to reattach the board assembly to the panel.

D) Place the two side brackets over the captive screws located on each side of the front panel. Be sure that the large side of each bracket is oriented toward the rack-screw cutouts in the panel.

E) Place the metal shield over the captive screws on each side of the front panel. Align the shield so that its cutouts are aligned with the cables attached to the circuit board assembly. Using a 3/16" nut driver, screw four hex nuts onto the captive screws.

F) Attach the front panel assembly to the unit:

a) Verify that all cables are dressed through cutouts in the shield.

b) Slide the front panel assembly into the front of the chassis so that the three threaded holes in the side brackets line up with the holes in the sides of the chassis.

c) Attach the front panel assembly by screwing the six screws removed in step (2.B)a) on page 4-2 into the holes in the sides of the chassis.

G) Reattach the four cables that connect the display board to the control board. Each cable has a different type or size of connector, so it is obvious which cable mates with which jack on the control board.

Carefully align the cables and connectors to avoid bending the pins.

11. Replacing the Top Cover:

Place the cover on the unit and reinstall the Phillips screws. (Be careful not to pinch any cables.)

Field Audit of Performance

Required Equipment:

- Ultra-low distortion sine-wave oscillator/THD analyzer/audio voltmeter

  With verified residual distortion below 0.01%. Audio Precision System One, or similar high-performance system.

  The *NAB Broadcast and Audio System Test CD* is an excellent source of test signals when used with a high-quality CD player.

- Spectrum analyzer with tracking generator

  Stanford Research Systems SR760 or equivalent. Alternatively, a sweep generator with 50-15,000 Hz logarithmic sweep can be used with an oscilloscope in X/Y mode, or you can use a computer-controlled test set like the Audio Precision System Two.

- Digital voltmeter

  Accurate to ±0.1%.

- Oscilloscope

  DC-coupled, triggered sweep, X/Y display-capable with 10 MHz or greater vertical bandwidth.

- Optional: Audio Precision System 1 (without digital option) or System 2 (for digital tests), Stanford Research Systems SR1 (for analog and digital tests), or NTI Audio Digilyzer DL1 (for digital output tests)

- Optional: Synthesized 10 MHz function generator for sync tests

  Stanford Research Systems DS340 or equivalent.

The technician should be thoroughly familiar with the operation of this equipment.

This procedure is useful for detecting and diagnosing problems with the 5518's performance. It includes checks of frequency response, noise and distortion performance, and output level capability.

This performance audit assesses the performance of the analog-to-digital and digital-to-analog converters and verifies that the digital signal processing section (DSP) is passing signal correctly. Ordinarily, there is a high probability that the DSP is performing the dynamic signal processing correctly. There is therefore no need to measure such things as attack and release times — these are defined by software and will automatically be correct if the DSP is otherwise operating normally.

It is often more convenient to make measurements on the bench away from high RF fields which could affect results. For example, in a high RF field it is very difficult to accurately measure the very low THD produced by a properly operating 5518 at most frequencies. However, in an emergency it is usually possible to detect many of the more severe faults that could develop in the 5518 circuitry even in high-RF environments.

See the assembly drawings in Section 6 for component locations.

Be sure to disconnect the AC line cord before removing or installing circuit boards.

Follow these instructions in order without skipping steps.

Note: To obtain an unbalanced output, jumper pin 1 (ground) to pin 3, and measure between pin 1 (ground) and pin 2 (hot).

Note: All analog output measurements are taken with a load resistance of 10K or higher, corresponding to the modern practice of terminating analog lines with a bridging load.

1. Test the power supply

The power supply is a module. In case of any power supply failure, the entire supply must be replaced by an exact replacement (available from Orban Service). Attempts to repair the supply on a component level and/or to replace the supply with a non-approved supply may compromise your 5518's compliance with the EMI and safety regulations in your country.

The +3.3V, +1.2V, and +2.5V supplies are locally regulated on the DSP and control boards (see Section 6).

Measure the power supply's regulated voltages at the DVM and observe the ripple with an oscilloscope, AC-coupled. Convenient sources of these voltages are the inductors adjacent to power supply connectors on the I/O+DSP board. Connect your probe to the sides of the inductors away from the power supply connectors. The results in Table 4-1 are typical.

Power Supply Rail	DC Voltage (volts)	AC Ripple (mV p-p)
+15VDC	+15 ± 0.5	<20
–15VDC	–15 ± 0.5	<20
+5VDC	+5 ± 0.25	<20

Table 4-1: Typical Power Supply Voltages and AC Ripple

2. Prepare the unit for audio measurements.

A) Use the front panel controls to set the 5518's software controls to their default settings as follows:

a) Navigate to *Setup* > I/O CALIB > ANLG IN CALIB. After writing down the old settings (so you can restore them later) or saving them via PC Remote, set controls as follows:

INPUT ..... analog
AI Ref VU ..... 0.0 dBu
R CH BAL.....0.0 dB

b) Navigate to *Setup* > I/O CALIB > DIG IN CALIB. Set controls as in the table below:

DI REF VU ..... –15.0 dBFS
R CH BAL ..... 0.0 dB

c) Navigate to *Setup* > I/O CALIB > ANLG OUT CALIB. Set controls as follows:

AO 100% ..... +10.0 dBu
AO PRE-E ..... Flat
AO SOURCE ..... FM

d) Navigate to *Setup* > I/O CALIB > DIG OUT CALIB. Set controls as follows:

DO 100% ..... –2.8 dBFS
DO PRE-E ..... flat
DO RATE ..... 32 kHz
DO SOURCE ..... FM
DO SYNC ..... PILOT SYNC
PILOT SYNC ..... Internal
DITHER ..... In
FORMAT ..... AES

e) Press the *Next* button. Set controls as follows:

WORD LENGTH 20

f) Navigate to *Setup* > STEREO ENCODER. Press the *Next* button. Set the ITU412 control to OFF.

g) Navigate to *Setup* > TEST. Set controls as follows:

MODE ..... Bypass
NOTE: Bypass defeats all protection limiting but retains the selected pre-emphasis (either 50µs or 75µs).

BYPASS GAIN ..... 0.0 dB
TONE FREQ ..... 400 Hz
TONE LVL 91%

h) Press the *Next* button.

i) Set controls as follows:

TONE CHAN ..... L+R
PILOT ..... ON

3. Adjust Analog Output Level Trim.

A) Verify 5518 software controls are set to their default settings. [Refer to step (2.A) on page 4-7.]

B) Feed the 5518 output with the built-in 400 Hz test tone:

a) Navigate to *Setup* > TEST.

b) Set the MODE to TONE.

C) Connect the audio voltmeter to the Left Analog Output.

D) Adjust output trim VR301 to make the meter read +10.0 dBu. (0 dBu = 0.775V rms.) Verify a frequency reading of 400 Hz.

E) Verify THD+N reading of <0.03% (<0.01% typical) using a 22 kHz low pass filter in the distortion analyzer.

F) Set the MODE to BYPASS.

> BYPASS defeats all compression, limiting, and program equalization but retains preemphasis.

G) Verify a reading (noise) of <–80 dBu at the output of the unit.

H) Using VR302, repeat steps (C) through (G) for the Right Analog Output.

4. Check frequency response of Analog I/O.

A) Verify 5518 software controls are set to their default settings. [Refer to step (2.A) on page 4-7.]

B) Be sure you are still in BYPASS mode and that the BYPASS GAIN = 0.0 dB [see step (3.F)].

C) Connect the oscillator to the Left Analog Input XLR connector.

D) Inject the Analog Input XLR connector with a level of +10 dBu with the oscillator set to 100 Hz.

> This is 17 dB below the clip level, which allows headroom for preemphasis. (75µs preemphasis will cause 17 dB of boost at 15 kHz.)

E) Connect the audio analyzer to the 5518's Left Analog Output XLR connector.

F) Verify a level of 0 dBu ±1 dB. Use this level as the reference level.

G) Verify that frequency response at 50 Hz, 100 Hz, 400 Hz, 5 kHz, and 15 kHz is within ±0.1 dB of the reference level. Figure 4-1 shows a typical result.

> This procedure tests the analog input circuitry, the A/D converter, the DSP, the D/A converter, and the analog output circuitry.

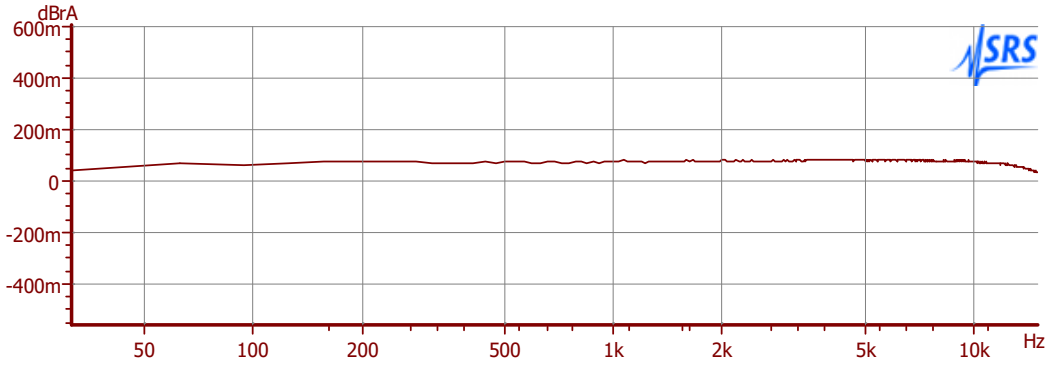


Figure 4-1: Typical Frequency Response, 30Hz to 15 kHz

H) Repeat steps (C) through (G) for the right channel.

5. Check distortion performance of Analog I/O.

A) Verify 5518 software controls are set to their default settings. (Refer to page 4-7.)

B) Be sure you are still in BYPASS mode [see step (3.F)] and set the BYPASS GAIN to +17.0 dB.

C) Set the AO 100% control to +20 dBu.

D) Connect a THD analyzer to the Left Analog Output XLR connector. Set the THD analyzer's bandwidth to 22 kHz.

E) Connect the oscillator to the Left Analog Input XLR connector. Set its frequency to 50 Hz and its output level to +10 dBu. This should produce a level of approximately +18 dBu at the 5518's output.

F) For each frequency used to measure THD, adjust the output level of the oscillator to make the COMP meter on the 5518 read 100. You will have to reduce the output level of the oscillator at higher frequencies to compensate for the preemphasis boost in the 5518. As the frequency increases, you will have to reduce the output level of the generator to follow the 75µs deemphasis curve. At 15 kHz, you should have to reduce the output of the generator to approximately –7 dBu.

G) Measure the THD+N at the frequency levels listed below.

Frequency	THD+N Typical	THD+N Maximum
50 Hz	0.015%	0.03%
100 Hz	0.015%	0.03%
400 Hz	0.015%	0.03%
1 kHz	0.015%	0.03%
2.5 kHz	0.015%	0.03%
5 kHz	0.015%	0.03%
7.5 kHz	0.015%	0.03%
10 kHz	0.015%	0.03%
15 kHz	0.015%	0.03%

H) Repeat the above measurements for the right channel. Connect the oscillator to the right analog input and the distortion analyzer to the right analog output.

I) Disconnect the oscillator and THD analyzer from the 5518.

6. Test Digital Sample Rate Converter (Receiver).

A) Verify 5518 software controls are set to their default settings. (Refer to page 4-7.)

B) Be sure you are still in BYPASS mode [see step (3.F)].

C) Navigate to *Setup* > I/O CALIB > DIG IN CALIB.

D) Set the INPUT to DIGITAL.

E) Connect the digital source generator to the AES3 Digital Input XLR connector of the 5518.

F) Set the frequency of the digital source generator to 400 Hz and its output level to 18 dB below full scale.

G) Inject the Digital Input with sample rates of 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, and 96 kHz. Use 24-bit words.

H) Listen to the analog outputs of the 5518 and verify that the output sounds clean and glitch-free regardless of the input sample rate.

I) Leave the digital source generator connected to the 5518.

7. Test Digital Sample Rate Converter (Transmitter).

A) Connect an AES3 analyzer (like the Audio Precision System 2) to the AES3 Digital Output XLR connector of the 5518.

B) Set the sample rate of the digital source generator to 48 kHz.

C) Navigate to *Setup* > I/O CALIB > DIG OUT CALIB.

D) Change the DO RATE to 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, and 96 kHz, and verify that the frequencies measured at the 5518's AES3 Digital Output follow the values in the chart below within given tolerances:

Sample Rate	Tolerance (PPM)	Tolerance (Hz)
32.0 kHz	100 PPM	±3.20 Hz
44.1 kHz	100 PPM	±4.41 Hz
48.0 kHz	100 PPM	±4.80 Hz
88.2 kHz	100 PPM	±8.82 Hz
96.0 kHz	100 PPM	±9.60 Hz

E) Disconnect the digital source generator from the 5518.

8. Test the 5518's synchronization capabilities.

A) Navigate to *Setup* > I/O CALIB > DIG OUT CALIB.

B) Press the *Next* button. Set the 5518's PILOT SYNC control to REF IN.

C) Sequentially apply a 32kHz, 44.1 kHz, 48 kHz, 88.2 kHz, and 96 kHz 1x wordclock signal to the 5518's REF IN connector. For each sample frequency, set the 5518's DO RATE control the same as the wordclock. Vary the frequency of the input reference slightly and verify that the sample frequency at the 5518's digital output tracks the changes you make to the reference frequency.

This test is most readily accomplished by using a synthesized function generator with a crystal-controlled timebase. Such a generator can also generate a 10 MHz reference signal for the next step.

An analog oscilloscope can be used for a more thorough test. Set the scope for X/Y operation (i.e., so that it generates Lissajous patterns).

Connect the reference generator to one input and the 5518's digital output to the other input. If correct synchronization is occurring, you should see an essentially stationary (although complex-looking) Lissajous pattern as opposed to one that precesses slowly either left or right. This should be true at any combination of input and output sample frequencies and a thorough test will test every permutation.

This test verifies that for non-identical reference and output sample frequencies (for example, locking a 32 kHz output sample rate to a 48 kHz wordclock), the output and input sample rates are exactly a ratio of integers. In the example, the output sample rate is exactly 2/3 of the wordclock frequency.

A digital oscilloscope is unlikely to work satisfactorily for this test.

D) Connect either a source of 1x wordclock (a TTL-level squarewave at the sample frequency) or a high-accuracy 10 MHz sinewave or squarewave generator to the 5518's REF IN BNC connector. Vary the frequency of the reference input by ±25 ppm and verify that the 5518's output sample rate tracks it. See the comments in step (C) above.

E) Set the 5518's PILOT SYNC control to DIG IN.

F) Sequentially apply AES3 or AES11 signals having 32kHz, 44.1 kHz, 48 kHz, 88.2 kHz, and 96 kHz sample frequencies to the 5518's AES3 Digital Input. Using the oscilloscope technique described in step (C) above, verify that for each input sample frequency, any 5518 output sample frequency (as set via the DO RATE control) will lock to any reference sample frequency.

G) Disconnect the generator from the 5518's REF IN connector.

H) Set the PILOT REF control to INTERNAL.

9. Test the 5518's stereo encoder functionality.

A) Connect an accurate stereo monitor like the Belar FMMS-1 ("Wizard") stereo demodulator to the COMPOSITE OUTPUT 1 BNC on the 5518's rear panel.

NOTE: The recommended Belar monitor is the only instrument we have encountered that can accurately measure the performance of the 5518's stereo encoder. With most older-technology monitors, you will be measuring the performance of the monitor, not the 5518's encoder. (Of course, we have not evaluated every monitor on the market.) While we have not yet tested it, we are confident that the Belar FMCS-1 (a newer model than the FMMS-1) will also work correctly.

B) On the 5518, navigate to *Setup* > TEST.

C) Set the MODE to TONE.

D) Set the test tone parameters as follows:

TONE FREQ ..... 400 Hz
TONE LVL 91%
TONE CHAN ..... L+R
PILOT ..... On

You will have to press the NEXT button to access all of these parameters.

E) Navigate to *Setup* > STEREO ENCODER.

F) Set the COMP1 LVL control to make the stereo monitor read 100% total modulation.

G) Navigate to *Setup* > TEST to access the 5518's tone oscillator parameters.

H) Measure the L–R level on the stereo monitor at several frequencies, in units of dB below 100% modulation. This is the main channel to subchannel crosstalk. It should not exceed –70 dB, 50-15,000 Hz.

I) Set the TONE CHAN to L–R. (You will have to press the *Next* button to access this setting and then the *Prev* button to return to the TONE FREQ control.) Measure the L+R level on the stereo monitor at several frequencies, in units of dB below 100% modulation. This is the subchannel to main channel crosstalk. It should not exceed –70 dB, 50-15,000 Hz.

J) Set the TONE CHAN to LEFT. Measure the Right level on the stereo monitor at several frequencies, in units of dB below 100% modulation. This is left-into-right stereo separation. It should not exceed –55 dB, 50-15,000 Hz.

K) Set the TONE CHAN to RIGHT. Measure the Left level on the stereo monitor at several frequencies, in units of dB below 100% modulation. This is right-into-left stereo separation. It should not exceed –55 dB, 50-15,000 Hz.

L) Set the TONE CHAN to L–R and the TONE FREQ to 5000.0 HZ. Measure the 38 kHz subcarrier suppression on the stereo monitor. It should not exceed –60 dB.

M) Measure the Pilot Modulation on the stereo monitor. It should read 0%.

N) Set *Setup* > STEREO ENCODER > COMP1 LVL to 0.0%. Measure the de-emphasized noise at the left and right outputs of the stereo monitor. It should not exceed –80 dB below 100% modulation.

O) Repeat steps (D) through (N) for the 5518's COMPOSITE OUTPUT 2. (Use the COMP2 LVL control instead of the COMP1 LVL control.)

P) Using the stereo monitor, verify that pilot tone injection is between 8% and 10% modulation. If it is outside these parameters, adjust it to 9% via *Setup* > STEREO ENCODER > *Next* > PILOT LVL.

> If the measured pilot level varies by more than a few tenths of percent from the pilot level indicated, this indicates there may be a problem elsewhere — either in your measuring setup, or with the 5518.

Q) With the COMP2 LVL still set to 0.0%, connect a frequency counter to either of the 5518's composite outputs. Verify that the pilot tone frequency is 19,000 Hz ±1 Hz.

10. Optional tests.

A) You can test each GPI (Remote Interface) input for functionality in the obvious way, by programming a function for it and then verifying that the function executes when you activate the input. To program a GPI input, see *Connecting to the 5518's* Ethernet Port or Serial Port via a Terminal Program on a PC on page 2-34.

B) You can test the RS-232 port for functionality by verifying that you can connect to a PC through a null modem cable. See *Networking and Remote Control* starting on page 2-42 (in particular, step 4 on page 2-44).

11. Return the 5518 to service.

A) Restore your normal operating parameters, using the notes you made in step (2.A) on page 4-7. If you are using PC Remote and saved your normal operating parameters as a setup file, you can restore it using the FILE > RESTORE FROM PC command.

B) Navigate to *Setup* > TEST > MODE and choose OPERATE.

C) Recall your normal operating preset.

Section 5 Troubleshooting

Problems and Potential Solutions

Always verify that the problem is not the source material being fed to the 5518, or in other parts of the system.

RFI, Hum, Clicks, or Buzzes

A grounding problem is likely. Review the information on grounding on page 2-10. The 5518 has been designed with very substantial RFI suppression on its analog and digital input and output ports, and on the AC line input. It will usually operate adjacent to high-powered transmitters without difficulty. In the most unusual circumstances, it may be necessary to reposition the unit to reduce RF interference, and/or to reposition its input and output cables to reduce RF pickup on their shields.

Particularly if you are using a long run of coaxial cable between the 8500 and the exciter, a ground loop may inject noise into the exciter's composite input—especially if the exciter's input is unbalanced. A Jensen JT-123-BMCF transformer can almost always cure this problem—see page 1-11.

The AES3 inputs and output are transformer-coupled and have very good resistance to RFI. If you have RFI problems and are using analog connections on either the input or output, using digital connections will almost certainly eliminate the RFI.

Unexpectedly Quiet On-Air Levels

The ITU412 multiplex power controller may have been turned on accidentally. See step 29 on page 2-22.

The audio processor driving the 5518 may be misadjusted or may have poor peak control. Note that audio processors intended for use in audio production will perform poorly when used as transmission audio processors for FM. The audio processor driving the 5518 must have a competently designed preemphasis limiter, set to match the FM preemphasis standard in your country, must have a non-overshooting peak limiter, and must band-limit their output to 17 kHz or below. Orban OPTIMOD-FM processors fulfill these requirements.

The 5518 may not be controlling peak modulation as desired. See the next topic below.

Poor Peak Modulation Control

When set up correctly and with its overshoot limiters (left/right and composite) enabled, the 5518 normally controls peak modulation to an accuracy of ±2%. This accuracy will be destroyed if the signal path following the 5518 has poor transient response. Almost any link can cause problems. Even the FM exciter can have insufficient flatness of response and phase-linearity (particularly at low frequencies) to disturb peak levels. Section 1 of this manual contains a complete discussion of the various things that can go wrong.

Digital STLs using lossy compression algorithms (including MPEG1 Layer 2, MPEG1 Layer 3, Dolby AC2, and APT-X) will overshoot severely (up to 3 dB) on some program material. The amount of overshoot will depend on data rate — the higher the rate, the lower the overshoot. However, when such a path is used between your audio processor and the 5518, the 5518's left/right overshoot limiter should be able to remove most of the overshoot, while the 5518's composite limiter should be able to remove the overshoot that remains.

Even if the transmission system is operating properly, the FM modulation monitor or reference receiver can falsely indicate peak program modulation higher than that actually being transmitted if the monitor overshoots at high and low frequencies. Many commercial monitors have this problem, but most of these problem units can be modified to indicate peak levels accurately.

Orban uses the Belar "Wizard" series of DSP-based monitors internally for testing, because these units do not have this difficulty.

If you are using SSB/VSB mode, you must activate the 5518's composite limiter to control modulation. See *SSB Stereo Encoder Operation* on page 3-6.

Unexpected Delay Between the Program Feed and the On-Air Signal

The diversity delay may have been accidentally applied to the output you are using to drive your transmitter. See step (5.F) on page 2-24 and step (6.B) on page 2-25.

Audible Distortion On-Air

Make sure that the problem can be observed on more than one receiver and at several locations. Multipath distortion at the monitoring site can be mistaken for real distortion (and will also cause falsely high modulation readings).

Verify that the output of the audio processor driving the 5518 is clean. Heavy processing can exaggerate even slightly distorted material, pushing it over the edge into unacceptability.

If you are using analog inputs, the peak input level must not exceed +27 dBu or the 5518's A/D converter will clip and distort.

> Unlike earlier digital 5518s, there is no input peak level adjustment for the A/D converter. Instead, we have provided adequate headroom for virtually any facility. This is possible because the A/D converter in the 5518 has higher dynamic range than older designs. Therefore, without compromising the 5518's noise level, we could eliminate a control that was frequently misadjusted.

You may be overdriving the 5518's left/right protection limiter and/or composite limiter. It is unwise to do more than 3 dB of gain reduction in the protection limiter or to set the COMPOSITE LIMIT DRIVE control higher than 1.0 DB. Review the level matching and setup instructions in section 2 of this manual starting on page 2-11.

Whistle on Air, Perhaps Only in Stereo Reception

The most likely cause is oscillation in the analog input or output circuitry. If the oscillation is in the output circuitry and is between 23 and 53 kHz, it will be detected in a receiver's stereo decoder and translated down into the audible range.

If you encounter this problem, check the analog or digital outputs with a spectrum analyzer to see if the spurious tone can be detected here. If it appears at both outputs, it is probably an input problem. If it only appears at the analog output, then it is likely a problem with the left/right D/A converter or other analog circuitry. If it appears only when you use the composite output, then it is likely a problem in the composite D/A converter or output amplifiers.

A whistle could also be caused by power supply oscillation, STL problems, or exciter problems.

Interference from stereo into SCA

A properly operating 5518 generates an immaculately clean baseband, with program-correlated noise below –80 dB above 57 kHz even when the composite limiter is used aggressively. If the 5518 and the rest of the transmission system are operating correctly, subcarriers should experience no interference.

Interference from the stereo into a subcarrier is best diagnosed with a spectrum analyzer. First examine the spectrum of the 5518's composite output to verify that program correlated noise is less than –80 dB below 100% modulation from 57 to 100 kHz. Any inadvertent composite clipping will dramatically degrade this protection. Make sure that the link between the 5518's composite output and the transmitter has sufficient headroom.

