

Operating Manual

**Digital
FM Stereo
Encoder/Generator
with Limiter**

Model 8218

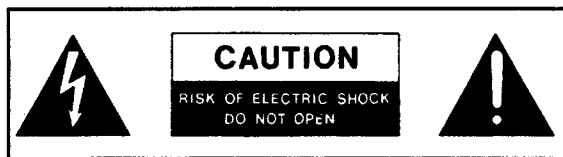
orban[®]

IMPORTANT NOTE: Refer to the unit's rear or side panel for your Model #.

Model Number:	Description:
8218/U	8218 Stereo Encoder, set to 115V (for 98-132V operation), switchable to 50 μ s or 75 μ s.
8218/E	8218 Stereo Encoder, set to 230V (for 196-264V operation), switchable to 50 μ s or 75 μ s.

Manual:

Part Number:	Description:
96082-000-02	8218 Manual



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.

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, (\perp), 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 erfassen. Beschädigte Netzkabel sofort auswechseln.

Gerät und Netzkabel keinen übertriebenen mechanischen Beanspruchungen 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 secour. 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 à une contrainte mécanique excessive.

Pour éviter tout contact avec une tension électrique dangereuse, on n'ouvrira 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. Éviter 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 après-vente 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.

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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, Subpart 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 dépassant les limites applicables aux appareils numeriques (de la 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 item. A much smaller static discharge is likely to completely destroy one or more of the CMOS semiconductors employed in this product. 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, many damaging discharges will not even be noticed.

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

Patents pending.

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Operating Manual

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Section 1

Introduction

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Figure 1: Front

8218 Digital FM Stereo Encoder

More and more FM stations are transporting their audio digitally, from studio to transmitter. However, digital links typically handle left/right rather than composite. Orban's 8218 Digital FM Stereo Encoder can extend your all-digital performance through to the stereo encoder. It's designed to perfectly complement Orban's OPTIMOD-FM digital audio processors in an all-digital transmission system.

All encoding is done entirely in the digital domain by a dedicated DSP chip, producing two analog composite outputs with outstanding specifications and long-term stability. The 8218 accepts either analog or AES/EBU digital inputs. The digital input automatically synchronizes to and de-jitters any standard incoming sampling rate. In addition, it responds to status bits in the AES/EBU data stream that may be used to turn de-emphasis on or off. This feature allows automatic switching of pre-emphasis and/or J.17 (NICAM) de-emphasis to accommodate different transmission schemes.

An Overshoot Control Limiter can be applied to the incoming audio, limiting overshoots to less than 0.5dB while introducing minimal (or no) audible artifacts and without contaminating the baseband spectrum above 57kHz. The Overshoot Control Limiter is particularly useful if the processed audio has been passed to the 8218 through a digital STL that uses lossy encoding, like MPEG, Dolby, or APT-X. The Overshoot Control Limiter uses lookahead techniques, and, when activated, adds a time delay of 4 milliseconds to the stereo encoding process.

Features

- >70dB separation, 20Hz-15kHz.
- <-90dB noise and distortion (after de-emphasis, and referenced to 100% modulation output).
- Digitally-created composite signal, from either analog or AES/EBU digital input. The 8218 also accepts two analog SCA inputs, and sums them with analog composite output. The analog composite appears on two outputs, each with individual level control.
- Built-in sample rate converter that allows 8218 to accept any digital AES/EBU input sample rate between 32kHz and 48kHz.
- Recessed front panel controls for selecting Input type (Analog/Digital), Stereo/MonoL/MonoR mode, Pilot On/Off, and Crosstalk Tests.
- Front panel metering of Left and Right inputs plus Composite or Pilot outputs.
- Recessed front panel multi-turn screwdriver potentiometers for Analog Left, Analog Right, and Digital input levels, as well as for Pilot, Composite #1, and Composite #2 output levels.
- Recessed rear panel DIP switch for selecting pre-emphasis In/Out, pre-emphasis type (50 μ s/75 μ s), J.17 de-emphasis In/Out, and whether or not the stereo encoder's pre-emphasis and J.17 de-emphasis settings respond to status bits of the

AES/EBU digital input, Overshoot Control Limiter in/out, and AES/EBU input range.

- Remote (contact closure) interface using opto-isolation has pins to select between analog or digital input, turn pre-emphasis on or off, and to select among stereo, mono from left, or mono from right operational modes. Also on the remote connector is a digital pilot reference output clock for external subcarrier generators like RDS. This is a TTL level signal with 0 to +5V transition occurring at the pilot zero crossing.
- Overshoot Control Limiter limits overshoot to less than 0.5dB with minimum artifacts.
- AES/EBU error alarm function provides an alarm that indicates if a faulty AES/EBU signal is being received at the 8218's digital input.

Input/Output Configurations

The 8218 provides:

- Analog left/right inputs or digital AES/EBU left/right input.
- Composite baseband outputs.
- SCA subcarrier inputs.
- Pilot Reference output.
- AES/EBU error alarm function.

Analog Left/Right Inputs

The left and right analog inputs are on XLR-type female connectors on the rear panel. Input impedance is greater than 100k Ω ; balanced and symmetrical. Inputs can accommodate from 0 to +15dBu for 100% modulation. (0dBu = 0.775Vrms).

Level control of the analog inputs is via the screwdriver-adjustable Left and Right Drive controls, located on the 8218's front panel.

The Left/Right meter on the 8218 shows input levels as a 10-segment bar graph (5 to 110%). 100% is the threshold of the built-in Overshoot Control Limiter. Inputs reading below 100% on this meter are unaffected.

Digital AES/EBU Left/Right Input

The digital input follows the professional AES/EBU standard. The left/right digital input is on one XLR-type female connector on the rear panel.

The digital input can accommodate a 20dB level adjustment, in four 6dB ranges. Fine level control of the AES/EBU input is via the screwdriver-adjustable Digital Drive control, located

on the 8218's front panel. Input level range select is via DIP switches located on the 8218's rear panel.

The 8218 accepts any digital AES/EBU input sample rate between 32kHz and 48kHz by use of a built-in sample-rate converter.

The 8218 can be switched between digital and analog inputs by the front panel Input select switch or by remote interface. Both analog and digital outputs are active continuously.

Composite Baseband Outputs

The stereo encoder has two unbalanced baseband outputs (Composite 1 and Composite