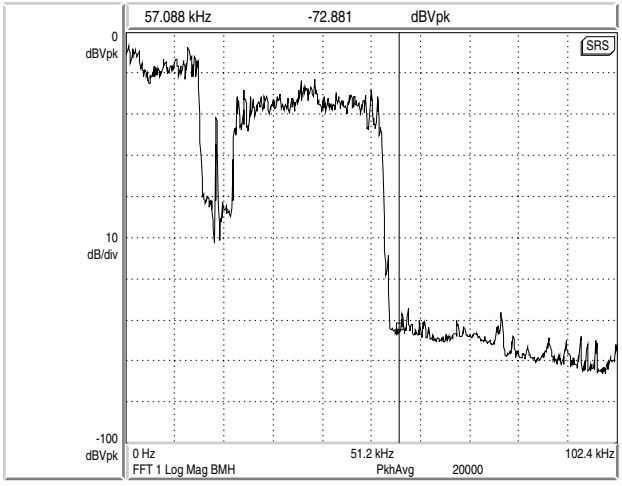


Figure 5-1: Typical 5518 baseband spectrum with heavy processing, 0-100 kHz.

If the exciter is nonlinear, this can cause crosstalk. In general, a properly operating exciter should have less than 0.1% THD at high frequencies to achieve correct operation with subcarriers.

To prevent truncation of the higher-order Bessel sidebands of the FM modulation, the RF system following the exciter must be wideband (better than ±500 kHz) and must have symmetrical group delay around the carrier frequency. An incorrectly

tuned transmitter can exhibit an asymmetrical passband that will greatly increase crosstalk into subcarriers.

Amplitude modulation of the carrier that is synchronous with the program ("synchronous AM") can cause program-related crosstalk into subcarriers. Synchronous AM should be better than 35 dB below 100% modulation as measured on a synchronous AM detector with standard FM deemphasis (50µs or 75µs).

The subcarrier receiver itself must receive a multipath-free signal, and must have a wide and symmetrical IF passband and a linear, low-distortion FM demodulator to prevent program-related crosstalk into subcarriers.

It is easy to accidentally overdrive the 5518's overshoot limiters by applying too much level to the input while relying on the these limiters to limit modulation to 100%. In addition, if the input signal has not been band-limited to 19 kHz or less, this can cause aliasing between the stereo main and subchannels. You can eliminate this aliasing (at the cost of overshoot, which the 5518's overshoot limiter can remove) by activating the input lowpass filter (step 21 on page 2-17).

Shrill, Harsh Sound

If the output of the audio processor driving the 5518 is preemphasized and the 5518 is also configured to apply preemphasis, this will cause very shrill sound and poor peak modulation control due to the double preemphasis applied to the audio.

If the 5518 has been left in BYPASS mode, it will apply preemphasis.

Dull Sound

If the output of the audio processor driving the 5518 is not preemphasized and the 5518 is not configured to apply preemphasis, the sound will be very dull.

System Receiving 5518's Digital Output Will Not Lock

Be sure that the 5518's output sample rate is set match the sample rate that the driven system expects. Be sure that the 5518's output FORMAT (AES3 or SPDIF) is set to match the standard expected by the driven system.

19 kHz Frequency Out-of-Tolerance

First, verify that a problem really exists by using a second frequency-measuring device and/or verifying the problem with a monitoring service. If the problem is real, contact Orban Customer Service for a crystal replacement; there is no frequency trim available.

L–R (Stereo Difference Channel) Will Not Null With Monophonic Input

This problem is often caused by relative phase shifts between the left and right channels prior to the 5518's input. This will cause innocuous linear crosstalk between the stereo main and subchannels. Such crosstalk does not cause subjective quality problems unless it is very severe. However, if a phase shift causes a non-constant delay in a given audio channel, it will add overshoot.

Security Passcode Lost (When Unit is Locked Out)

Please see *If You Have Forgotten Your Passcode* on page 2-33.

Connection Issues between the 5518 and a PC, Modem, or Network

- **User Interface Slowdown**: The more user presets you make, the more slowly the 5518 will respond to front-panel commands. Delete any user presets you do not need.

- **Quick Setup**: On the Station ID screen (Quick Setup 9): Use Escape in place of Cancel. The Cancel button will not work.

- **Software Updates**: Close any running Windows programs before attempting to update.

- **Interrupted Software Updates**: If you canceled an update before it completed, wait at least one minute before attempting your next update.

- **Software Updates via Modem**: If you are updating via the modem, do not change the "connection type" parameter on the 5518 while the modem is connected or attempting to connect.

- **Security Passcode**: An ALL SCREENS (administrator) security passcode is required for upgrading, regardless of whether you are using a Direct, Modem, or Ethernet connection.

- **MAC Address**: To see the MAC address of your 5518's Ethernet hardware, hold down the *Setup* button until the address appears.

Troubleshooting Connections

- If you get an error message such as "the specified port is not connected" or "There is no answer"…

  You may have the wrong interface type set on your 5518. Navigate to *Setup* > NETWORK & REMOTE > PC CONNEC and check the interface setting.

  If you are connecting via Direct Serial Connection or modem, review the Properties you have set on that connection. Double-check to ensure that you have set Windows parameters as described in *Appendix: Setting Up Serial Communications* on page 2- 51.

- If your Direct Connect does not work:

  A) Check to make sure that the cables are connected properly.

  B) Check that you are using a null modem cable.

  C) Ensure that the null modem cable is connected to the 5518's serial connector.

- If your Modem Connect does not work:

A) Ensure that the modem cables and phone lines are connected properly.

B) Check that you have entered the correct phone number for connection.

C) Check that you have entered the passcode correctly on the 5518, and the passcode has also been entered correctly on your PC.

D) Ensure that you enabled the correct PC modem port settings.

E) Ensure that the external modem attached to your 5518 is set to AUTO ANSWER.

F) Make sure that the only "Allowed Network Protocol" is TCP/IP. "NetBUI" and "IPX/SPX Compatible" must *not* be checked.

You Cannot Access the Internet After Making a Direct or Modem Connection to the 5518:

If you are connected to the 5518 via modem or direct connect, *you cannot access any other TCP/IP connection*. The PPP connection becomes the default protocol and the default gateway defaults to the 5518 unit's IP address. This means that all existing network connections point to the 5518 unit. To correct this:

A) In Start > Settings > Network and Dialup Connections, open the direct or modem connection you are using to connect to 5518.

B) Select "Properties."

C) Click the tab that reads "Networking."

D) Highlight "Internet protocol (TCP/IP)."

E) Select "Properties."

F) Select "Advanced."

G) Uncheck the "Use default gateway on remote network" box.

H) Select "OK."

If this "Use default gateway on remote network" box is not selected, the gateway will not point to the 5518 unit when you establish a direct or modem connection.

OS-Specific Troubleshooting Advice

Troubleshooting Windows 2000 Direct Connect:

If you are having trouble establishing a connection, check your New Connection's properties to make sure they are set up correctly:

A) Click "Start > Programs > Accessories > Communications > Network and Dialup Connections" to bring up the Network Connections screen.

B) In the “Network Connections” window, right-click “5518 - Direct” and choose “Properties.”

C) The “Properties” window opens for “5518 - Direct

D) Click the “Networking” tab.

E) Set “Type of dial-up server I am calling” to “PPP: Windows 95/98/NT4/2000, Internet.”

F) Select the “Settings” button and make sure all PPP settings are unchecked. Then click “OK.”

G) In “Components checked are used by this connection,” uncheck all except for “Internet Protocol (TCP/IP).”

H) Select “Internet Protocol (TCP/IP)” and then click the “Properties” button. The “Internet Protocol (TCP/IP) Properties” window opens.

I) Choose “Obtain an IP address automatically” and “Obtain DNS server address automatically”

J) Click the “Advanced…” button on the “Internet Protocol (TCP/IP)” Window.

K) In the “Advanced TCP/IP Settings” select the “General” Tab; make sure that no check boxes are checked.

L) In the “Advanced TCP/IP Settings” select the “DNS” Tab.

M) In the “Advanced TCP/IP Settings” select the “WINS” Tab.

N) Click “OK” to dismiss the “Advanced TCP/IP Settings” window.

O) Click “OK” to dismiss the “Internet Protocol (TCP/IP) Properties” window.

P) Click “OK” to dismiss the window whose name is your new connection.

Q) Click “Cancel” to dismiss the “Connect [nnnn]” dialog box

R) Restart your computer. (This resets the serial port and reduces the likelihood that you will encounter problems connecting to the 5518.)

S) If you see: “Error 777: The connection failed because the modem (or other connecting device) on the remote computer is out of order”:

The “remote computer” is actually the 5518 and it is not out of order; you just need to set the Maximum Speed (Bits per second) to 115200. If you already set this speed when you configured your PC ports, you shouldn’t have this problem.

> The 5518 communicates at 115200 bps. COM ports on some older PCs are incapable of communications at this rate and may not work reliably. Most newer PCs use 16550-compatible UARTS, which support the 115200 bps rate.

If you do see this warning message, you can reset the Maximum BPS Speed by accessing PROPERTIES for the connection:

a) Click START > PROGRAMS > ACCESSORIES > COMMUNICATIONS > NETWORK AND DIAL-UP CONNECTIONS.

b) Right click the name of your connection and access "PROPERTIES."

c) Go to the "GENERALS" TAB and select the "CONFIGURE" button.

d) Set the MAXIMUM SPEED (BPS) to 115200.

e) Select OK and try your connection again.

T) If you see: "Error 619: The specified port is not connected."

Make sure the INTERFACE TYPE on the 5518 is correct:

a) On the 5518, go to Setup > Network & Remote > Pc Connec.

b) Set PC CONNECT to DIRECT.

c) Try your connection again.

Troubleshooting Windows 2000 Modem Connect:

If you are having trouble establishing a connection, check your New Connection's properties to make sure they are set up correctly:

A) Click "Start > Programs > Accessories > Communications > Network and Dialup Connections" to bring up the Network Connections screen.

B) In the "Network Connections" window, right-click "5518 - Modem" and choose "Properties."

C) The "Properties" window opens for "5518 – Modem".

D) Click the "Properties" button.

E) Select the "General" tab and make sure that "Connect Using" displays the correct modem and port.

F) Click the "Configure…" button.

G) Set the "Maximum Speed (bps) to 115200.

H) Check the "Enable hardware flow control," make sure all other hardware features are unchecked. Then click "OK."

I) Click the "Networking" tab on the "Properties" window.

J) Set "Type of dial-up server I am calling" to "PPP: Windows 95/98/NT4/2000, Internet."

K) Select the "Settings" button and make sure all PPP settings are unchecked. Then click "OK."

L) In "Components checked are used by this connection," uncheck all except for "Internet Protocol (TCP/IP)."

M) Select "Internet Protocol (TCP/IP)" and then click the "Properties" button. The "Internet Protocol (TCP/IP) Properties" window opens.

N) Choose "Obtain an IP address automatically" and "Obtain DNS server address automatically"

O) Click the “Advanced…” button on the “Internet Protocol (TCP/IP)” Window.

P) In the “Advanced TCP/IP Settings” select the “General” Tab; make sure that no check boxes are checked.

Q) Click “OK” to dismiss the “Advanced TCP/IP Settings” window.

R) Click “OK” to dismiss the “Internet Protocol (TCP/IP) Properties” window.

S) Click “OK” to dismiss the window whose name is your new connection.

T) Click “Cancel” to dismiss the “Connect [nnnn]” dialog box

U) Restart your computer.

Although not strictly necessary, this resets the serial port and reduces the likelihood that you will encounter problems connecting to the 5518.

Troubleshooting Windows XP Direct Connect:

If you are having trouble establishing a connection, check your New Connection’s properties to make sure they are set up correctly:

A) Click “Start > Programs > Accessories > Communications > Network Connections” to bring up the Network Connections screen.

B) In the “Network Connections” window, right-click “5518 - Direct” and choose “Properties.”

C) The “Properties” window opens for “5518 - Direct.”

D) Click the “Networking” tab.

E) Set “Type of dial-up server I am calling” to “PPP: Windows 95/98/NT4/2000, Internet”

F) Select the “Settings” button and make sure all PPP settings are unchecked, then click “OK.”

G) In “This connection uses the following items,” uncheck all except for “Internet Protocol (TCP/IP).” You can also leave “QoS Packet Scheduler” checked if you like.

H) In “This connection uses the following items,” select “Internet Protocol (TCP/IP)” and then click the “Properties” button. The “Internet Protocol (TCP/IP) Properties” window opens.

I) Choose “Obtain an IP address automatically” and “Obtain DNS server address automatically”

J) Click the “Advanced…” button on the “Internet Protocol (TCP/IP)” Window.

K) In the “Advanced TCP/IP Settings” select the “General” Tab; make sure that no check boxes are checked.

L) Click “OK” to dismiss the “Advanced TCP/IP Settings” window.

M) On the “Properties” window for “5518 – Modem” click the “Advanced” tab.

N) Click “OK” to dismiss the window whose name is your new connection.

O) Click “Cancel” to dismiss the “Connect [nnnn]” dialog box

P) Restart your computer.

This resets the serial port and reduces the likelihood that you will encounter problems connecting to the 5518.

Troubleshooting Windows XP Modem Connect:

If you are having trouble establishing a connection, check your New Connection’s properties to make sure they are set up correctly.

A) Click “Start > Programs > Accessories > Communications > Network Connections” to bring up the Network Connections screen.

B) In the “Network Connections” window, right-click “5518 - Modem” and choose “Properties.”

The “Properties” window opens for “5518 - Modem.”

C) Click the “Networking” tab.

D) Set “Type of dial-up server I am calling” to “PPP: Windows 95/98/NT4/2000, Internet”

E) Select the “Settings” button. Make sure all PPP settings are unchecked, and then click “OK.”

F) In “This connection uses the following items,” uncheck all except for “Internet Protocol (TCP/IP).” You can also leave “QoS Packet Scheduler” checked if you like.

G) In “This connection uses the following items,” select “Internet Protocol (TCP/IP)” and then click the “Properties” button.

The “Internet Protocol (TCP/IP) Properties” window opens.

H) Choose “Obtain an IP address automatically” and “Obtain DNS server address automatically.”

I) Click the “Advanced…” button on the “Internet Protocol (TCP/IP)” Window.

J) In the “Advanced TCP/IP Settings,” select the “General” Tab; make sure that no check boxes are checked.

K) Click “OK” to dismiss the “Advanced TCP/IP Settings” window.

L) Click “OK” to dismiss the window whose name is your new connection.

M) Restart your computer. (This resets the serial port and reduces the likelihood that you will encounter problems connecting to the 5518.)

Troubleshooting IC Opamps

IC opamps are operated such that the characteristics of their associated circuits are essentially independent of IC characteristics and dependent only on external feedback components. The feedback forces the voltage at the (–) input terminal to be extremely close to the voltage at the (+) input terminal. Therefore, if you measure more than a few millivolts difference between these two terminals, the IC is probably bad.

Exceptions are opamps used without feedback (as comparators) and opamps with outputs that have been saturated due to excessive input voltage because of a defect in an earlier stage. However, if an opamp's (+) input is more positive than its (–) input, yet the output of the IC is sitting at –14 volts, the IC is almost certainly bad.

The same holds true if the above polarities are reversed. Because the characteristics of the 5518's circuitry are essentially independent of IC opamp characteristics, an opamp can usually be replaced without recalibration.

A defective opamp may appear to work, yet have extreme temperature sensitivity. If parameters appear to drift excessively, freeze-spray may aid in diagnosing the problem. Freeze-spray is also invaluable in tracking down intermittent problems. But *use it sparingly,* because it can cause resistive short circuits due to moisture condensation on cold surfaces.

Technical Support

If you require technical support, contact Orban customer service. See http://www.orban.com/contact/ for contact information. Be prepared to describe the problem accurately. Know the serial number of your 5518 — this is printed on the rear panel of the unit.

Please check Orban's website, www.orban.com, for Frequently Asked Questions and other technical tips about 5518 that we may post from time to time. Manuals (in .pdf form) and 5518 software upgrades will be posted there too — click "Downloads" from the home page.

Factory Service

Before you return a product to the factory for service, we recommend that you refer to this manual. Make sure you have correctly followed installation steps and operation procedures. If you are still unable to solve a problem, contact our Customer Service for consultation. Often, a problem is relatively simple and can be quickly fixed after telephone consultation.

If you must return a product for factory service, please notify Customer Service by telephone, *before* you ship the product; this helps us to be prepared to service your

unit upon arrival. Also, when you return a product to the factory for service, we recommend you include a letter describing the problem.

Please refer to the terms of your Limited One-Year Standard Warranty, which extends to the first end user. After expiration of the warranty, a reasonable charge will be made for parts, labor, and packing if you choose to use the factory service facility. Returned units will be returned C.O.D. if the unit is not under warranty. Orban will pay return shipping if the unit is still under warranty. In all cases, the customer pays transportation charges to the factory (which are usually quite nominal).

Shipping Instructions

Use the original packing material if it is available. If it is not, use a sturdy, double-walled carton no smaller than 7″ (H) x 15.5″ (D) x 22″ (W) — 18 cm (H) x 40 cm (D) x 56 cm (W), with a minimum bursting test rating of 200 pounds (91 kg). Place the chassis in a plastic bag (or wrap it in plastic) to protect the finish, then pack it in the carton with at least 1.5 inches (4 cm) of cushioning on all sides of the unit. "Bubble" packing sheets, thick fiber blankets, and the like are acceptable cushioning materials; foam "popcorn" and crumpled newspaper are not. Wrap cushioning materials tightly around the unit and tape them in place to prevent the unit from shifting out of its packing.

Close the carton without sealing it and shake it vigorously. If you can hear or feel the unit move, use more packing. Seal the carton with 3-inch (8 cm) reinforced fiberglass or polyester sealing tape, top and bottom in an "H" pattern. Narrower or parcel-post type tapes will not withstand the stresses applied to commercial shipments.

Mark the package with the name of the shipper, and with these words in red:

DELICATE INSTRUMENT, FRAGILE!

Insure the package properly. Ship prepaid, not collect. Do not ship parcel post. Your **Return Authorization Number** must be shown on the label, or the package will *not* be accepted.

Section 6
Technical Data

Specifications

It is impossible to characterize the listening quality of even the simplest limiter or compressor based on specifications, because such specifications cannot adequately describe the crucial dynamic processes that occur under program conditions. Therefore, the only way to evaluate the sound of an audio processor meaningfully is by subjective listening tests.

Certain specifications are presented here to assure the engineer that they are reasonable, to help plan the installation, and make certain comparisons with other processing equipment.

Performance

Specifications apply for measurements from analog left/right input to stereo composite output and to FM analog left/right output.

Frequency Response (Bypass Mode): Follows standard 50µs or 75µs preemphasis curve ±0.10 dB, 20 Hz–15 kHz. Analog left/right output and digital output can be user-configured for flat or pre-emphasized output.

Noise: <–85 dB below 100% modulation, 30-15,000 Hz, deemphasized.

Total System Distortion (de-emphasized, 100% modulation): <0.01% THD, 20 Hz–1 kHz, rising to <0.05% at 15 kHz. <0.02% SMPTE IM Distortion.

Total System L/R Channel Separation: >55 dB, 20 Hz – 15 kHz; 60 dB typical.

Polarity (Two-Band and Bypass Modes): Absolute polarity maintained. Positive-going signal on input will result in positive-going signal on output.

Processing Sample Rate: The 5518 is a “multirate” system, using internal rates from 64 kHz to 512 kHz as appropriate for the processing being performed. L/R overshoot limiters operate at 256 kHz (and are anti-aliased), while the composite limiter operates at 512 kHz.

Processing Resolution: Internal processing has 24 bit (fixed point) or higher resolution.

Installation

Analog Audio Input

Configuration: Stereo.

Impedance: >10kΩ load impedance, electronically balanced[1].

Nominal Input Level: Software adjustable from –9.0 to +13.0 dBu (VU).

Maximum Input Level: +27 dBu.

Connectors: Two XLR-type, female, EMI-suppressed. Pin 1 chassis ground, Pins 2 (+) and 3 electronically balanced, floating and symmetrical.

A/D Conversion: 24 bit 128x oversampled delta sigma converter with linear-phase anti-aliasing filter.

Filtering: RFI filtered.

Analog Audio Output

Configuration: Stereo. Flat or pre-emphasized (at 50µs or 75µs), software-selectable.

Source Impedance: 50Ω, electronically balanced and floating.

Load Impedance: 600Ω or greater, balanced or unbalanced. Termination not required or recommended.

Output Level (100% peak modulation): Adjustable from –6 dBu to +24 dBu peak, into 600Ω or greater load, software-adjustable.

Signal-to-Noise: >= 90 dB unweighted (Bypass mode, de-emphasized, 20 Hz–15 kHz bandwidth, referenced to 100% modulation).

L/R Crosstalk: <= –70 dB, 20 Hz–15 kHz.

Distortion: <= 0.01% THD (Bypass mode, de-emphasized) 20 Hz–15 kHz bandwidth.

Connectors: Two XLR-type, male, EMI-suppressed. Pin 1 chassis ground, Pins 2 (+) and 3 electronically balanced, floating and symmetrical.

D/A Conversion: 24 bit 128x oversampled, with highpass filter at 0.15 Hz (–3 dB).

Filtering: RFI filtered.

Digital Audio Input

Configuration: Stereo per AES3 standard, 24 bit resolution, software selection of stereo, mono from left, mono from right or mono from sum.

Sampling Rate: 32, 44.1, 48, 88.2, or 96 kHz, automatically selected.

Connector: XLR-type, female, EMI-suppressed. Pin 1 chassis ground, pins 2 and 3 transformer balanced and floating, 110Ω impedance.

Input Reference Level: Variable within the range of –30 dBFS to –10 dBFS.

J.17 Deemphasis: Software-selectable.

Filtering: RFI filtered.

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[1] No jumper selection available for 600Ω. Surface-mount pads are available on I/O module for user-installed 600Ω termination.

Digital Audio Output

Configuration: Stereo per AES3 standard. Output configured in software as flat or pre-emphasized to the chosen processing preemphasis (50µs or 75µs), with or without J.17 preemphasis.

Sample Rate: Internal free running at 32, 44.1, 48, 88.2 or 96 kHz, selected in software. Can also be synced to the AES3 digital input at 32, 44.1, 48, 88.2 or 96 kHz, as configured in software.

Word Length: Software selected for 24, 20, 18, 16 or 14-bit resolution. First-order highpass noise-shaped dither can be optionally added, dither level automatically adjusted appropriately for the word length.

Connector: XLR-type, male, EMI-suppressed. Pin 1 chassis ground, pins 2 and 3 transformer balanced and floating, 110Ω impedance.

Output Level (100% peak modulation): –20.0 to 0.0 dBFS software controlled.

Filtering: RFI filtered.

Wordclock/10 MHz Sync Reference Input

Configuration: Accepts 1x wordclock or 10 MHz reference signals, automatically selected. The DSP master clock can be phase-locked to these signals, which in turn phase-locks the 19 kHz pilot tone frequency, facilitating singe-frequency network operation. The digital output sample frequency can also be locked to these signals.

Level: Unit will lock to 1x wordclock and 10 MHz squarewaves and sinewaves having a peak value of 0.5 V to 5.0 V.

Connector: BNC female, grounded to chassis, non-terminating to allow reference signals to be looped through via an external BNC “tee” connector (not supplied).

Composite Baseband Output

Configuration: Two outputs, each with an independent software-controlled output level control, output amplifier and connector.

Source Impedance: 0Ω voltage source or 75Ω, jumper-selectable.

Load Impedance: 37Ω or greater. Termination not required or recommended.

Maximum Output Level: +16.0 dBu (13.82Vp-p).

Pilot Level: Adjustable from 6.0% to 12.0%, software controlled.

Pilot Frequency Stability: 19 kHz, ±1.0 Hz (10 degrees to 40 degrees C).

D/A Conversion: 24-bit

Signal-to-Noise Ratio: >= 85 dB (Bypass mode, de-emphasized, 20 Hz – 15 kHz bandwidth, referenced to 100% modulation, unweighted).

Distortion: <= 0.02% THD (Bypass mode, de-emphasized, 20 Hz – 15 kHz bandwidth, referenced to 100% modulation, unweighted).

Stereo Separation: > 55 dB, 30 Hz - 15 kHz. 65 dB typical at 400 Hz.

Crosstalk-Linear: <= –80 dB, main channel to sub-channel or sub-channel to main channel (referenced to 100% modulation).

Crosstalk-Non-Linear: <= –80 dB, main channel to sub-channel or sub-channel to main channel (referenced to 100% modulation).

38 kHz Suppression: >= 70 dB (referenced to 100% modulation).

76 kHz & Sideband Suppression: >= 80 dB (referenced to 100% modulation).

Connectors: Two BNC, shell connected to chassis ground, EMI suppressed.

Maximum Load Capacitance: 0.047 μF (0Ω source impedance). Maximum cable length of 100 feet/30 meters RG–58A/U.

Filtering: RFI filtered.

Subcarrier (SCA) Inputs

Configuration: Two subcarrier inputs sum directly into composite baseband outputs; COMPx LVL control settings have no effect on the absolute subcarrier levels.

Impedance: 600Ω

SCA Sensitivity: Variable from <100 mV p-p to >10 V p-p to produce 10% injection assuming 100% modulation = 4 V p-p at the 5518's composite outputs. Rear-panel accessible PC-board-mounted trim pots allow user to adjust the sensitivities of the two SCA inputs.

Connectors: Two BNC, shell connected to chassis ground, EMI suppressed.

19 kHz Pilot Reference: SCA2 input can be re-jumpered to provide a 19 kHz pilot reference output.

Remote Computer Interface

Supported Computer and Operating System: IBM-compatible PC running Microsoft Windows® 2000 (SP3 or higher), XP, Vista, or 7.

Configuration: TCP/IP protocol via direct cable connect, modem, or Ethernet interface. Suitable null modem cable for direct connect is supplied. Modem and other external equipment is not supplied.

Serial Connector: RS–232 on DB–9 male connector, EMI-suppressed. Uses PPP to provide for direct or modem connection to the 5518 PC Remote application.

Ethernet Connector: Female RJ45 connector for 10-100 Mbps networks using CAT5 cabling. Native rate is 100 Mbps. Provides for connection to the 5518 PC Remote application through either a network, or, using a crossover Ethernet cable, directly to a computer.

Ethernet Networking Standard: TCP/IP.

Remote Control (GPI) Interface

Configuration: Eight (8) inputs, opto-isolated and floating.

Voltage: 6–15V AC or DC, momentary or continuous. +12VDC provided to facilitate use with contact closure.

Connector: DB–25 male, EMI-suppressed.

Control: User-programmable for any eight of user presets, factory presets, bypass, test tone, stereo or mono modes, analog input, digital input.

Filtering: RFI filtered.

Tally Outputs

Circuit Configuration: Two NPN open-collector outputs.

Voltage: +15 volts maximum. Do not apply negative voltage. When driving a relay or other inductive load, connect a diode in reverse polarity across the relay coil to protect the driver transistors from reverse voltage caused by inductive kickback.

Current: 30 mA maximum

Indications: Tally outputs can be programmed to indicate a number of different operational and fault conditions, including Input: Analog, Input: Digital, Analog Input Silent, AES Input Silent, and AES Input Error.

Power

Voltage: 85–264 VAC, 50–60 Hz, 30 VA.

Connector: IEC, EMI-suppressed. Detachable 3-wire power cord supplied.

Fuse: 2.5A 20mm Quick Acting HBC, mounted on the power supply circuit board.

Grounding: In order to meet EMI standards, circuit ground is hard-wired to chassis ground. To avoid ground loops, we recommend using an FM exciter with a balanced composite input.

Safety Standards: ETL listed to UL standards, CE marked.

Environmental

Operating Temperature: 32° to 122° F / 0° to 50° C for all operating voltage ranges.

Humidity: 0–95% RH, non-condensing.

Dimensions (W x H x D): 19” x 1.75” x 14.25” / 48.3 cm x 4.5 cm x 36.2 cm. One rack unit high.

Humidity: 0–95% RH, non-condensing.

RFI/EMI: Tested according to Cenelec procedures. FCC Part 15 Class A device.

Shipping Weight: 10 lbs / 4.6 kg

Warranty

Two Years, Parts and Service: Subject to the limitations set forth in Orban's Standard Warranty Agreement.

Because engineering improvements are ongoing, specifications are subject to change without notice.

Circuit Description

This section provides a detailed description of user-serviceable circuits used in the 5518. We do not provide detailed descriptions of the digital circuitry because most of this is built with surface-mount components that cannot be removed or replaced with typical tools available in the field. Field repair ordinarily consists of swapping entire PC boards.

The section starts with an overview of the 5518 system, identifying circuit sections and describing their purpose. Then each user-repairable section is treated in detail by first giving an overview of the circuits followed by a component-by-component description.

The drawing on page 6-27 shows circuit board locations.

Overview

- The Control Circuits control the DSP, display, and input/output sections of the 5518 system.

- The Input Circuits include the connectors and RF filtering for the analog and digital audio inputs, as well as the circuitry to interface these inputs to the digital processing.
- The Output Circuits include the connectors and RF filtering for the analog and digital audio outputs, and the circuitry to interface the digital processing to these outputs.
- The DSP Circuits implement the bypass, test tone, overshoot limiting, and stereo encoding using digital signal processing.

A block diagram of the DSP signal processing appears on page 6-51.

- The Power Supply provides power for all 5518 circuit sections.

Control Circuits

The control circuit is based on an AMD Elan SC520 microprocessor, which is a 586-class processor running an Orban executable program over a third-party real-time operating system. A flash memory emulates a hard drive. The memory is non-volatile and does not rely on a battery to retain information when mains power is off.

The flash memory holds the operating system, the Orban executable program, and all preset files, both factory and user. It also contains a write-protected "boot segment" that functions as a boot ROM.

The control circuits process and execute user-initiated requests to the system. The source of these requests is the front panel buttons and rotary encoder, the rear panel RS-232 port, Ethernet port, and the remote contact closures. These changes affect hardware function and/or DSP processing. The control circuits also send information to the LCD display.

The control circuit communicates with display circuitry through the SC520's general-purpose bus and with the DSP via an SPI serial connection.

The SC520 periodically refreshes a watchdog timer. If the timer times out without being refreshed, it assumes that the control program has crashed and automatically reboots the SC520. The DSP chips will continue to process audio until the time comes to reload DSP program code into them. At this point, the audio will mute for about a second until the DSP code download has finished. If you hear a brief audio mute on air and you know that its input was not interrupted, you can assume that the 5518 has rebooted for some reason. Be prepared to convey this fact to Orban customer service if you call for technical assistance.

The control board contains interface circuitry, the CPU, the Ethernet interface chip, the flash memory, the DRAM, the RS-232 serial interface circuitry, the GPI/O interface circuitry, and the real-time clock, which keeps time for the 5518's automation functions. The real-time clock is backed up by a DL2032 battery so that it keeps accurate time even when the 5518 is powered down. The battery is socketed and can be readily accessed by removing the 5518's top cover; the battery is located on the control board.

User Control Interface and LCD Display Circuits

The user control interface enables the user to control the 5518's functionality. A rear panel GPI connector allows optically isolated remote control of certain functions, such as recalling presets, via contact closure. An RS-232 serial port and an Ethernet port allow you to connect a modem or computer to the 5518. Front panel pushbutton switches select between various operational modes and functions. A rotary encoder allows the user to adjust parameters and enter data.

Remote Interface and RS-232 Interfaces

Located on control board

A remote interface connector and circuitry implements remote control of certain operating modes; Model 5518 has eight remote contact closure inputs.

A valid remote signal is a momentary pulse of current flowing through remote signal pins. Current must flow consistently for 50msec for the signal to be interpreted as valid. Generally, the 5518 will respond to the most recent control operation, regardless of whether it came from the front panel, remote interface, or RS-232.

Component-Level Description:

After being current limited by resistors, the GPI control signals are applied to two quad optoisolators, U17, U19, and then to the control circuitry.

Transceiver U12 interfaces the RS-232 signal levels at SERIAL DB-9 connector J5 to/from the TTL levels of the corresponding pins of the SC520 microcontroller.

U12, U17, and U19 are socketed for easy field replacement in the event of overload, lightning damage, etc. All other circuitry is surface-mount and is not field-repairable.

Switch Matrix and LED Indicators

Located on display board

Eleven front panel pushbutton switches are arranged in a matrix, configured as three columns and four rows. These switches are the primary element of the physical user interface to the 5518 control software. The host microprocessor controls the system setup and function of the DSP according to the switch/rotary encoder entered commands, the AES status bits from the digital input signal, the RS-232, and the remote control interface status. The microprocessor updates the LED control status indicators accordingly.

Component-Level Description:

S1-S11 are the front panel pushbutton switches. CR11-CR15 are the front panel LED control status indicators. The control microprocessor communicates with these components through the general-purpose bus.

LED Meter Circuits

Located on display board

The meter LEDs are arranged in an 8x16 matrix, in rows and columns.

Each row of LEDs in the matrix has a 1/8 duty cycle ON time. The rows are multiplexed at a fast rate so that the meters appear continuously illuminated. Via the general-purpose bus, the DSP sends meter data values to the control microprocessor, which sends the appropriate LED control words (eight bits at a time) to the data latches that drive the LEDs directly.

Component-Level Description:

The meter LED matrix consists of ten 10-segment LED bar graph assemblies (CR1-CR9, CR16) and one discrete LED (CR10). Row selector latches IC4, IC5, IC6, and IC9 are controlled by the host microprocessor and alternately sink current through the LEDs selected by column selector latches IC1 and IC2, which are also controlled by the SC520. IC1 and IC2 drive the selected row of LEDs through current limiting resistor packs RP1 and RP2.

Input Circuits

This circuitry interfaces the analog and digital inputs to the DSP. The analog input stages scale and buffer the input audio level to match it to the analog-to-digital (A/D) converter. The A/D converts the analog input audio to digital audio. The digital input receiver accepts AES3-format digital audio signals from the digital input connector and sample rate-converts them as necessary. The digital audio from the A/D and SRC is transmitted to the DSP.

Analog Input Stages

Located on input/output/DSP board

The RF-filtered left and right analog input signals are each applied to a floating, balanced amplifier that has an adjustable (digitally controlled) gain. Analog switches set the gain. The outputs of a latch set the state of the switches. By writing data to the latch, the control circuits preset the gain. This circuit feeds an RC lowpass filter that applies the balanced signal to the analog-to-digital (A/D) converter.

> The digitally controlled gain circuitry was included on the circuit board for possible use in future products. In the 5518, its gain is preset so that the A/D will clip at +27 dBu with respect to the 5518's analog inputs.

Note that the small RFI "tee" filter assemblies connected to the input and output connectors are socketed and user-replaceable.

Component-Level Description:

The left channel balanced audio input signal is applied to the filter / load network made up of the various passive components preceding IC201. (There are

solder pads available in the PC board to accept an optional 600Ω termination load [R201] on the input signal if the user wishes to install one.) A conventional three-opamp instrumentation amplifier (IC201 and associated circuitry) receives the input signal. R225-231 and quad analog switch IC203 make up the circuit that sets the gain of IC201. The switches in IC203 set the gain of the instrumentation amplifier by switching resistors in parallel with R223. (Smaller total resistances produce larger gains.)

IC201 feeds IC205 and associated components. This stage balances, DC-biases, and scales the signal to the proper level for the analog-to-digital (A/D) converter IC208. IC207A and associated components comprise a servo amp to correctly DC-bias the signal feeding the A/D converter. R253, R255-R257, C217, C219 make an attenuator / RC filter necessary to filter high frequency energy that would otherwise cause aliasing distortion in the A/D converter.

The corresponding right channel circuitry is functionally identical to that just described.

IC201 and IC202 are through-hole parts, which permits easy field replacement using simple tools. All other circuitry is surface-mounted. Replacement requires surface-mount rework tools and skills to prevent circuit board damage.

Stereo Analog-to-Digital (A/D) Converter

Located on input/output/DSP board

The A/D converter, IC208, is a stereo 24-bit sigma-delta converter. (This is a surface-mount part and is not field-replaceable.)

The A/D oversamples the audio, applies noise shaping, and emits a bitstream at 64 kHz sample rate.

Digital Input Receiver and Sample Rate Converter (SRC)

Located on input/output/DSP board

The receiver IC501A accepts digital audio signals using the AES3 interface format (AES3-1992). It applies its output to sample rate converter (SRC) IC503B. This accepts and sample-rate converts any of the standard 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, and 96 kHz rates in addition to any digital audio sample rate within the range of 32 kHz and 96 kHz. The SRC converts the input sample rate to 64 kHz for processing by the DSP.

Wordclock/10 MHz Sync Reference Input

Located on input/output/DSP board

The 5518's internal system clock (which drives the DSPs) can be synchronized to a wordclock or 10 MHz reference applied to J502A. This allows the 19 kHz pilot tone in the 5518's composite output to be frequency-synchronized to an accurate frequency standard like GPS or a rubidium-disciplined oscillator.

The input reference waveform is converted to a square wave via IC505 and associated circuitry, which implement a comparator with hysteresis. IC1103 is a CPLD (complex programmable logic device) that accepts the reference square wave.

IC1001 is a PIC microcontroller that measures the frequency of the reference square wave and (re)configures the CPLD as directed by the main microprocessor. In turn, the CPLD works with IC1101, IC1102, and IC1104 to implement a phase-locked loop to generate the system clocks. IC1104 is the phase comparator. The single-order loop filter consists of R1100, R1106, R1107 and C1100. The 27 MHz voltage-controlled oscillator IC1101 receives the output of the loop filter. The output of IC1101 drives IC1102, which is a phase-locked loop frequency generator that locks to the 27 MHz output of IC1101 and generates four clock signals from it. The four outputs of IC1102 are applied to the CPLD, which closes the phase-locked loop as directed by the PIC and main microprocessor. The CPLD generates the clocks (FCLK and BCLK) used by the DSP.

Output Circuits

This circuitry interfaces the DSP to the analog and digital audio outputs. The digital audio from the DSP is transmitted to the digital-to-analog converter (D/A) and output sample rate converter (SRC). The digital-to-analog (D/A) converter converts the digital audio words generated by the DSP to analog audio. The analog output stages scale and buffer the D/A output signal to drive the analog output XLR connectors with a low impedance balanced output. The digital output transmitter accepts the digital audio words from the output sample rate converter (SRC) and transmits them as AES3-format digital audio signals on the digital output connector.

Stereo Digital-to-Analog (D/A) Converter

Located on Input/Output/DSP board

The D/A, IC306, is a stereo, 24-bit delta-sigma converter. It receives the serial left and right audio data samples from the DSP at 64 kHz sample rate and converts them into audio signals requiring further, relatively undemanding analog filtering.

Analog Output Stages

Located on Input/Output/DSP board

The left and right analog signals emerging from IC306 are each filtered, amplified, and applied to a floating-balanced integrated line driver, which has a 50Ω output impedance. The line driver outputs are applied to the RF-filtered left and right analog output connectors. These analog signals can represent either the transmitter or monitor output of audio processing.

Component-Level Description:

IC303 and associated components filter the left channel signal emerging from IC306. The purpose of these stages is to reduce the out-of-band noise energy resulting from the delta-sigma D/A's noise-shaping filter and to translate the

differential output of the D/A converter into single-ended form. These components apply a 3rd order lowpass filter to the differential signal from the D/A. This filter does not induce significant overshoot of the processed audio, which would otherwise waste modulation.

IC305B and associated components form a low-frequency servo amplifier to remove residual DC from the signal. The 0.1Hz −3 dB frequency prevents tilt-induced overshoot in the processed audio.

The buffered output of IC303B is passed through gain trimmer VR301, which allows the gain of the output circuitry to be calibrated to a standard. IC301, a balanced output line driver, receives the output of VR301. This driver emulates a floating transformer; its differential output level is independent of whether one side of its output is floating or grounded. IC301 and its right channel counterpart IC302 are socketed in through-hole packages to facilitate field replacement with simple tools. All other circuitry is surface-mounted.

The corresponding right channel circuitry is functionally identical to that just described.

Digital Sample Rate Converter (SRC) and Output Transmitter

Located on Input/Output/DSP board

Output sample rate converter (SRC) IC503A converts the 64 kHz 5518 system sample rate to any of the standard 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, and 96 kHz rates for the 5518's Digital Out 1. The sample rate converter drives digital audio interface transmitter IC501B, which encodes digital audio signals using the AES3 interface format (AES3-1992).

Composite Output Circuit

Located on the Input/Output/DSP board and Composite/SCA daughterboard

A dual composite D/A converter drives the two composite outputs. Using a dual D/A converter permits the levels of the two composite outputs to be set independently in DSP. Each channel of the D/A converter drives a passive LC third-order anti-imaging filter.

The SCA inputs are summed with the composite output in the analog domain. The composite output level controls (COMP1 LVL and COMP2 LV) therefore do not affect the absolute level of the SCA appearing at the 5518's outputs.

The second SCA input can be jumpered to serve as a pilot reference source for RDS generators (your 5518 is shipped from the factory in this configuration).

Component-Level Description:

We will describe the signal path for composite 1 output; the signal path for composite 2 output is exactly analogous. IC401 is a dual-channel high-speed D/A converter chip that receives the digital composite signal at a 170.66 (512/3) kHz sample rate. Its differential outputs drive current-to-voltage converter amplifier IC403, which drives differential amplifier IC405A. IC405A removes common-mode noise from the D/A output.

IC405B is a DC servo amplifier that removes DC offsets from the D/A output without introducing significant amounts of low frequency tilt to the composite waveform.

IC405A drives a third-order passive LC reconstruction filter C9, C10, L9, R17, R18, on the Composite/SCA daughterboard. (This filter is equalized and phase-corrected in DSP to obtain excellent flatness and phase-linearity. This optimizes stereo separation.) The resulting signal is a filtered analog representation of the composite signal generated by the DSP. IC2B buffers this signal and sums it with the SCA signals from SCA INPUT buffer IC1. Any contribution from the SCA inputs is therefore not indicated on the COMPOSITE LEVEL meter displayed by the 5518, because this meter indicates only the composite signal generated by the DSP.

IC2B and IC3 together form a composite high-current buffer amplifier that receives the output of IC405A and drives the composite output connector J3 through RFI filter L3 and optional 75Ω build-out resistor R11.

The pilot reference D/A converter IC402 receives serial data from the DSP circuitry. After being buffered and lowpass filtered by IC407B, the resulting 19 kHz sine wave signal is passed to the Composite/SCA daughterboard and can be connected to J2 through jumper J6.

The composite line driver amplifiers IC3 and IC4 are socketed in through-hole packages to facilitate field replacement with simple tools. All other components are surface-mounted and are not field-replaceable.

DSP Circuit

The DSP circuit consists of two Freescale DSPB56724AG dual-core 24-bit fixed-point DSP chips that execute DSP software code to implement digital signal processing algorithms. The chips operate at a core clock frequency of 245.76MHz.

Each of the four DSP cores operates at approximately 250 million instructions per second (MIPS). A sampling rate of 32 kHz and power-of-two multiples thereof, up to 512 kHz, is used. In stand-alone stereo encoder mode, the minimum sample rate is 64 kHz.

System initialization normally occurs when power is first applied to the 5518 and can occur abnormally if the 5518's watchdog timer forces the SC520 to reboot. Upon initialization, the SC520 CPU downloads the DSP executable code stored in the flash memory. This typically takes about 7 seconds. Once a DSP chip begins executing its program, execution is continuous. The SC520 provides the DSP program with parameter data (representing information like the settings of various processing controls), and extracts the front panel metering data from the DSP chips.

During system initialization, the SC520 queries the DSP hardware about its operational status and will display an error message on-screen if the DSP fails to initialize normally. Please note any such messages and be ready to report them to Orban Customer Service.

The DSP chips are located on the I/O+DSP board — see the drawings starting on page 6-35. IC1202 is a local voltage regulator on the DSP board that derives the +1.2V core supply for the DSP chips from the +5V Power Supply.

Power Supply

Warning! Hazardous voltages are present in the power supply when it is connected to the AC line. Several parts, including the heat sink, are hot to the AC power line. Except for servicing, do not remove the insulating shield from the power supply.

The power supply is a modular switching supply to minimize heat buildup and power consumption. It converts an AC line voltage input to +15, –15, and +5 volts. All other supply voltages are derived from these three voltages via local regulation. The supply accepts inputs from 85 to 264 VAC, 50 – 60 Hz.

The only fuse in your 5518 is a 2.5A 20mm Quick Acting HBC fuse mounted on the power supply's circuit board. Because the supply's outputs are automatically current-limited, the fuse will usually open only if the power supply fails. *Be sure to disconnect your 5518 from AC power before replacing the fuse!*

Because of safety and EMI suppression requirements in the power supply, there are no user-serviceable parts in it. In case of failure, replace the entire supply with an Orban-supplied replacement (Orban part number 29270.000.01.1), which ensures that your 5518 will continue to meet all regulatory requirements for safety and emissions.

Abbreviations

Some of the abbreviations used in this manual may not be familiar to all readers:

A/D (or A to D)	analog-to-digital converter
AES	Audio Engineering Society
AGC	automatic gain control
A-I	analog input
A-O	analog output
BAL	balanced (refers to an audio connection with two active conductors and one shield surrounding them).
BBC	British Broadcasting Corporation
BNC	a type of RF connector
CALIB	calibrate
CIT	composite isolation transformer
CMOS	complementary metal-oxide semiconductor
COFDM	Coded Orthogonal Frequency Division Multiplex — a robust type of digital modulation using many narrow-bandwidth, low data rate, mutually non-interfering carriers to achieve an aggregate high data rate with excellent multipath rejection.
COM	serial data communications port
D/A (or D to A)	digital-to-analog converter
dBm	decibel power measurement. 0 dBm = 1mW applied to a specified load. In audio, the load is usually 600Ω. In this case only, 0 dBm = 0.775V rms.

dBu	decibel voltage measurement. 0 dBu = 0.775V RMS. For this application, the dBm-into-600Ω scale on voltmeters can be read as if it were calibrated in dBu.
DI	digital input
DJ	disk jockey, an announcer who plays records in a club or on the air
DO	digital output
DOS	Microsoft disk operating system for IBM-compatible PC
DSP	digital signal processor (or processing). May also refer to a special type of microprocessor optimized for efficiently executing arithmetic.
EBU	European Broadcasting Union
EBS	Emergency Broadcasting System (U.S.A.)
EMI	electromagnetic interference
ESC	escape
FCC	Federal Communications Commission (USA regulatory agency)
FDNR	frequency-dependent negative resistor—an element used in RC-active filters
FET	field effect transistor
FFT	fast Fourier transform
FIFO	first-in, first-out
G/R	gain reduction
HD Radio	*See IBOC*
HF	high-frequency
HP	highpass
IBOC	“In-Band On-Channel” — a form of digital radio commercialized by iBiquity Corporation where the digital carriers use a form of COFDM modulation and share the frequency allocation of the analog carriers. Also known by its trademarked name of “HD Radio.”
IC	integrated circuit
IM	intermodulation (or “intermodulation distortion”)
I/O	input/output
ITU	International Telecommunications Union (formerly CCIR). ITU-R is the arm of the ITU dedicated to radio.
JFET	junction field effect transistor
LC	inductor/capacitor
LCD	liquid crystal display
LED	light-emitting diode
LF	low-frequency
LP	lowpass
LVL	level
MHF	midrange/high-frequency
MLF	midrange/low-frequency
MOD	modulation
N&D	noise and distortion
N/C	no connection
OSHOOT	overshoot
PC	IBM-compatible personal computer
PCM	pulse code modulation
PPM	peak program meter
RAM	random-access memory
RC	resistor/capacitor
RDS/RBDS	Radio (Broadcasting) Data Service — a narrowband digital subcarrier centered at 57 kHz in the FM baseband that usually provides program or network-related data to the consumer in the form of text that is displayed on the radio. Occupied bandwidth is ±2500 Hz.
REF	reference
RF	radio frequency
RFI	radio-frequency interference
RMS	root-mean-square

ROM	read-only memory
SC	subcarrier
SCA	subsidiary communications authorization — a non program-related subcarrier in the FM baseband above 23 kHz (monophonic) or 57 kHz (stereophonic)
SMT	surface-mount
S/PDIF	Sony/Philips digital interface (standardized as IEC958)
TRS	tip-ring-sleeve (2-circuit phone jack)
THD	total harmonic distortion
TX	transmitter
μs	Microseconds. For FM preemphasis, the +3 dB frequency is $1 / (2 \pi \tau)$, where τ is the pre-emphasis time constant, measured in seconds.
VCA	voltage-controlled amplifier
VU	volume unit (meter)
XLR	a common style of 3-conductor audio connector
XTAL	crystal

Parts List

Many parts used in the 5518 are surface-mount devices ("SMT") and are not intended for field replacement because specialized equipment and skills are necessary to remove and replace them without damage to the circuit boards. The list below includes substantially all of the parts used in the 5518 (including surface-mount devices), and inclusion of a part in this list does not imply that the part is field-replaceable.

See the following assembly drawings for locations of components.

Obtaining Spare Parts

Special or subtle characteristics of certain components are exploited to produce an elegant design at a reasonable cost. It is therefore unwise to make substitutions for listed parts. Consult the factory if the listing of a part includes the note "selected" or "realignment required."

Orban normally maintains an inventory of tested, exact replacement parts that can be supplied quickly at nominal cost. Standardized spare parts kits are also available. When ordering parts from the factory, please have available the following information about the parts you want:

Orban part number
Reference designator (e.g., C3, R78, IC14)
Brief description of part
Model, serial, and "M" (if any) number of unit — see rear-panel label

To facilitate future maintenance, parts for this unit have been chosen from the catalogs of well-known manufacturers whenever possible. Most of these manufacturers have extensive worldwide distribution and may be contacted through their web sites.

Control Board

	Control Board	
PART #	**DESCRIPTION**	**COMPONENT IDENTIFIER**
20128.000.01	RESISTOR, 0 Ω, 0805	R21, R46
20128.010.01	RESISTOR, 10 Ω, 0805	R31, R34, R86, R89
20128.022.01	RESISTOR 22 Ω 1% 0805	R5, R6
20128.332.01	RESISTOR, 33.2 Ω, 0805	R10, R11
20128.499.01	RESISTOR 49.9 Ω 1% 0805	R19, R20, R22, R23
20129.301.01	RESISTOR, 301Ω, 0805	R24, R25, R47, R66
20130.100.01	RESISTOR, 1.00K 1% 0805	R17, R35
20130.200.01	RESISTOR, 2.00K, 0805	R71, R79, R84, R88, R3, R4, R7, R8, R26, R27, R28, R29, R30, R32
20130.475.01	RESISTOR, 4.75K, 0805	(R36, NO, STUFF), R205, R207, R209, R211, R213, R215, R217
20130.562.01	RESISTOR, 1/8W, 1%, 5.62K, 0805	R74
20131.100.01	RESISTOR, 10K, 0805	R1, R2, R9, R33, R37, R38, R39, R72
20131.113.01	RESISTOR, 1/8W, 1%, 11.3K, 0805	R87
20131.147.01	RESISTOR, 1/8W, 1%, 14.7K, 0805	R18, R73
20132.100.01	RESISTOR, 100K, 0805	R40, R41, R42, R43, R44, R45, R50, R54, R57, R59, R65, R70, R78, R83, R85
20135.002.01	RESISTOR, 0805, 5%, 2Ω	R63, R67, R75
20136.000.01	RESISTOR 300 Ω 5% 1/2W 2010	R81
20233.472.01	RESISTOR NETWORK 4.7K CTS745C 8R BUS	RN1, RN2, RN3, RN4
20237.472.01	RESISTOR NETWORK 8R, ISO, 5%	RN5
21136.010.01	CAPACITOR-SURFACE MOUNT 1206-10PF-5	C5
21139.000.01	CAPACITOR, X7R, 0.1UF, 10%, 0805	C6, C7, C8, C9, C19, C20, C21, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C39, C43, C45, C177, C179, C182, C184, C186, C187, C188, C200
21141.000.01	CAPACITOR, NPO, 1000PF, 1%, 0805	C11
21142.000.01	CAPACITOR, NPO, 100PF, 1%, 0805	C22, C34, C40, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C58, C59, C61, C62, C63, C64, C65, C66, C67, C68, C69, C70, C71, C72
21146.310.01	CAPACITOR, .01uf, 0805, 10%	C10, C126, C127, C133, C134, C156, C158, C160, C162, C180, C185
21167.047.01	CAPACITOR 4.7pf 50V X7R 0805	C1
21170.018.01	CAPACITOR 18pf 1% 50V COG 0805	C3, C4
21171.105.01	CAPACITOR 1uf X7R 0805	C14, C17, C36, C37, C38, C125, C132, C151, C153, C155, C157, C159, C161, C175, C176, C178, C181, C183, (C201, NO, STUFF)
21322.547.01	CAPACITOR, 4.7uf, TANTALUM, 3528 10%	C12
21325.610.01	CAPACITOR 10UF 10% TANTALUM 3528	C13, C15, C16, C18, C35, C42, C44, C202
22101.001.01	DIODE, 1N4148WT/R	CR1, CR2, CR3, CR4, CR5
22209.000.01	DIODE, SHOT 1A, 60V, SMD	CR6, CR7, CR8, CR9
24331.025.01	IC VOLTAGE REGULATOR LT1963-2.5	U14

	Control Board	
PART #	**DESCRIPTION**	**COMPONENT IDENTIFIER**
	SOT223	
24331.033.01	IC VOLTAGE REGULATOR LT1963-3.3 SOT223	U15
24417.000.01	IC OCT D-TYPE FLIPFLOP W/	U20
24541.000.01	IC SDRAM MT48LC16 TSOP54P	U2, U3
24638.000.01	IC, OCTAL BUS TRANS W/3	U22
24654.000.01	IC, PWRST MIC8115	U5
24656.475.01	IC, PWRST MCP120 SOT-23	U16
24900.000.01	IC, HEX INVERTER, SURFACE MOUNT	U23, U24
24965.000.01	IC, 74ALVC164245DGG	U7, U8, U9
24968.000.01	IC, MAX208ECNG	U12
24972.520.01	IC MICROPROCESSOR ELANSC520 BGA388	U1
24979.000.01	IC, BAT54C-7	CR11, CR12
24983.000.01	IC, 7064STC100-10	U6
25008.000.01	IC, PS2506-4 *	U17, U19
27017.009.01	CONNECTOR, RT AGL, PC MNT, 9P	J5
27017.025.01	CONNECTOR, RT AGL, PC MNT, 25P	J9
27147.124.01	IC, SCKT, DIP, 24 PIN, DUAL	SU12
27306.000.01	CONNECTOR RJ45 PCMT W/MAGS	J1
27406.014.01	CONNECTOR, SOCKET, STRIP, 14 PIN	JP1
27421.004.01	CONNECTOR, HDR, DBL RW, 4P, 2 X 2	J8, J10, J13
27421.006.01	CONNECTOR, HDR, DBL RW, 6P, 2 X 3	J14
27421.010.01	CONNECTOR, HDR, DBL RW, 23", 2 X 5	J3
27421.016.01	CONNECTOR, HDR, STR, .23", 2 X 8	(J6, NO, STUFF)
27451.005.01	CONNECTOR, STR, DBL ROW, 26 PIN	J11
27630.001.01	JUMPER, PC MNT, TEST POINT	TP100
28031.000.01	HOLDER, BATTERY, LITH CELL	BT1, HLDR
28041.000.01	CELL, COIN, BATTERY, LITHIUM, 3V	BT1
28089.000.01	OSCILLATOR 33MHZ SG636PCE 4P SMD	X1
28090.000.01	IC TCXO DS32KHZ 36P BGA	U13
28091.000.01	XTAL 25MHZ RXD MP35L SMD	Y1
44099.100.01	FIRMWARE 8300 U4 28F128	U4
20129.604.01.1	R0805 604Ω 1% 1/8W	R48, R49, R51, R53, R55, R56, R58, R60, R62, R64, R68, R69, R76, R77, R80, R82
20238.000.01.1	RESISTOR NET 100K 8RESISTOR 2512	RN52, RN61
22210.000.01.1	DIODE MBR530 SOD123	CR10
23216.000.01.1	TRANSISTOR MMBT4400 SOT23	Q1, Q2, Q3
24646.000.01.1	IC 74ACT244 OCTAL TSSOP	U18
24674.000.01.1	IC 10/100BT ETHERNET CONTROLLER (NATIONAL SEMICONDUCTOR)	U10
24761.000.01.1	IC LO POWER DC/DC CONVERT	U21
27374.000.01.1	HEADER, 2MM 2 X 10	(J4, NO, STUFF)
27375.000.01.1	HEADER, 2MM 2 X 6	J7
27479.002.01.1	CONNECTOR HEADER .156 CENTER 2 PIN	J12
29535.000.01.1	INDUCTOR 3.9uH CHIP 1008	L1, L2, L3
29536.000.01.1	INDUCTOR SURFACE MOUNT 10uH 10%	L4
43050.014.01.1	SASY CBL IDC 60PIN 1.4"	J2

Combined Input/Output and DSP (I/O+DSP) Board

	I/O+DSP BOARD	
PART #	**DESCRIPTION**	**COMPONENT IDENTIFIER**
24421.000.01	IC SN74ALVCH16373DGGR	IC802
21139.101.01	CAPACITOR CER 100PF 10% 50V0805	C1221, C1222, C1223, C1224, C1225, C1226
27058.000.01	CONNECTOR BNC RIGHT ANGLE 75Ω	J502
21185.220.01	CAPACITOR 22uF 6.3V X5R 20% 080	C1215, C1216
24649.000.01	IC SN74AC11D AND-GATE	IC701
27426.005.01	HEADER UNSHRD	J1002
27408.003.01	CONNECTOR 3PIN SOCKET STRIP	SL203, SL204, SL205, SL206, SL303, SL304, SL305, SL306
27147.008.01	IC SOCKET DIP 8 PIN DUAL	SIC201, SIC202, SIC301, SIC302
44128.100.01	FIRMWARE FPGA IC1103 5500	
44127.100.01	FIRMWARE PIC MCU IC1001 5500	
24681.000.01	IC PCM1798DB D/A CONVERTER	IC401
24516.000.01	IC IDT5V40501DCG	IC400
21329.000.01	CAPACITOR TANTALUM 47uF 6.3V 20% SURFACE-MOUNT	C400
20129.604.01	RESISTOR 0805 604Ω 1% 1/8W	(R201, R202, NO, STUFF)
20133.100.01	RESISTOR 1/8W 1% 1.0M 0805	R251, R252, R305, R306, R425, R426, R513
24795.000.01	IC XC95144XL-10TQG144C	IC1103
27468.006.01	CONNECTOR 6P MOLEX PCB MOUNT	J401
24843.000.01	IC CD74HC4046AM 16-SOIC	IC1104
29552.000.01	INDUCTOR POWER 1.5UH 9A SMD	L1201, L1202
24348.000.01	IC REGULATOR SYNC BUCK CLK 4A	IC1201, IC1202
24794.000.01	IC DSP DSPB56724AG	IC601, IC606, (IC602, IC603, IC604, IC605, NO, STUFF)
24793.000.01	IC MT48LC2M32B2P-6	IC801
21325.622.01	CAPACITOR 22UF 10% TANTALUM 3528	C1201, C1202, C1203, C1204
24711.000.01	IC LMV7219M5 CMPRTR	IC505
20129.100.01	RESISTOR 100Ω 0805	(R335, R336, R337, R338, NO, STUFF)
27451.009.01	HEADER STR DOUBLE-ROW 60P PCB MOUNT	J1001
27426.003.01	CONNECTOR HEADER 3PIN SINGLE-ROW	J505, J1101, J5052
21137.447.01	CAPACITOR .47UF 25V 10% 1206	C215, C216, C319, C320, C428, C429
21325.610.01	CAPACITOR 10UF 10% TANTALUM 3528	C221, C222, C223, C224, C225, C401, C402, C403, C404, C405, C406, C1001, C1002, C1003, C1004, C1005, C1006, C1007, C1008, C1103, C1205, C1206, C1207, C1208, C1239
27421.010.01	CONNECTOR HEADER DOUBLE ROW 23" 2 X 5	J1102, J1204
24538.000.01	IC PCM1744 D/A SOIC14	IC402
24417.000.01	IC OCTAL D FLIP-FLOP AC374	IC209

	I/O+DSP BOARD	
PART #	**DESCRIPTION**	**COMPONENT IDENTIFIER**
28093.000.01	OSCILLATOR VCXO 3.3V 27MHz FVXO-	IC1101
24337.000.01	IC LOW-DROPOUT VOLT REGULATOR 1.8V 200m	IC1002
24772.000.01	IC PIC18LF4420 MICRO CONTROLLER	IC1001
24769.000.01	IC 4CHANNEL ASYNCHRONOUS CONVERTER	IC503, (IC504, NO, STUFF)
24768.000.01	IC 2CHANNEL ASYNCHRONOUS CONVERTER	IC501, (IC502, NO, STUFF)
27057.000.01	CONNECTOR DUAL BNC PCB MOUNT INTERNAL CAPACITOR	(J502 NO STUFF)
27630.001.01	JUMPER PC MOUNT TEST POINT	TP1201, TP1202 (TP1203, TP1204, TP1205, NO STUFF)
29539.000.01	CHOKE COMMON-MODE 1KΩ SM	L201, L202, L301, L302, L501, L503, L5022 (L502, L504, NO STUFF)
21138.247.01	CAPACITOR SMD1206 4700PF 50V 5%	C217, C218, C219, C220, C1229, C1230
21139.000.01	CAPACITOR X7R 0.1UF 10% 0805	C226, C227, C228, C229, C230, C231, C232, C233, C234, C235, C236, C237, C238, C239, C240, C241, C242, C243, C244, C304, C305, C306, C307, C308, C309, C310, C311, C312, C313, C314, C407, C408, C409, C410, C411, C412, C413, C414, C415, C416, C417, C418, C419, C420, C421, C501, C503, C505, C507, C901, C902, C903, C904, C905, C906, C907, C908, C909, C910, C911, C912, C913, C914, C915, C916, C917, C918, C919, C920, C921, C922, C923, C924, C925, C926, C927, C928, C929, C930, C931, C932, C933, C934, C935, C936, C937, C938, C939, C940, C941, C942, C943, C944, C945, C946, C947, C948, C1010, C1011, C1012, C1013, C1014, C1015, C1016, C1017, C1018, C1019, C1020, C1021, C1022, C1023, C1024, C1025, C1026, C1100, C1104, C1105, C1106, C1107, C1108, C1109, C1110, C1217, C1218, C1219, C1220, C1235, C1236, C1237, C1240, (C502, C504, C506, C508 NO-STUFF)
29015.000.01	TRANSFORMER SURFACE-MOUNT SCIENTIFIC CONVERSION	T501, T503, (T502, T504, NO, STUFF)
20130.499.01	RESISTOR R0805 4.99K 1% 1/8W	R211, R212, R213, R214, R215, R216, R217, R218, R1005, R1101, R1108, R1213, R1214
20130.150.01	RESISTOR 0805 1.50K 1% 1/8W	(R207, R208, R209, R210 NO STUFF), R245, R246, R247, R248, R249, R250
20135.002.01	RESISTOR 5% 2Ω 0805	R1001, R1002, R1201, R1202,

	I/O+DSP BOARD	
PART #	**DESCRIPTION**	**COMPONENT IDENTIFIER**
		R1203, R1204
20129.301.01	RESISTOR 301Ω 0805	R510
20129.110.01	RESISTOR 0805 110Ω 1% 1/8W	R260, R303, R304, R501, R503, R1217, R1218 (R502, R504 NO STUFF)
20129.475.01	RESISTOR 475Ω 1% 1/8W 0805	(R339, R340, R341, R342 NO STUFF)
21170.282.01	CAPACITOR 0805 .0082U 50 5% COG	(C211, C212, C213, C214 NO STUFF)
29522.000.01	INDUCTOR 1200UH 5% 1-M-10-22	L207, L208, L209, L210 (L311, L312, L313, L314, NO, STUFF)
20128.000.01	RESISTOR 0Ω 0805	R505, R506, R1007 (R1109 NO STUFF)
29537.102.01	INDUCTOR 0805 FERRITE 1000Ω	L1001, L1002, L1003, L1004, L1101, L1102, L1103
29508.210.01	FILTER EMI SUPPRESS 100V 10	L203, L204, L205, L206, L303, L304, L305, L306
29506.001.01	BEAD FERRITE ON WIRE	L505, L507, L509, L511, L5062, L5082 (L506, L508, L510, L512 NO STUFF)
27054.003.01	CONNECTOR FEMALE INSERT RIGHT ANGLE	J201, J202, J501
27053.003.01	CONNECTOR MALE INSERT RIGHT ANGLE	J301, J302, J503 (J504 NO STUFF)
24997.000.01	IC DAC AK4393VSP VSOP	IC306
24963.000.01	IC ADC AK5383 SOP IC,5383	IC208
24960.000.01	IC OPA2134UA	IC205, IC206, IC207, IC303, IC304, IC305, IC403, IC404, IC405, IC406, IC407
24958.000.01	IC DRV134PA	IC301, IC302
24307.901.01	IC LINEAR DC REGULATOR 5V POSITIVE I	IC1203
24024.000.01	IC OPA2134PA	IC201, IC202
23214.000.01	TRANSISTOR NPN MMBT3904	Q1001
22106.000.01	DIODE VSTT SMCJ26 DO214	CR201, CR202, CR203, CR204, CR301, CR302, CR303, CR304
22083.068.01	DIODE VOLTAGE SUPPRESSOR 6.8 VL	CR1201
20130.210.01	RESISTOR 1/8W 1% 2.10K 0805	R227, R228, R407, R408, R409, R410, R411, R412, R413, R414
21319.610.01	CAPACITOR 10uf TANTALUM SMT	C1231, C1232, C1233
21227.747.01	CAPACITOR RADIAL LEADS 470UF 16V HF	C1238
21171.105.01	CAPACITOR 1uf X7R 0805	C301, C302, C303, C511, C805, C806, C807, C808, C949, C950, C951, C952, C953, C954, C955, C956, C957, C958, C959, C960, C1009, C1101, C1102, C1209, C1210, C1211, C1212, C1213, C1214, C1234
21147.022.01	CAPACITOR 22pf 0805 1%	C423, C424, C425, C426, C427

	I/O+DSP BOARD	
PART #	**DESCRIPTION**	**COMPONENT IDENTIFIER**
21146.310.01	CAPACITOR 0.01uf 0805 10% 0805	C430, C601, C602, C603, C604, C605, C606, C607, C608, C609, C610, C611, C612, C613, C614, C615, C616, C617, C618, C619, C620, C621, C622, C623, C624, C625, C626, C627, C628, C629, C630, C631, C632, C633, C634, C635, C636, C637, C638, C639, C640, C641, C642, C643, C644, C645, C646, C647, C648, C649, C650, C651, C652, C653, C654, C655, C656, C657, C658, C659, C660, C661, C662, C663, C664, C665, C666, C667, C668, C669, C670, C671, C672, C701, C801, C802, C803, C804, C1027, C1111, C1112, C1113, C1114, C1115, C1227, C1228, C5022
21144.000.01	CAPACITOR 5% 100V 47PF 1206	C200, C201, C202, C203, C204, C205, C206
21143.000.01	CAPACITOR NPO 1500PF 1% 0805	C321, C322, C422 (C327, C328, C329, C330 NO STUFF)
21141.000.01	CAPACITOR NPO 1000PF 1% 0805	C207, C208, C209, C210 (C323, C324, C325, C326 NO STUFF)
21140.000.01	CAPACITOR NPO 470PF 1% 0805	C315, C316, C317, C318
20511.310.01	TRIM-POT 10K 10% 3/8TOP ADJ	VR301, VR302
20237.472.01	RESISTOR NETWORK 8R ISO 5%	RN801, RN802
20151.536.01	RESISTOR 0.1% 5.36K 0805	R219, R220, R221, R222
20151.365.01	RESISTOR 0.1% 3.65K 0805	R233, R234, R235, R236, R237, R238, R239, R240
20132.100.01	RESISTOR 1/8W 1% 100K R0805	R1008, R1009, R1102, R1103, R1104, R1106, R1107
20131.825.01	RESISTOR 1/8W 1% 82.5K 0805	R223, R224, R317, R318, R319, R320, R419, R420, R421, R422, R423, R424
20131.147.01	RESISTOR 1/8W 1% 14.7K 0805	R231, R232
20131.113.01	RESISTOR 1/8W 1% 11.3K 0805	R327, R328, R329, R330
20131.100.01	RESISTOR 10K 0805	R301, R302, R401, R402, R403, R404, R405, R406, R511, R512, R601, R602, R603, R604, R605, R606, R607, R608, R609, R610, R611, R612, R1006, R1205, R1206, R1207, R1208, R1209, R1210, R1211
20130.845.01	RESISTOR 1/8W 1% 8.45K 0805	R307, R308, R309, R310, R311, R312, R313, R314, R315, R316
20130.562.01	RESISTOR 1/8W 1% 5.62K 0805	R229, R230
20130.348.01	RESISTOR 1/8W 1% 3.48K 0805	R321, R322, R323, R324, R325, R326, R415, R416, R417, R418, R1215
20130.162.01	RESISTOR 1/8W 1% 1.62K 0805	R241, R242, R243, R244, R1212
20130.100.01	RESISTOR 1.00K 1% 0805	R203, R204, R205, R206, R1003, R1004, R1100, R1216

	I/O+DSP BOARD	
PART #	**DESCRIPTION**	**COMPONENT IDENTIFIER**
20129.768.01	RESISTOR 1/8W 1% 768Ω 0805	R225, R226
20129.249.01	RESISTOR 1/8W 1% 249Ω 0805	R255, R256, R257, R258, R259
20129.150.01	RESISTOR 1/8W 1% 150Ω 0805	R253, R254, R507, R508, R509, R1105
20128.499.01	RESISTOR 49.9Ω 1% 0805	(R331, R332, R333, R334 NO STUFF)
24766.000.01	IC PLL1707DBQ	IC1102
27479.004.01	CONNECTOR HEADER .156CTR 4 PIN	J1202
29535.000.01	INDUCTOR 3.9uH CHIP 1008	L307, L308, L309, L310
27479.006.01	CONNECTOR HEADER .156CTR 6 PIN	J1201
27479.002.01	CONNECTOR HEADER .156CTR 2 PIN	J1203
24760.000.01	IC QUAD CMOS SPST SWITCH	IC203, IC204
22210.000.01	DIODE MBR530 SOD123	CR1001, CR1002

Composite/SCA Daughterboard

	COMPOSITE/SCA DAUGHTERBOARD	
PART #	**DESCRIPTION**	**COMPONENT IDENTIFIER**
29538.000.01	INDUCTOR 3300UH 10% RL-1160-33	L9, L10
27758.006.01	CONNECTOR 6P MOLEX RT ANGLE	J5
27421.004.01	CONNECTOR HEADER DOUBLE ROW 4P 2X2	J6, J7, J8
29508.210.01	FILTER EMI SUPPRESSOR 100V 10	L1, L2, L3, L4
27056.000.01	CONNECTOR BNC METAL RIGHT ANGLE	J1, J2, J3, J4
29535.000.01	INDUCTOR 3.9uH CHIP 1008	L5, L6, L7, L8
21142.560.01	CAPACITOR 560pf 50v 1% NPO 0805	C9, C10, C11, C12
24025.000.01	IC 8DIP BUF634P	IC3, IC4
24960.000.01	IC OPA2134UA	IC1, IC2
21147.022.01	CAPACITOR 22pf 0805 1%	C1, C2, C3, C4
21146.310.01	CAPACITOR 0.01uF 0805 10% 0805	C5, C6, C7, C8
20170.182.01	RESISTOR 1.82K 1/8W 0.1% 0805	R17, R18, R19, R20
20508.350.01	TRIMPOTS 50K 18T SIDE ADJUST	VR1, VR2
21139.000.01	CAPACITOR X7R 0.1UF 10% 0805	C13, C14, C15, C16
20135.100.01	RESISTOR 1/8W 5% 1.00M 0805	R1, R2
20129.604.01	RESISTOR 0805 604 Ω 1% 1/8W	R5, R6, R7, R8, R9, R10
20130.210.01	RESISTOR 1/8W 1% 2.10K 0805	R3, R4
20130.348.01	RESISTOR 1/8W 1% 3.48K 0805	R13, R14, R15, R16
20128.075.01	RESISTOR 75 Ω 1% 0805	R11, R12

Display Board (Front)

	DISPLAY BOARD (FRONT)	

PART #	DESCRIPTION	COMPONENT IDENTIFIER
15057.010.01	SPACER, .100" HIGH	CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR8, CR9, CR16
15061.005.01	LED MNT, 1 POS'N, .240"HIGH	MNTCR10
25106.001.01	LED, YELLOW, T-1, HIGH EFFICIENCY LAMP	CR11, CR12, CR13, CR14, CR15
25106.003.01	LED, RED, T-1, HIGH EFFICIENCY LAMP	CR10
25167.000.01	LED, ARRAY, 1 RED, 1 YEL, 8 GRN	CR7, CR16
25168.000.01	LED, ARRAY, 9 YELLOW, 1 RED	CR1, CR2, CR3, CR4, CR5, CR6
27368.000.01	CONNECTOR, 100 SCKT, 5X2 LOPRO	J1
27369.000.01	CONNECTOR, 100 SCKT, 8X2, LOPRO	J2, J3, J4
25172.000.01.1	LED ARRAY ALL YELLOW	CR8, CR9

Display Board (Back)

PART #	DESCRIPTION	COMPONENT IDENTIFIER
42007.100	FLAT CABLE 26P 10"	JP203
15065.355.01	LED-MNT-1 POS-0.355	FOR, CR1 USE 2
20122.110.01	RESISTOR, TF, 1/8W, 1%, 110 Ω	R17, R18, R19, R20, R21, R22, R23, R24
20124.100.01	RESISTOR TF 1/8W 1% 1206 10K	R29, R30
20125.100.01	RESISTOR, TF, 1/8W, 1%, 100K	R25, R26, R27, R28
20226.000.01	RESISTOR, NETWORK, DIL, 2%, 100 Ω	RP1, RP2
21131.410.01	CAPACITOR, SURFACE MOUNT 1206, .1UF, 50V, 20%	C2, C3, C4, C5, C6, C7, C8
21144.000.01	CAPACITOR, 5%, 100V, 47PF, 1206	C9, C10, C11, C12, C13, (C14, NO, STUFF)
21313.568.01	CAPACITOR, TANTALUM, 6.8UF, 25V, 10%	C1
24635.000.01	IC 74HCT374	IC3
24636.000.01	IC 74ACT574	IC1, IC2
24900.000.01	IC, HEX INVERTER, SURFACE MOUNT	IC7
24905.000.01	IC, CMOS OCTAL D REG. 3 ST	IC4, IC5, IC6, IC9
24967.000.01	IC, 74ACT245DW	IC8
25112.001.01	LED, RED/GREEN, BI-COLOR/POLAR	CR1
26085.000.01	SWITCH, ROT, VERTICAL MOUNT, 2 BIT	S12
27366.000.01	CONNECTOR, 100 POSTS, 5X2 MLE	P1
27367.000.01	CONNECTOR, 100 POSTS, 8X2	P2, P3, P4
27404.000.01	CONNECTOR, PLUG, POLAR, WHITE, NYL	P5-6
27420.002.01	CONNECTOR 2 PIN RIGHT ANGLE	J1
43008.501.01	ASSEMBLY-WIRE-BLK-12	
43008.503.01	ASSEMBLY-WIRE-RED-12	

Schematics and Parts Locator Drawings

These drawings reflect the actual construction of your unit as accurately as possible. Any differences between the drawings and your unit are probably due to product improvements or production changes since the publication of this manual.

If you intend to replace parts, please read page 6-15. Please note that because surface-mount parts are used extensively in the 5518, few parts are field-replaceable. Servicing ordinarily occurs by swapping circuit board assemblies. However, many vulnerable parts connected to the outside world are socketed and can be readily replaced in the field.

Function	Description	Drawing	Page
Chassis	Circuit Board Locator and Basic Interconnections	Top view (not to scale)	6-27
Control board	Control microprocessor. Services front panel, serial port, Ethernet, and DSP+I/O board. ***Contains***:	Parts Locator Drawing	6-28
	General Purpose bus, address decoder, I/O+DSP interface	Schematic 1 of 5	6-29
	Memory and clock generation	Schematic 2 of 5	6-30
	Ethernet	Schematic 3 of 5	6-31
	Miscellaneous input/output	Schematic 4 of 5	6-32
	Power and Ground	Schematic 5 of 5	6-33
I/O+DSP Board	Analog Input/output AES3 Input/output DSP Chips; Local regulators. Contains:	Parts Locator Drawing	6-34
	Interconnects	Schematic 1 of 12	6-35
	L and R Analog Inputs	Schematic 2 of 12	6-36
	L and R Analog Outputs	Schematic 3 of 12	6-37
	Composite And Pilot Reference Signal Generators	Schematic 4a of 12	6-38
	Composite/SCA Daughterboard	Schematic & Parts Locator 4b of 12	6-39
	Digital I/O & Sync Input	Schematic 5 of 12	6-40
	DSP Enhanced Serial Audio Interface	Schematic 6 of 12	6-41
	DSP Control Interface	Schematic 7 of 12	6-42
	DSP External Memory Control Interface	Schematic 8 of 12	6-43
	DSP Power and Ground	Schematic 9 of 12	6-44
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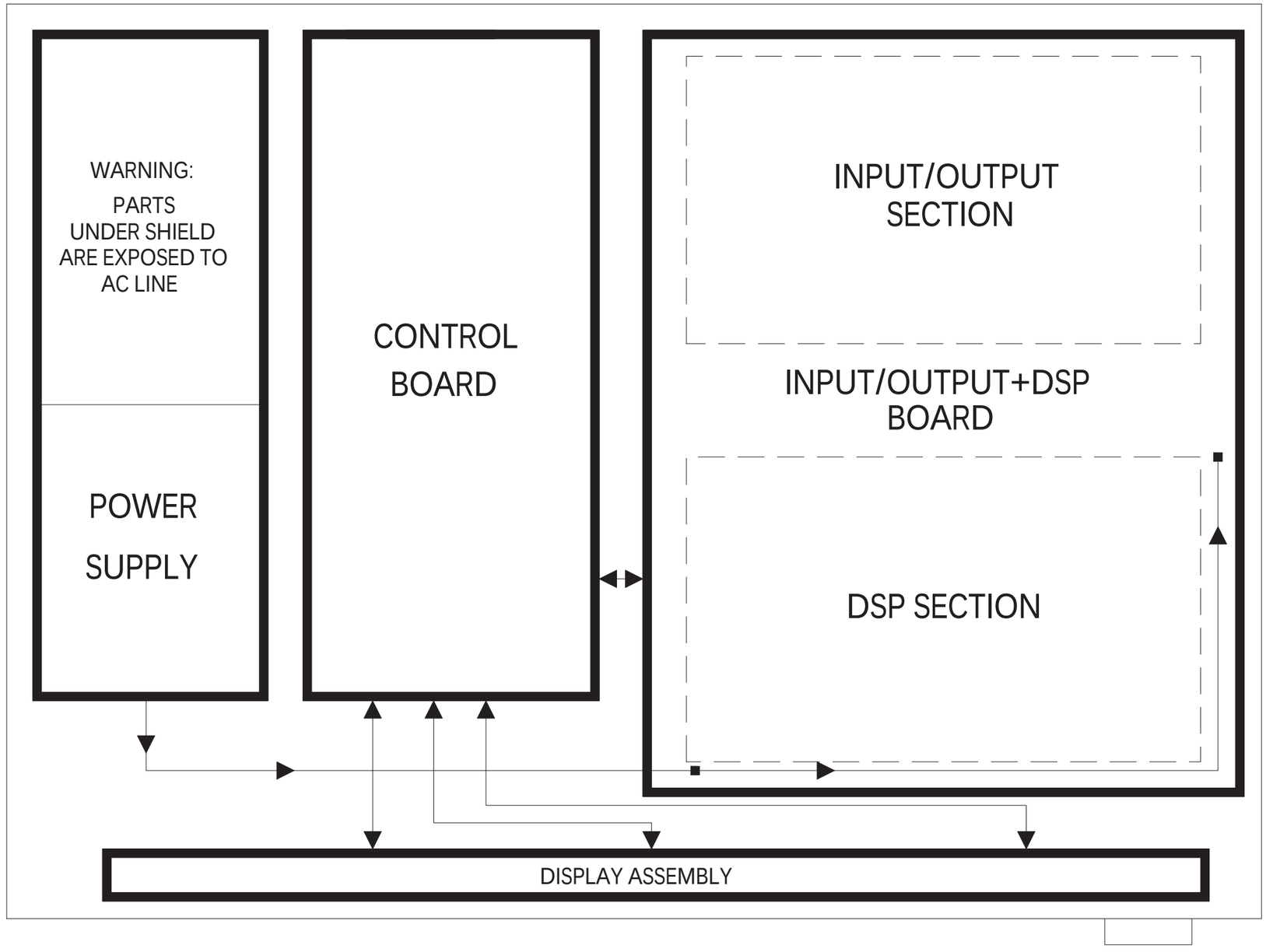
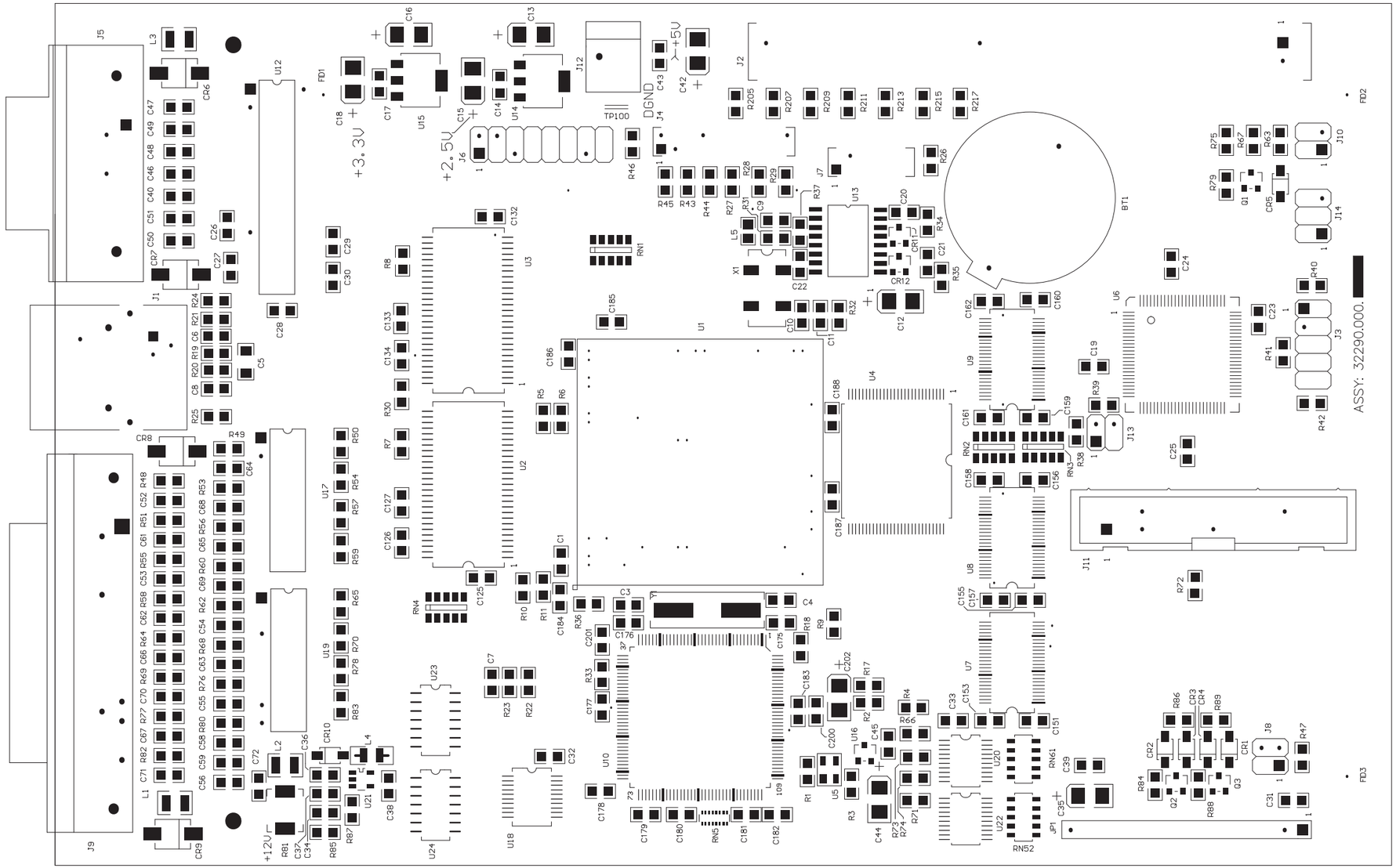
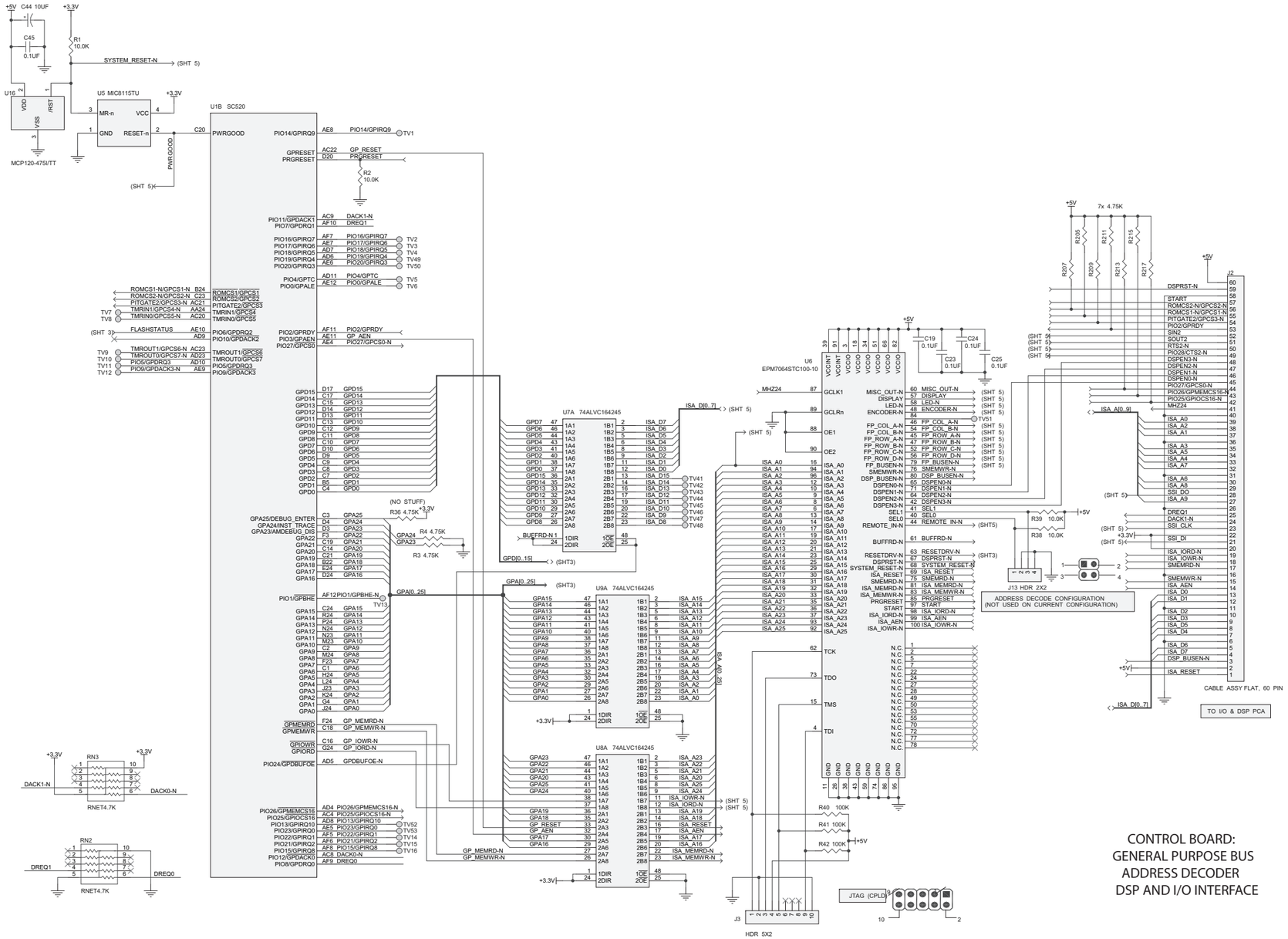
	Power Distribution	Schematic 12 of 12	6-47
Display Board	Front-Panel LCD, LEDs, Buttons, and Rotary Encoder Contains:	Parts Locator Drawing	6-48
	Front of board	Schematic 1 of 2	6-49
	Rear of board		6-50
DSP Block Diagram	Shows signal processing		6-51

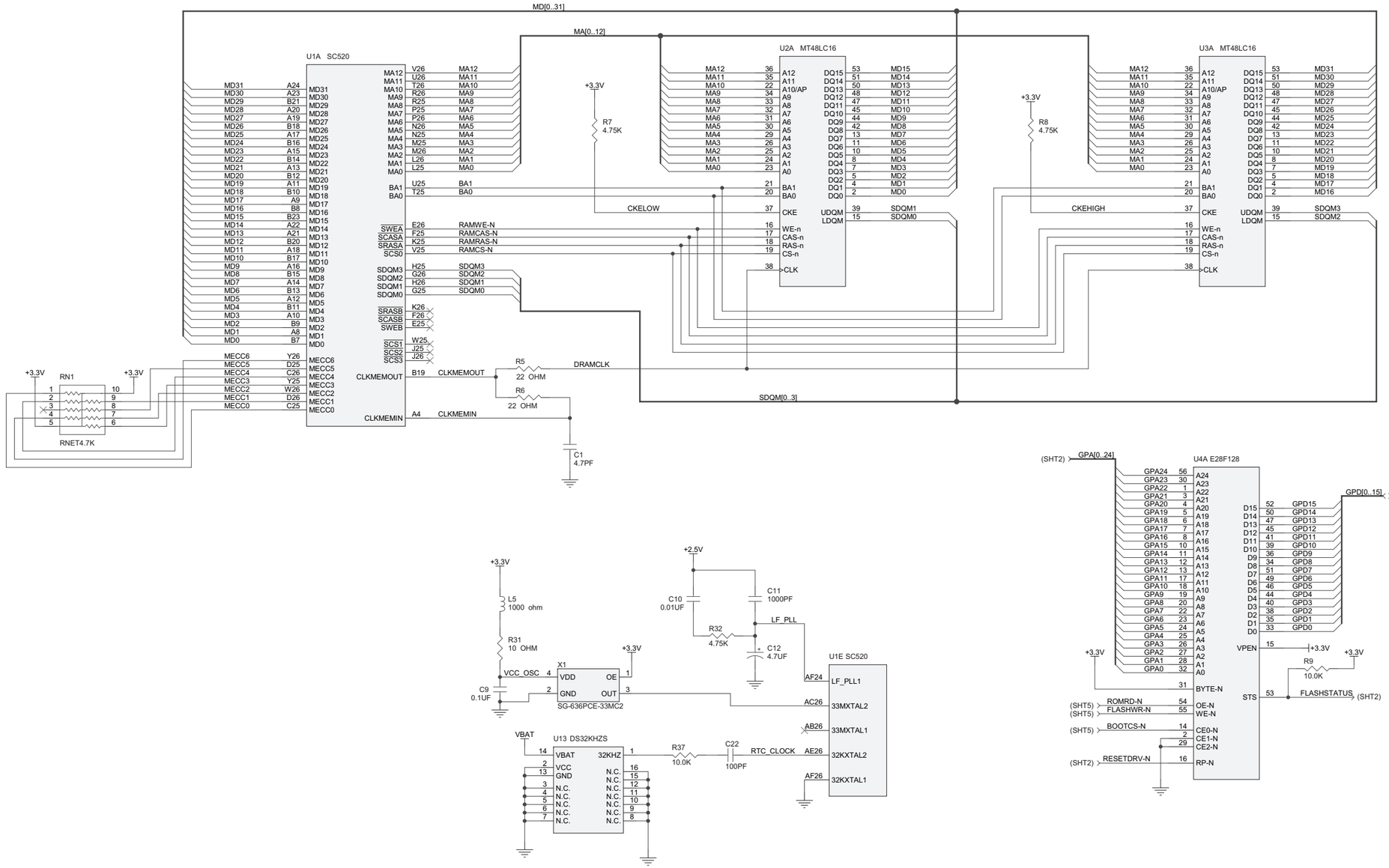

WARNING:
PARTS
UNDER SHIELD
ARE EXPOSED TO
AC LINE
POWER
SUPPLY
CONTROL
BOARD
INPUT/OUTPUT
SECTION
INPUT/OUTPUT+DSP
BOARD
DSP SECTION
DISPLAY ASSEMBLY



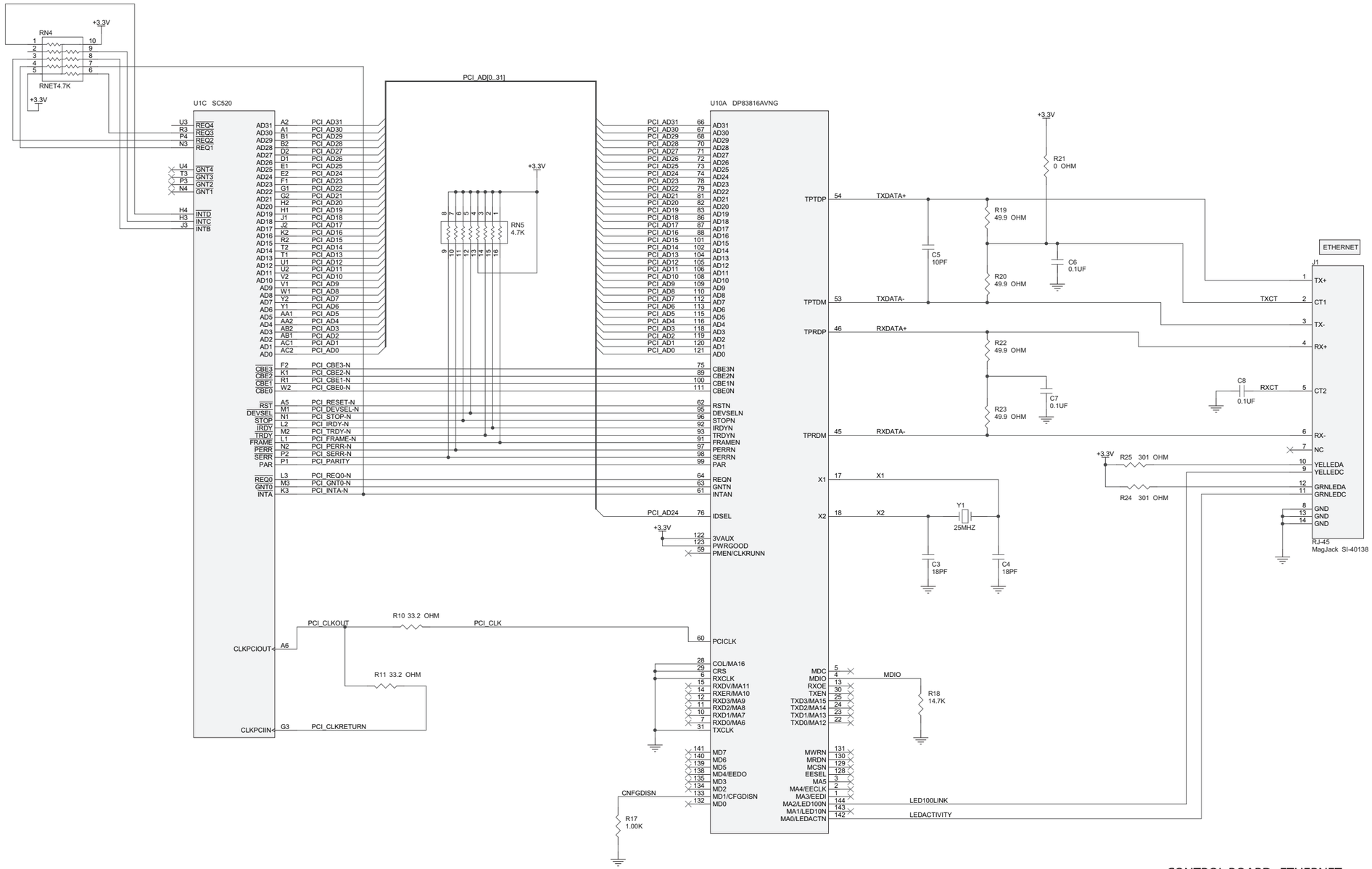
CONTROL BOARD PARTS LOCATOR



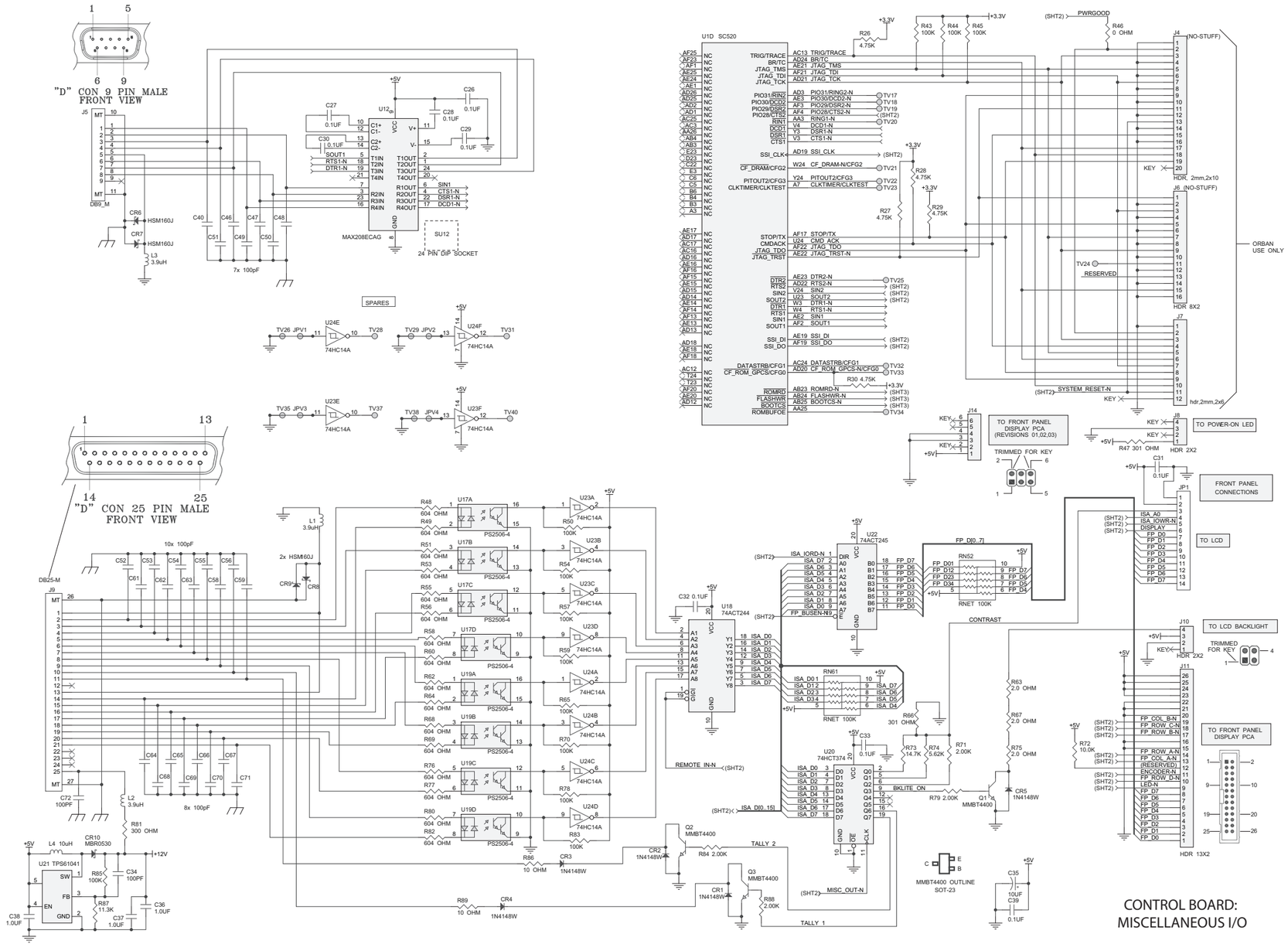
CONTROL BOARD:
GENERAL PURPOSE BUS
ADDRESS DECODER
DSP AND I/O INTERFACE



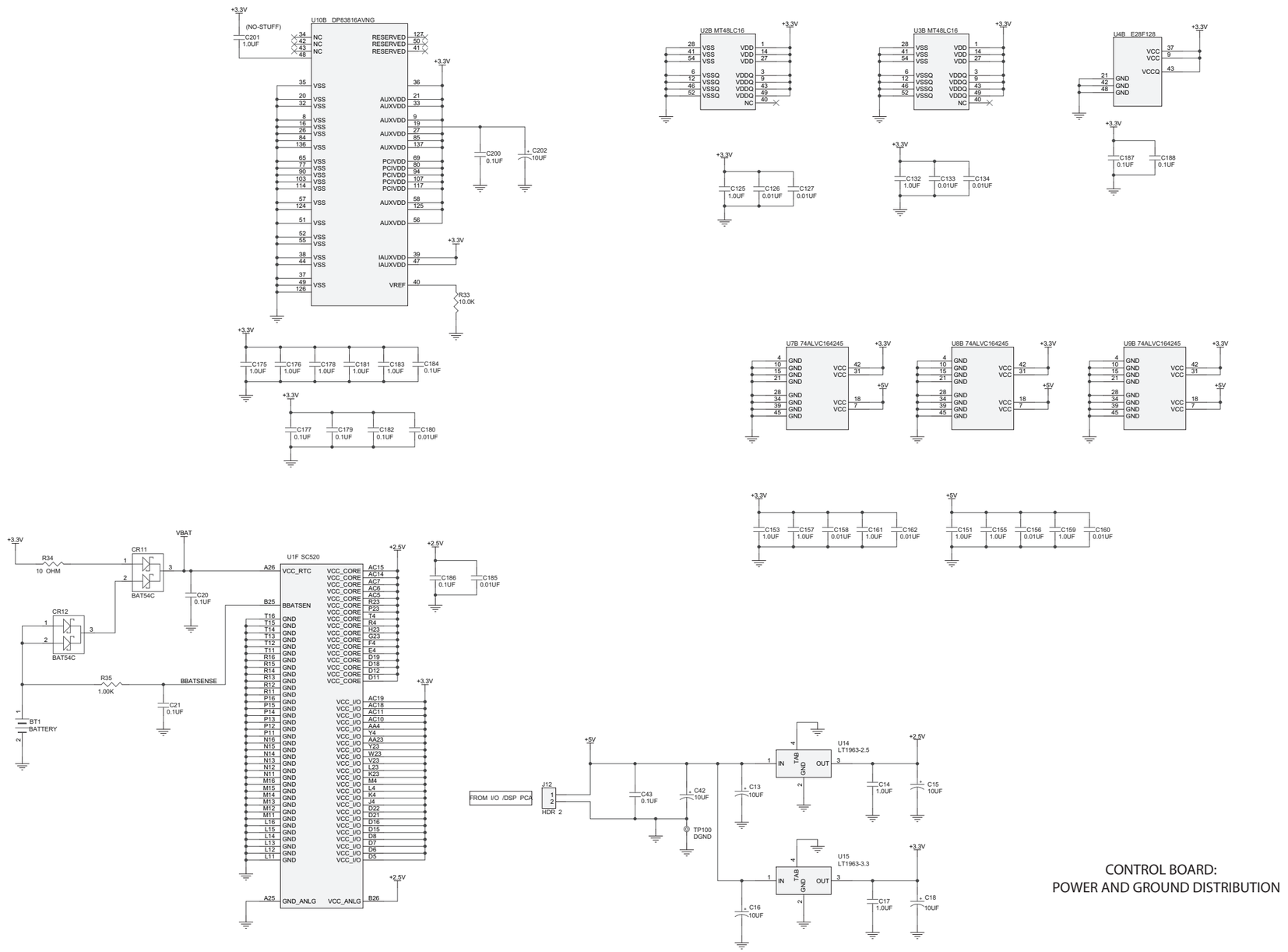
CONTROL BOARD:
MEMORY AND CLOCK GENERATION



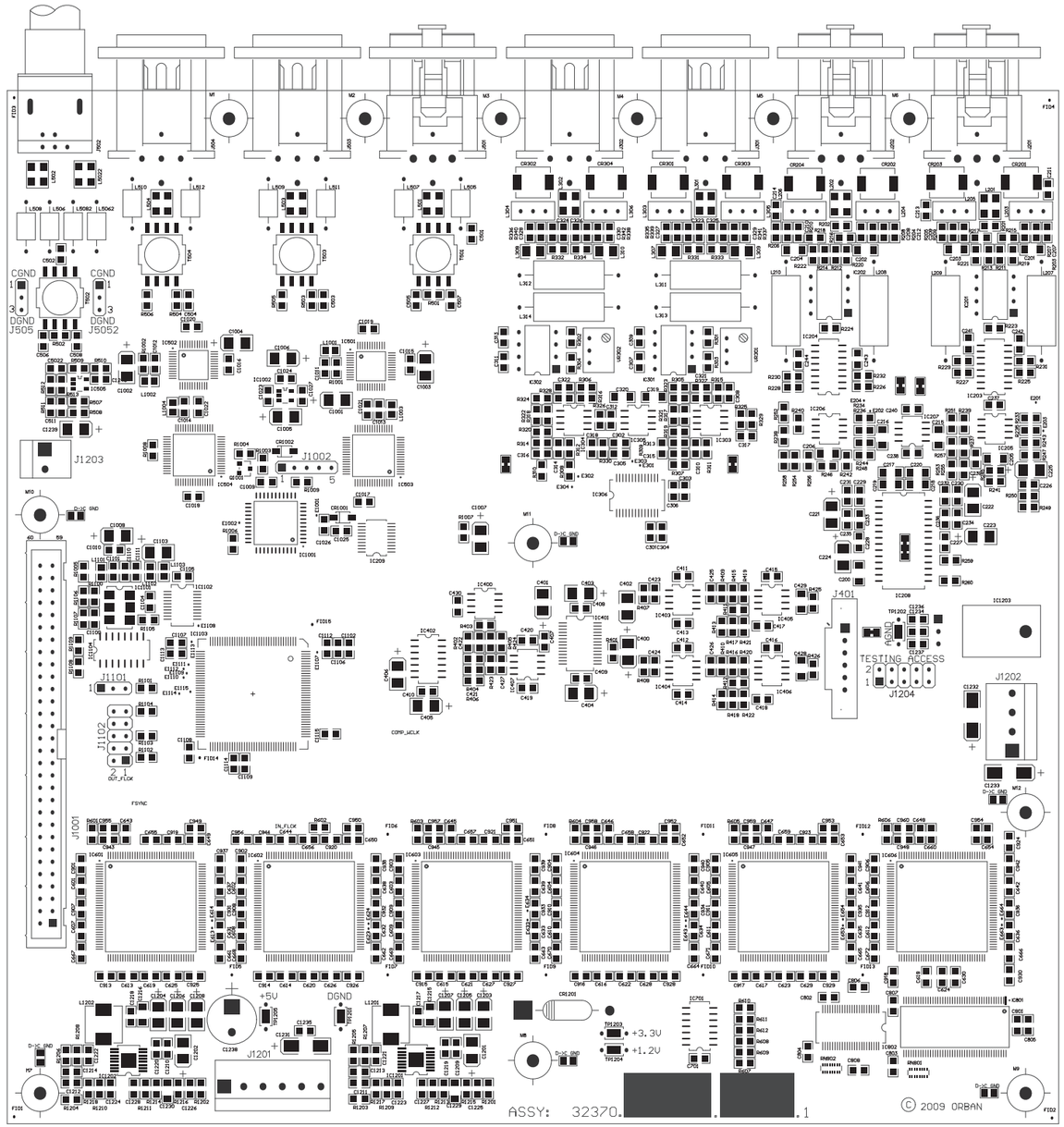
CONTROL BOARD: ETHERNET



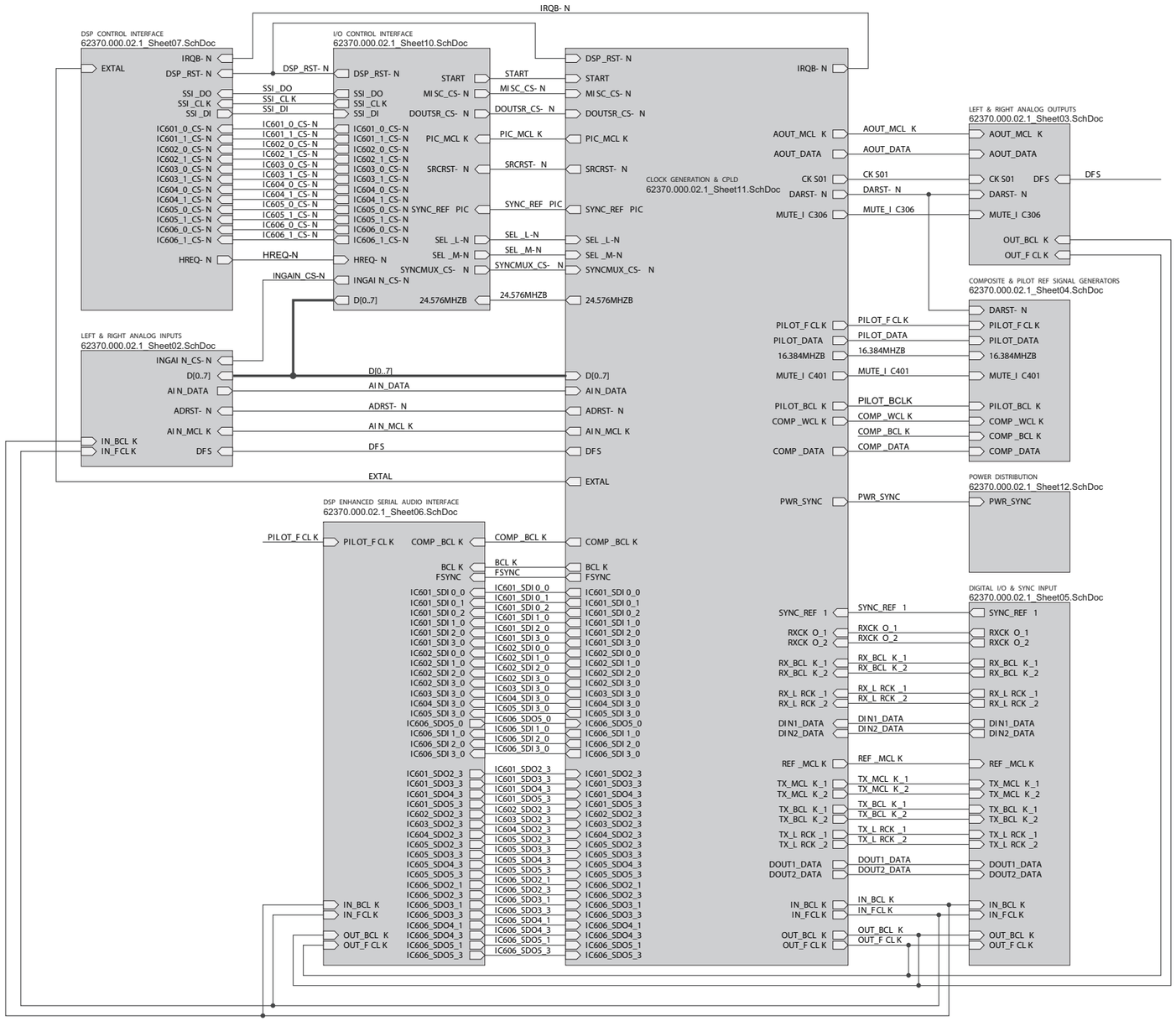
CONTROL BOARD:
MISCELLANEOUS I/O



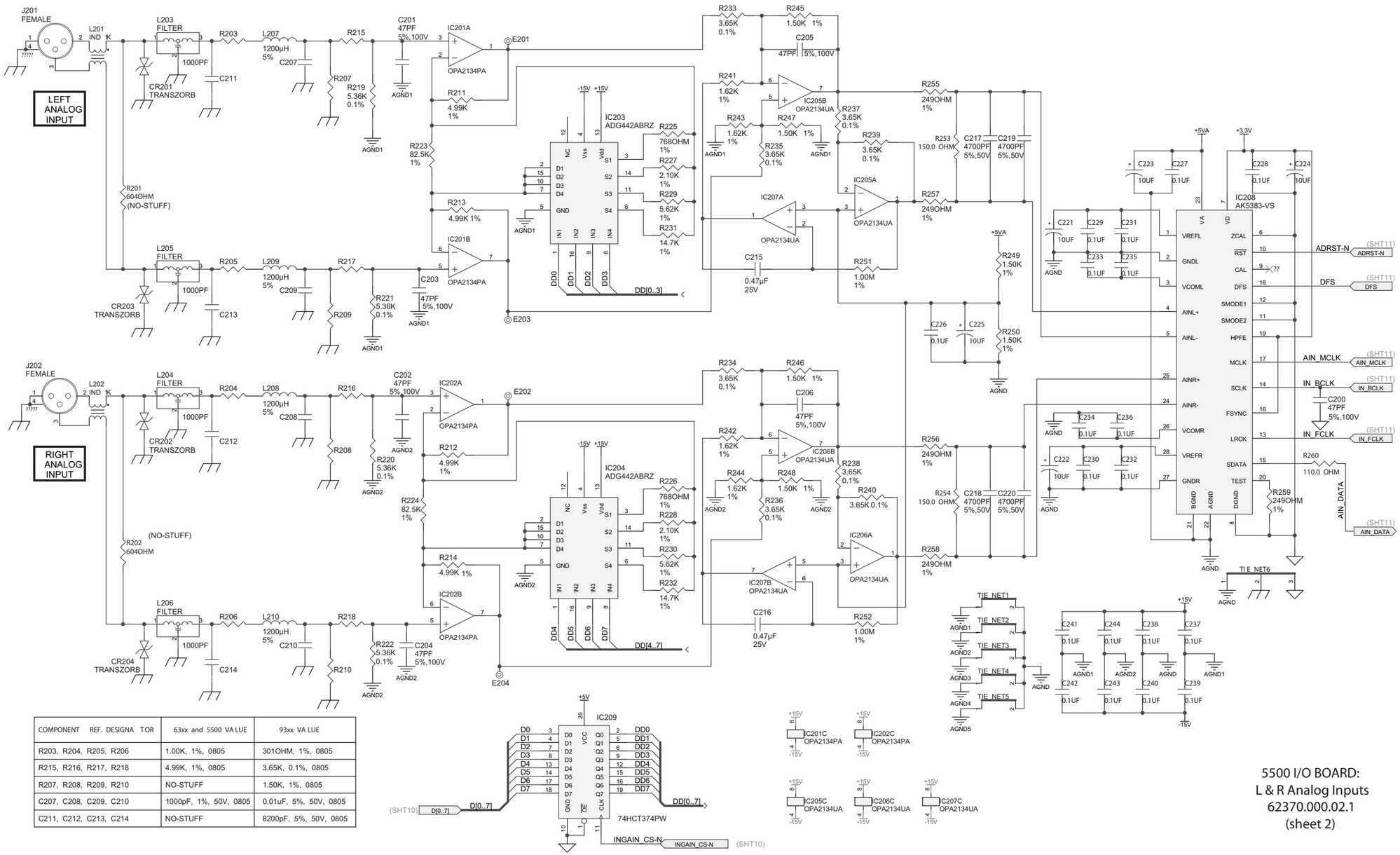
CONTROL BOARD:
POWER AND GROUND DISTRIBUTION



5500 I/O BOARD:
Parts Locator Drawing
32370.000.02.1
(sheet 1 of 1)

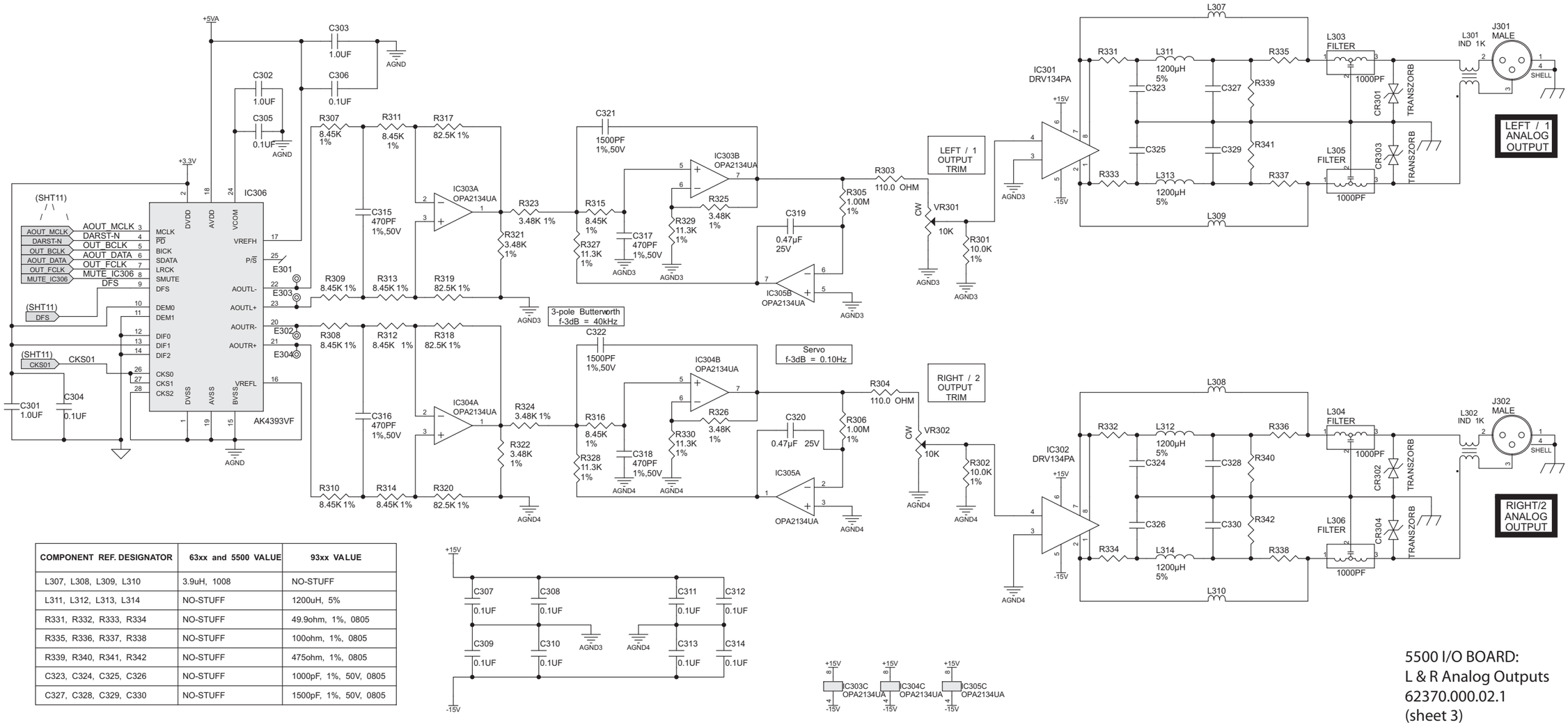


5500 I/O BOARD:
Interconnects
62370.000.02.1
(sheet 1)



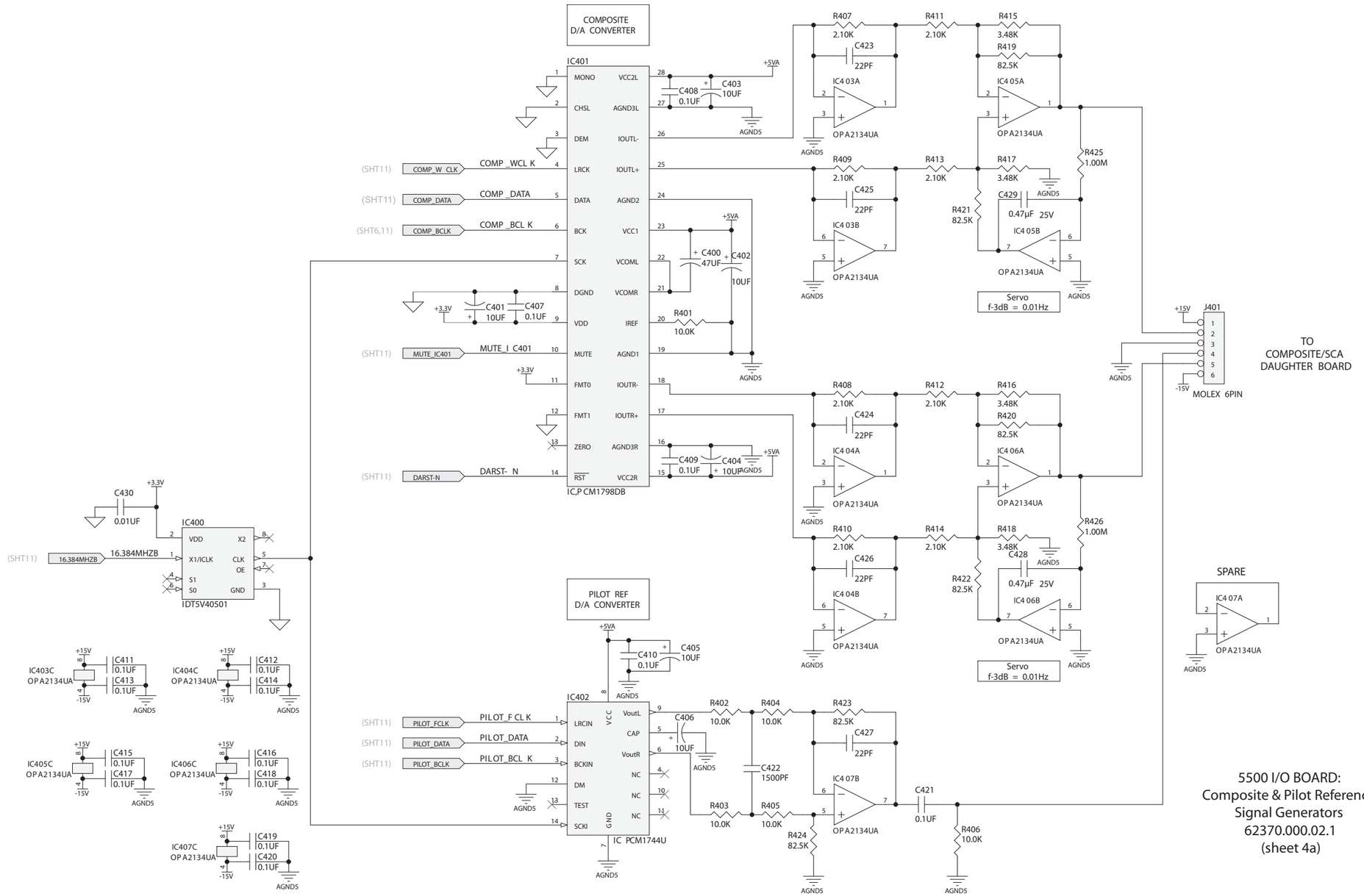
COMPONENT REF. DESIGNA TOR	63xx and 5500 VA LUE	93xx VA LUE
R203, R204, R205, R206	1.00K, 1%, 0805	301OHM, 1%, 0805
R215, R216, R217, R218	4.99K, 1%, 0805	3.65K, 0.1%, 0805
R207, R208, R209, R210	NO-STUFF	1.50K, 1%, 0805
C207, C208, C209, C210	1000pF, 1%, 50V, 0805	0.01uF, 5%, 50V, 0805
C211, C212, C213, C214	NO-STUFF	8200pF, 5%, 50V, 0805

5500 I/O BOARD:
L & R Analog Inputs
62370.000.02.1
(sheet 2)

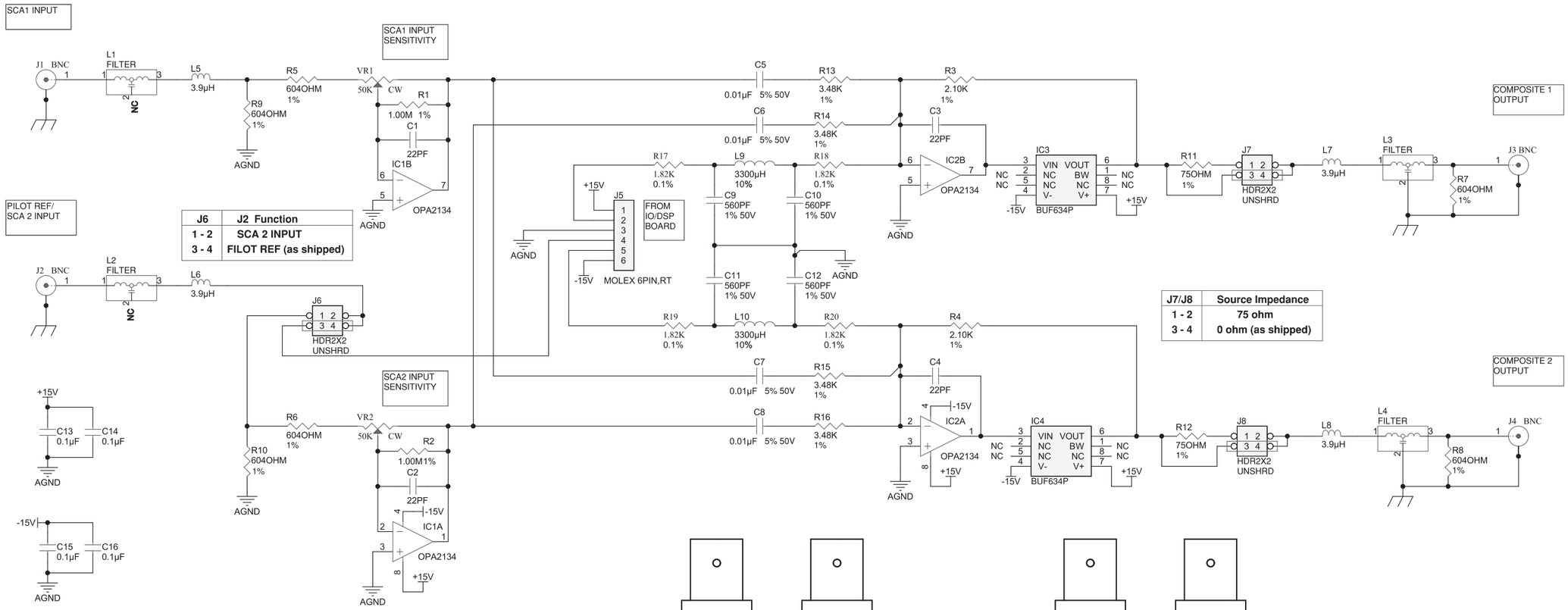


COMPONENT REF. DESIGNATOR	63xx and 5500 VALUE	93xx VALUE
L307, L308, L309, L310	3.9uH, 1008	NO-STUFF
L311, L312, L313, L314	NO-STUFF	1200uH, 5%
R331, R332, R333, R334	NO-STUFF	49.9ohm, 1%, 0805
R335, R336, R337, R338	NO-STUFF	100ohm, 1%, 0805
R339, R340, R341, R342	NO-STUFF	475ohm, 1%, 0805
C323, C324, C325, C326	NO-STUFF	1000pF, 1%, 50V, 0805
C327, C328, C329, C330	NO-STUFF	1500pF, 1%, 50V, 0805

5500 I/O BOARD:
L & R Analog Outputs
62370.000.02.1
(sheet 3)

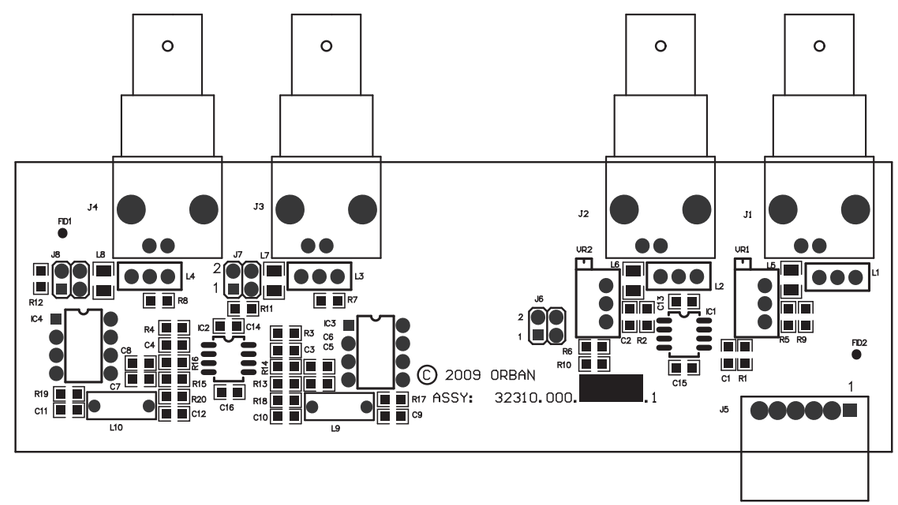


5500 I/O BOARD:
Composite & Pilot Reference
Signal Generators
62370.000.02.1
(sheet 4a)

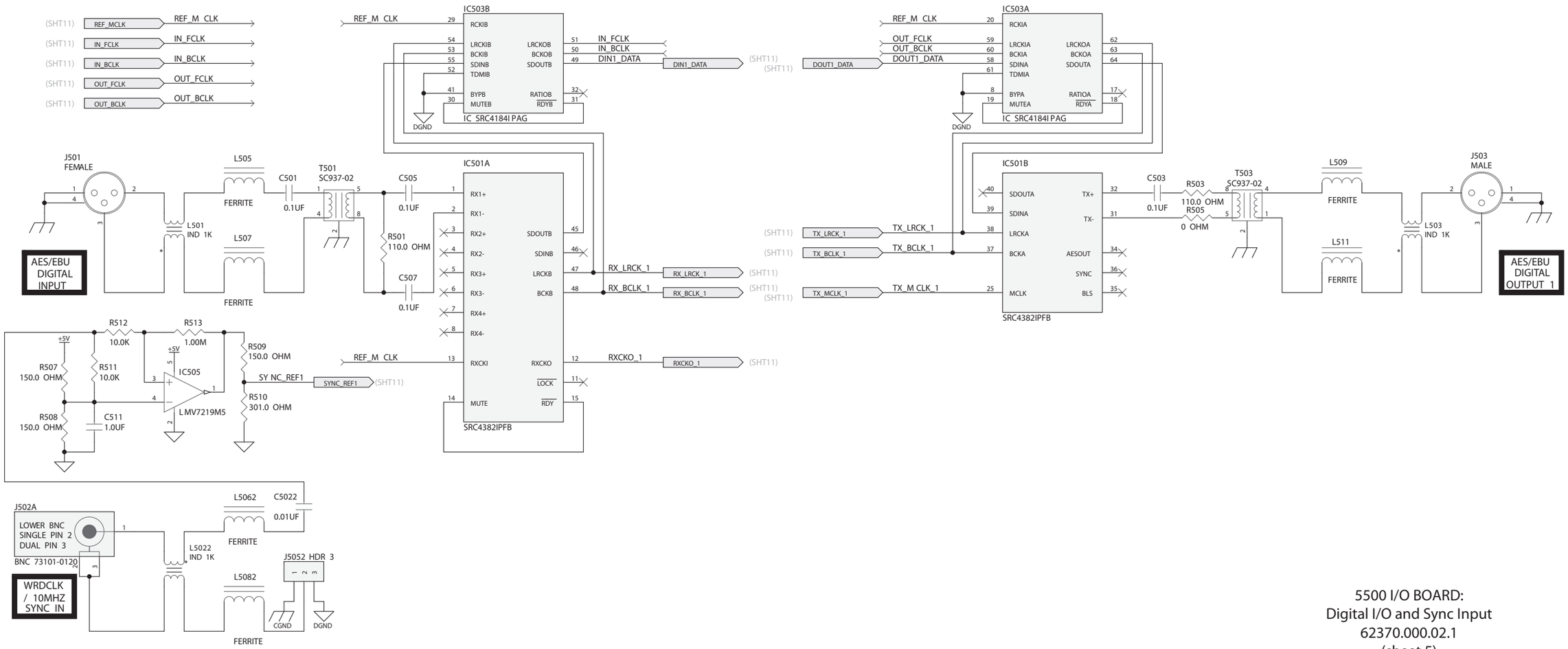


J6	J2 Function
1 - 2	SCA 2 INPUT
3 - 4	FILOT REF (as shipped)

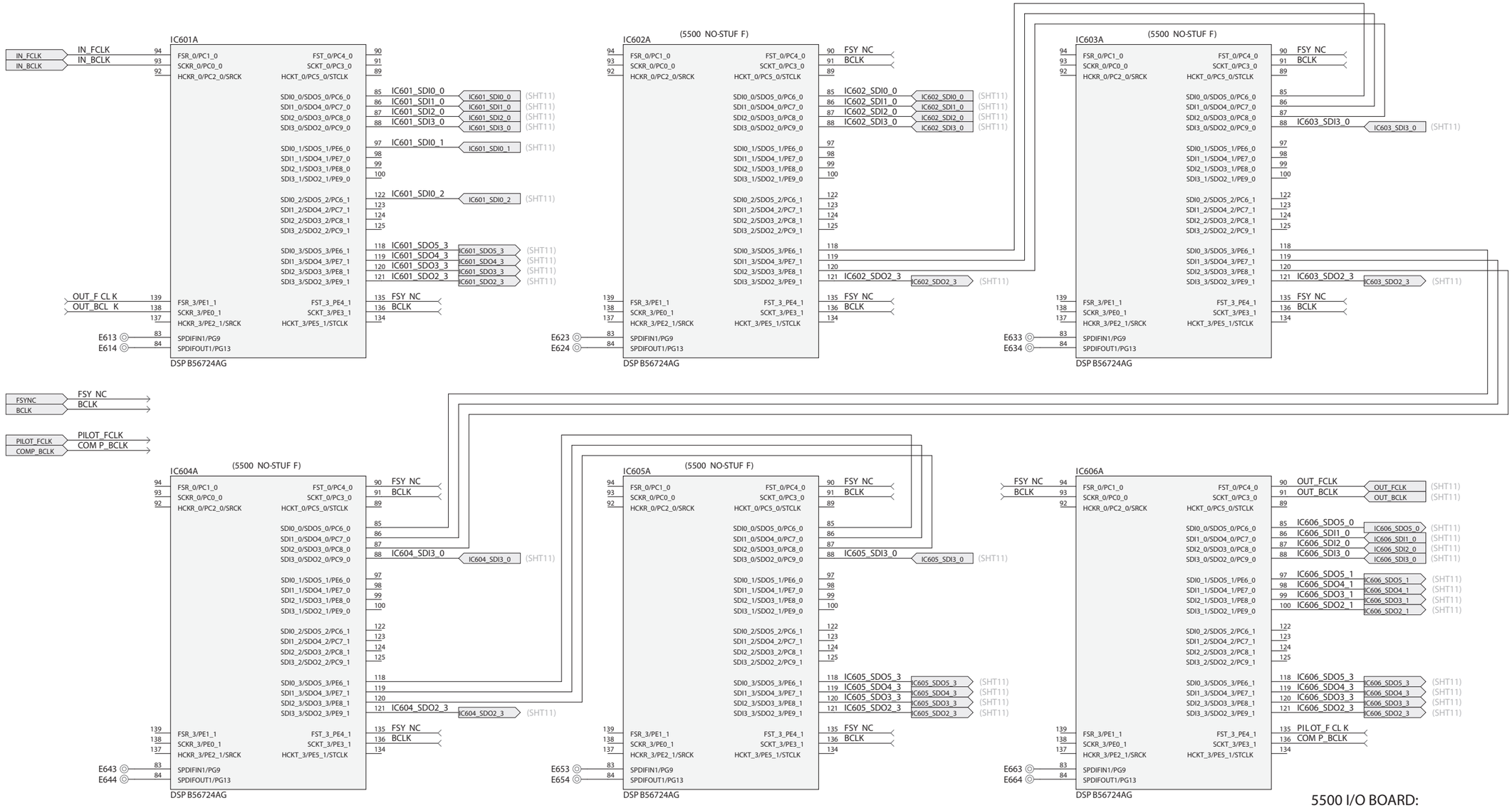
J7/J8	Source Impedance
1 - 2	75 ohm
3 - 4	0 ohm (as shipped)



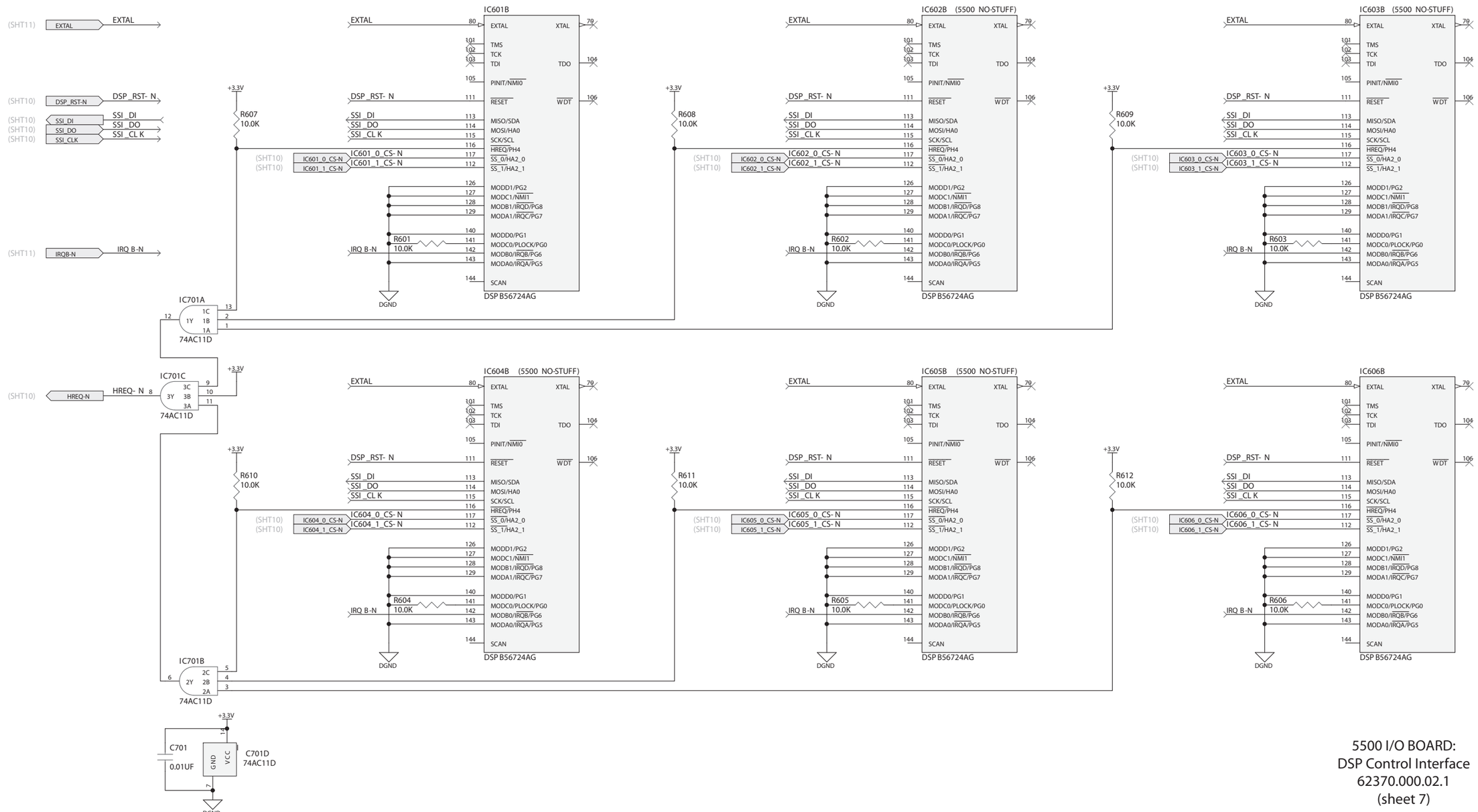
5500 I/O BOARD:
Composite/SCA
Daughter Board
62310.000.02.1
(sheet 4b)



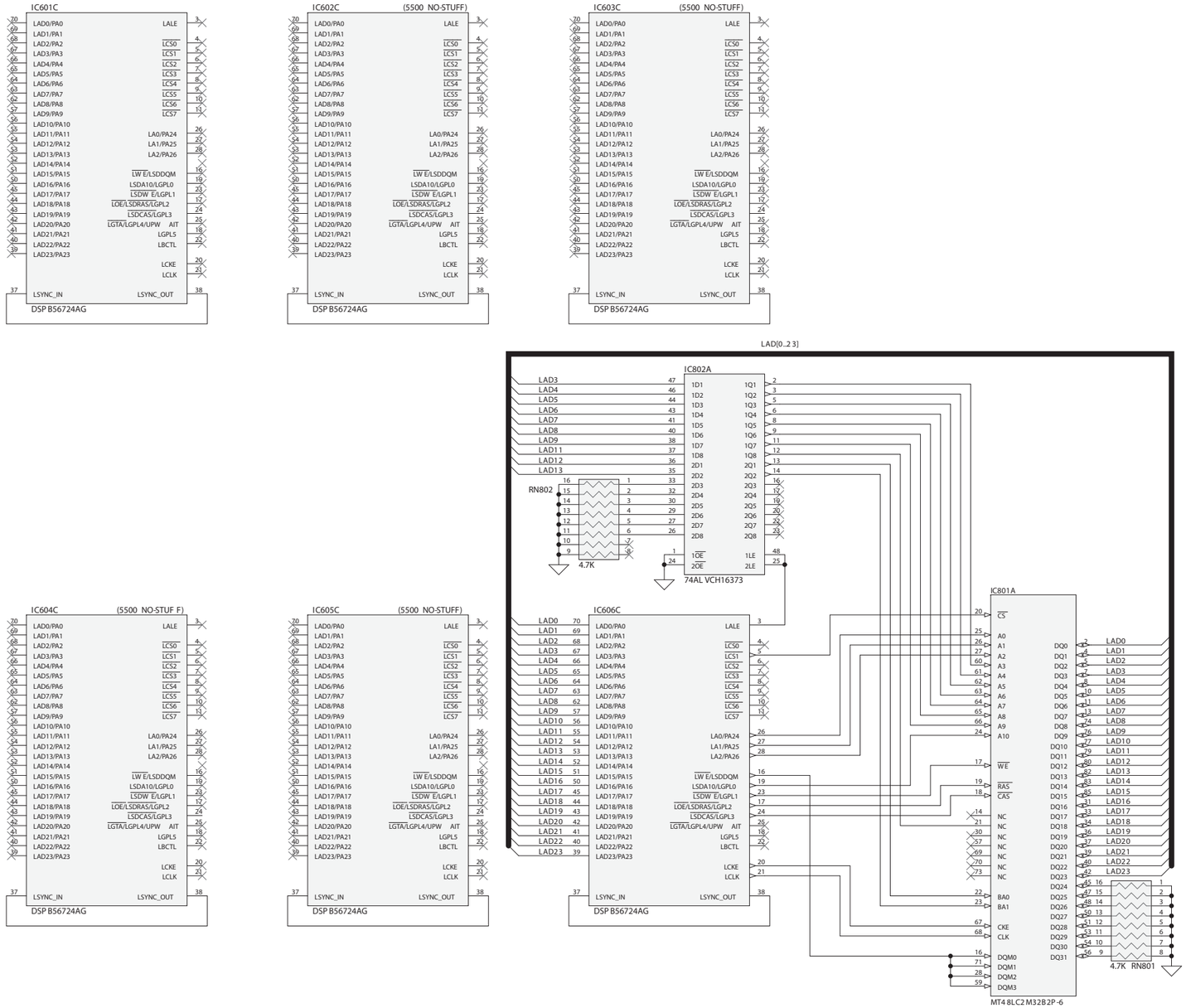
5500 I/O BOARD:
Digital I/O and Sync Input
62370.000.02.1
(sheet 5)



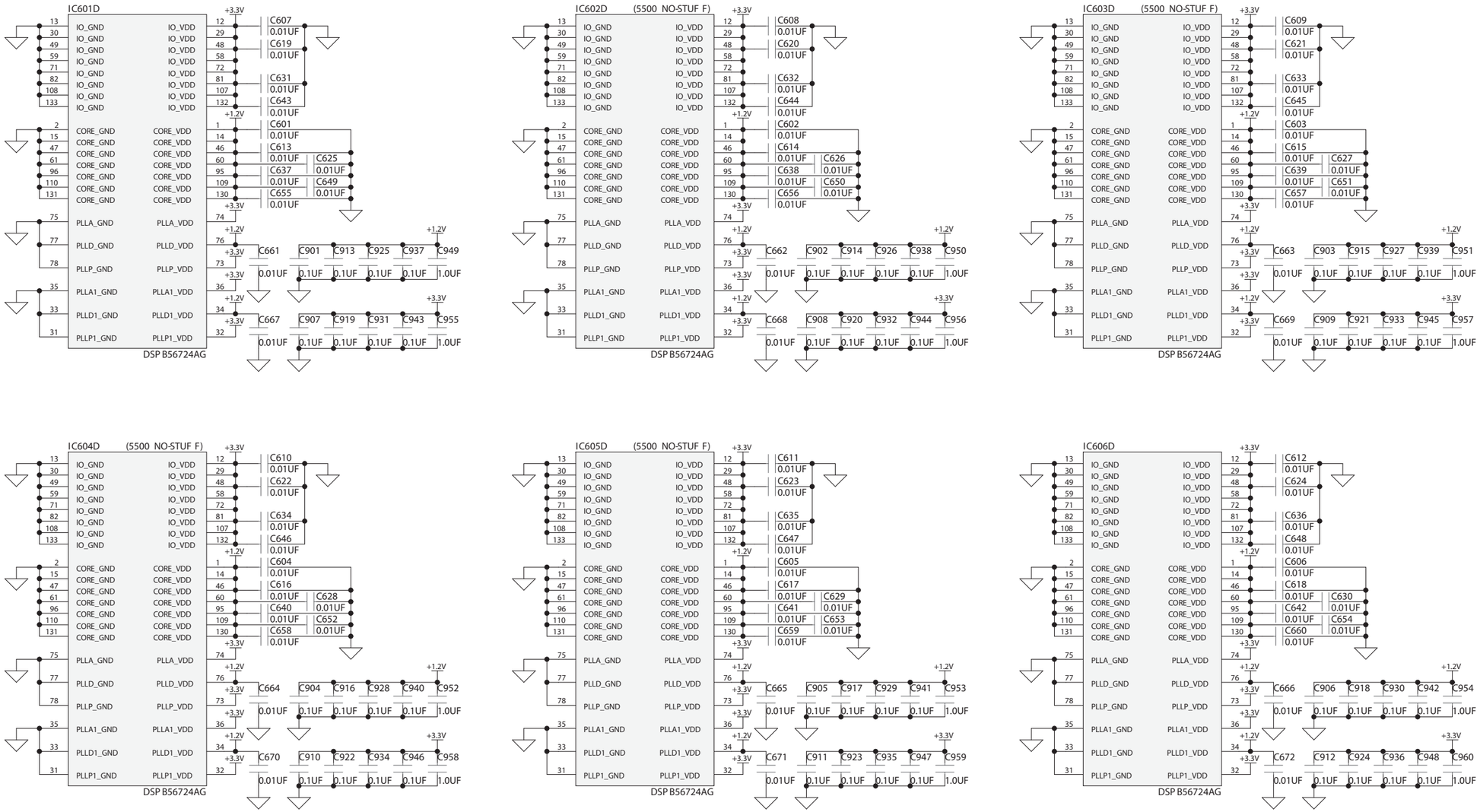
5500 I/O BOARD:
DSP Enhanced Serial Audio Interface
62370.000.02.1
(sheet 6)



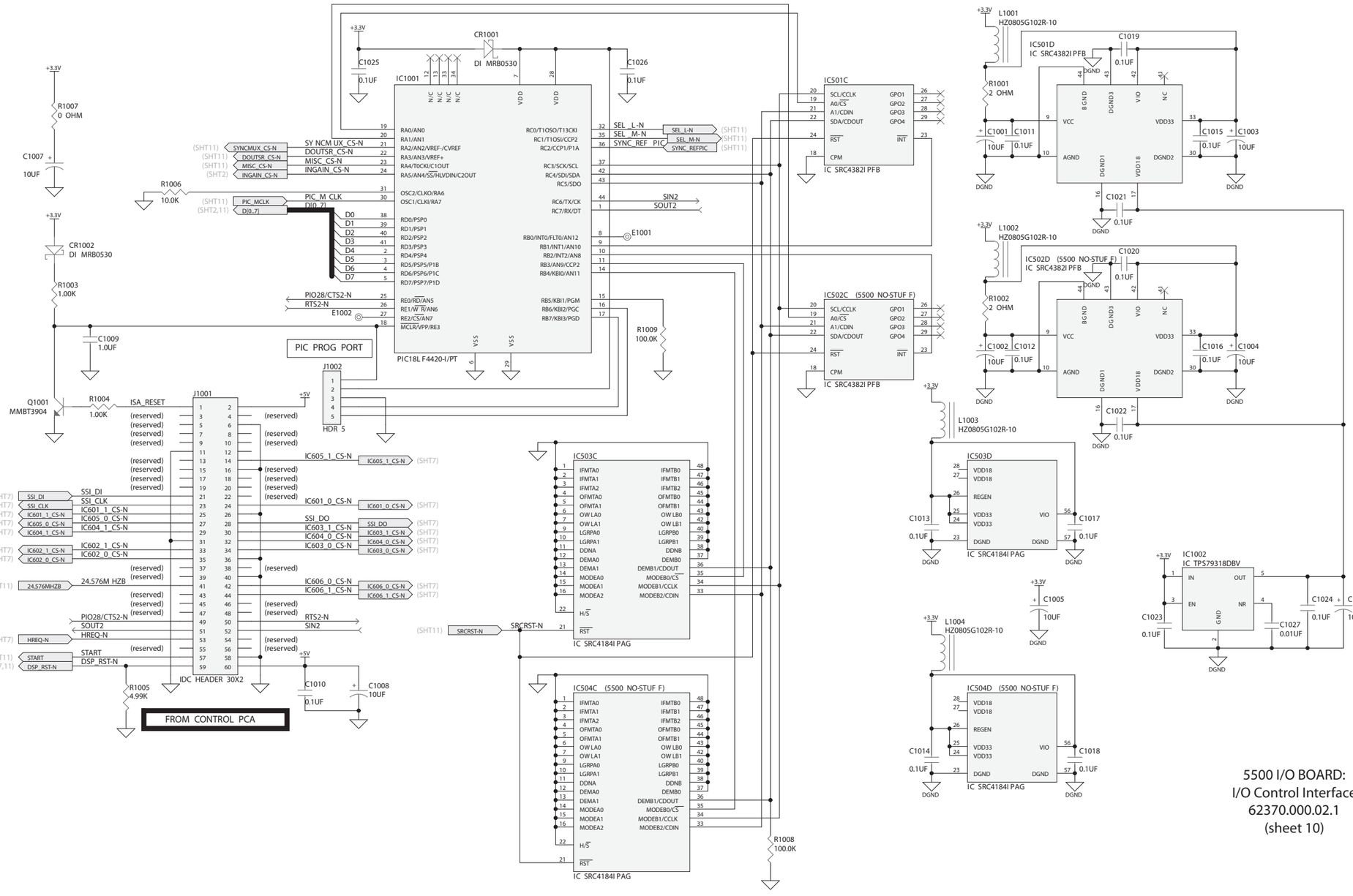
5500 I/O BOARD:
DSP Control Interface
62370.000.02.1
(sheet 7)



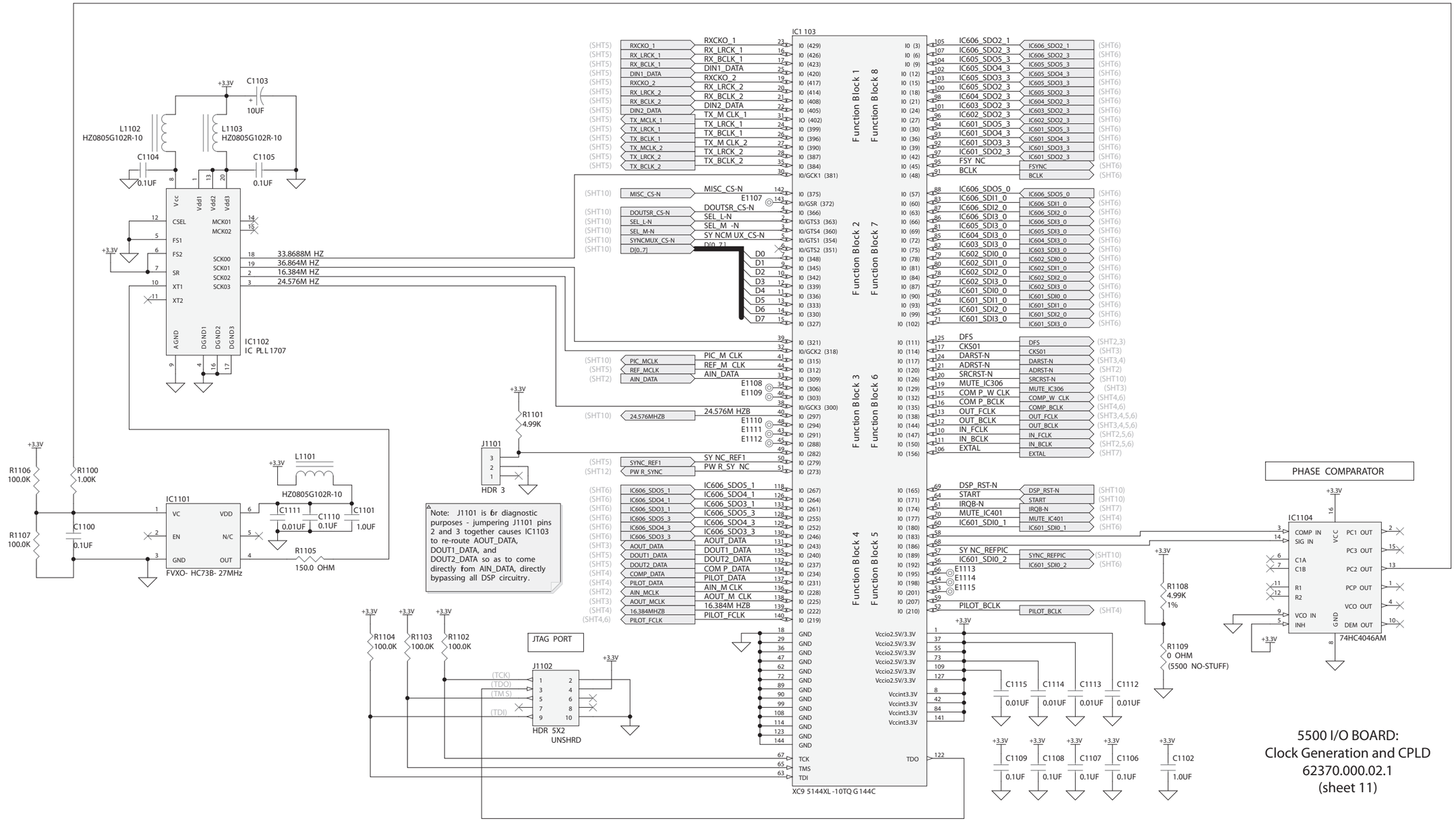
5500 I/O BOARD:
DSP External Memory Control Interface
62370.000.02.1
(sheet 8)

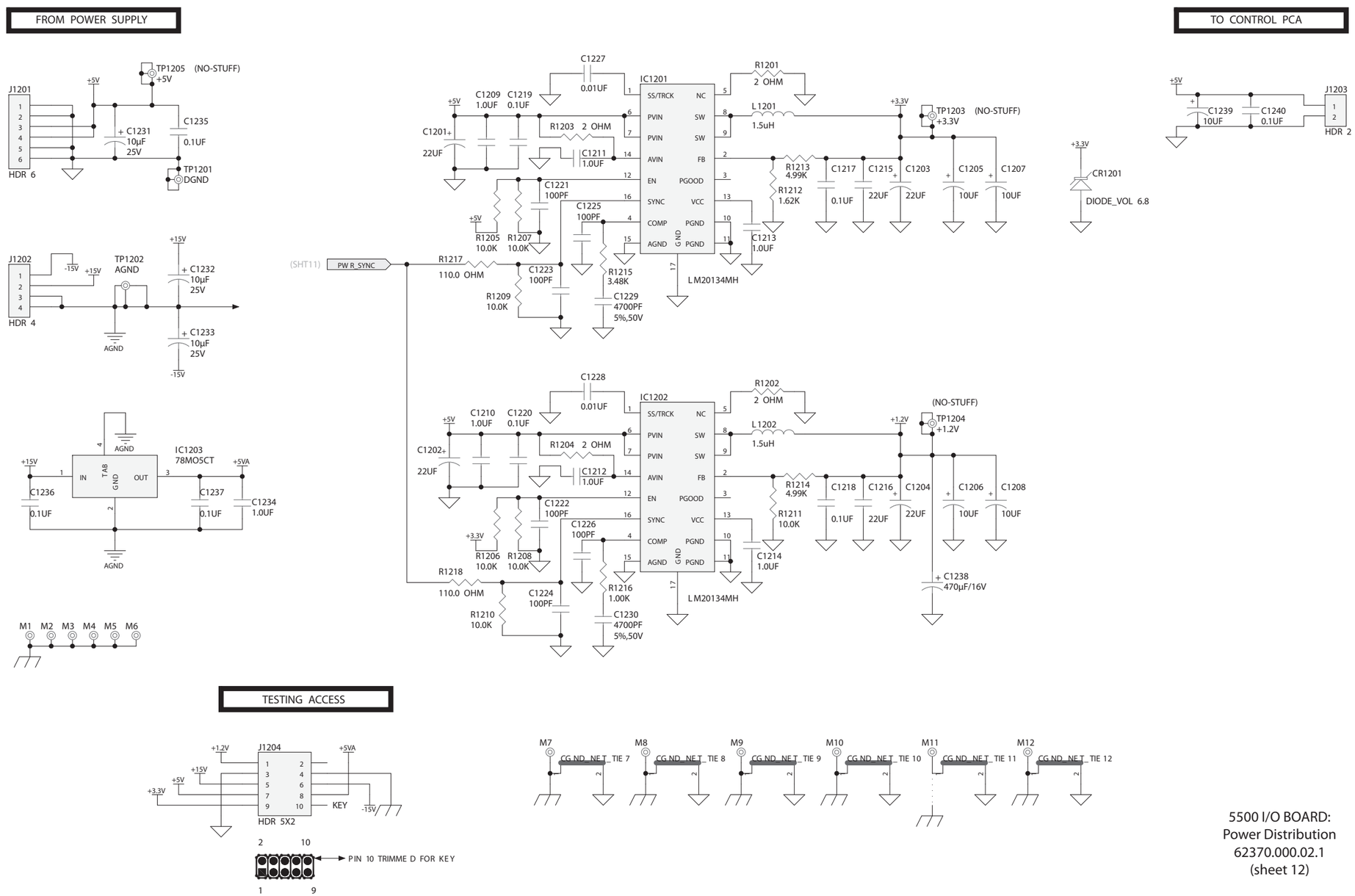


5500 I/O BOARD:
DSP Power and Ground
62370.000.02.1
(sheet 9)

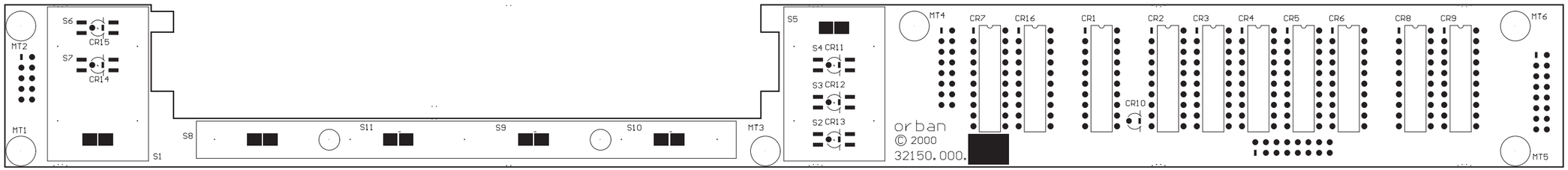


5500 I/O BOARD:
I/O Control Interface
62370.000.02.1
(sheet 10)

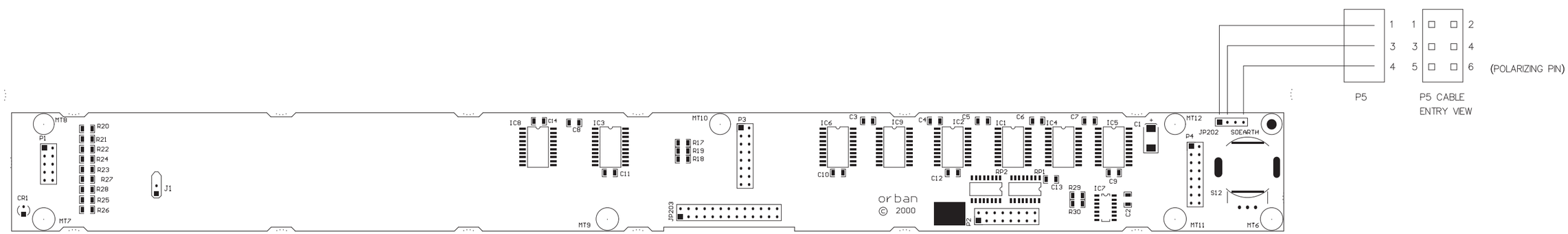

IC1 103
XC9 5144XL -10TQ G144C
Function Block 1
Function Block 8
Function Block 2
Function Block 7
Function Block 3
Function Block 6
Function Block 4
Function Block 5
IC1102
IC PLL1707
33.8688M HZ
36.864M HZ
16.384M HZ
24.576M HZ
L1102
HZ0805G102R-10
L1103
HZ0805G102R-10
C1103
10UF
C1104
0.1UF
C1105
0.1UF
L1101
HZ0805G102R-10
IC1101
FVXO- HC73B- 27MHz
R1100
1.00K
R1106
100.0K
R1107
100.0K
C1100
0.1UF
R1105
150.0 OHM
C1111
0.01UF
C1110
0.1UF
C1101
1.0UF
R1101
4.99K
J1101
HDR 3
Note: J1101 is for diagnostic purposes - jumpering J1101 pins 2 and 3 together causes IC1103 to re-route AOUT_DATA, DOUT1_DATA, and DOUT2_DATA so as to come directly from AIN_DATA, directly bypassing all DSP circuitry.
R1104
100.0K
R1103
100.0K
R1102
100.0K
JTAG PORT
J1102
HDR 5X2
UNSHRD
PHASE COMPARATOR
IC1104
74HC4046AM
R1108
4.99K
1%
R1109
0 OHM
(5500 NO-STUFF)
C1115
C1114
C1113
C1112
0.01UF
C1109
C1108
C1107
C1106
0.1UF
C1102
1.0UF
5500 I/O BOARD:
Clock Generation and CPLD
62370.000.02.1
(sheet 11)



5500 I/O BOARD:
Power Distribution
62370.000.02.1
(sheet 12)

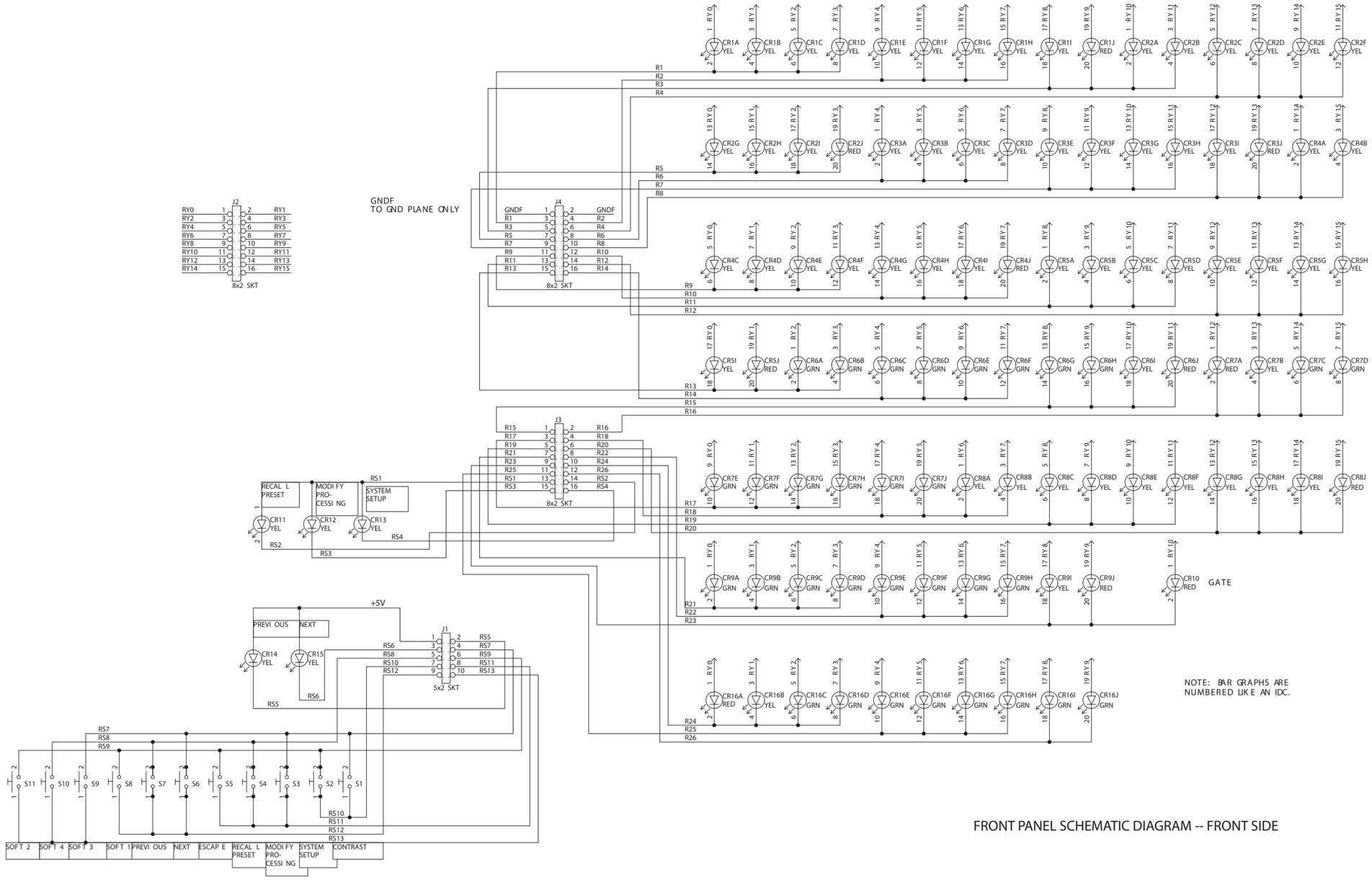


FRONT VIEW

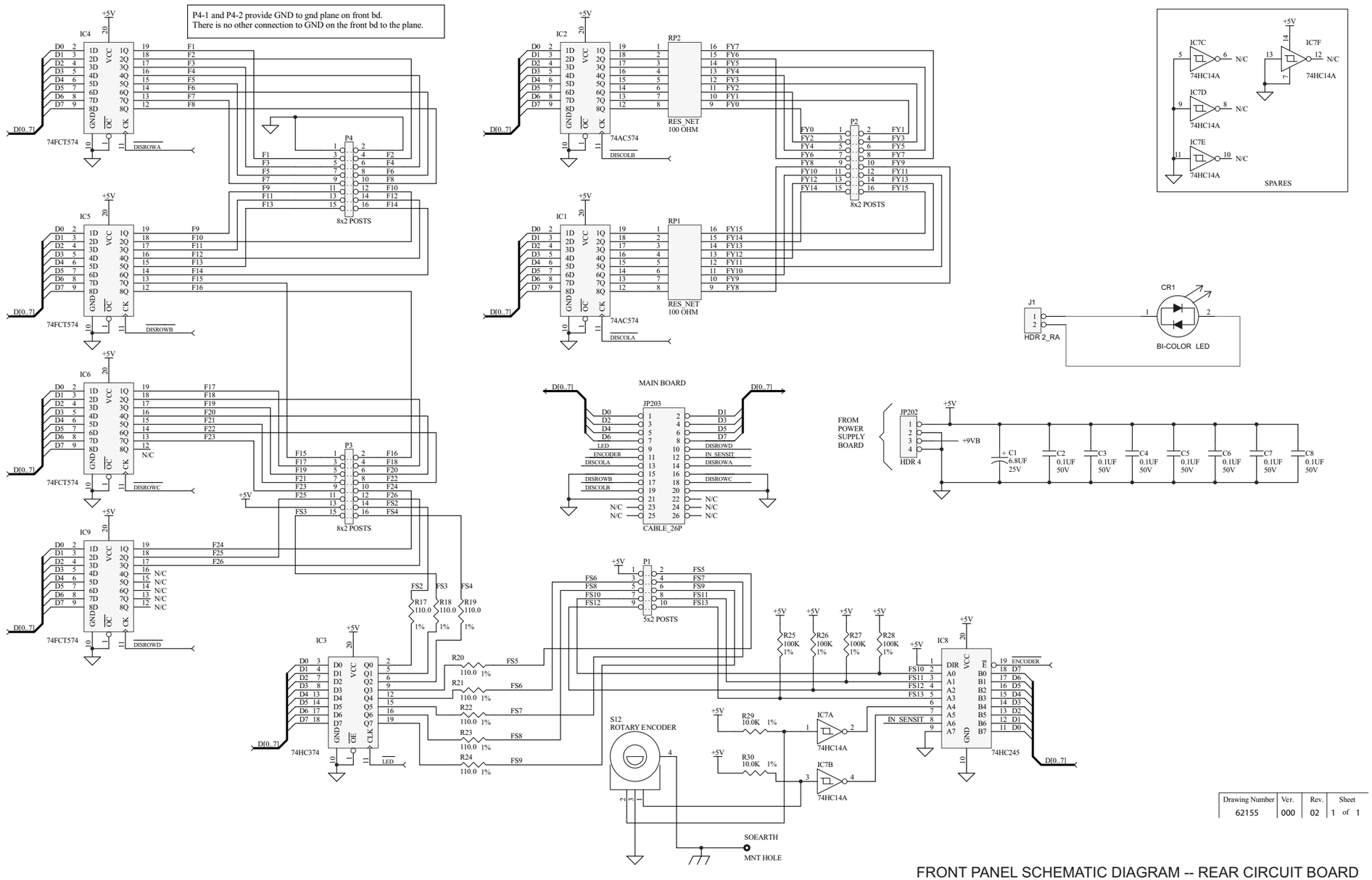


REAR VIEW

FRONT PANEL PARTS LOCATOR DIAGRAM

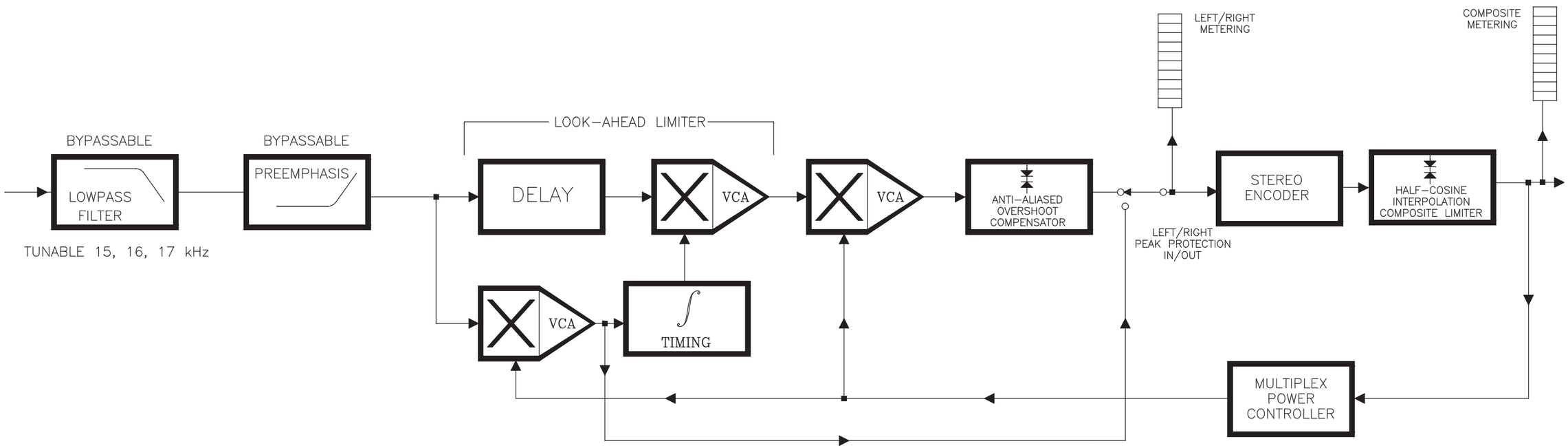


FRONT PANEL SCHEMATIC DIAGRAM -- FRONT SIDE



Drawing Number	Ver.	Rev.	Sheet
62155	000	02	1 of 1

FRONT PANEL SCHEMATIC DIAGRAM -- REAR CIRCUIT BOARD



OPTIMOD 5500/5518
STAND–ALONE STEREO ENCODER
SIMPLIFIED BLOCK DIAGRAM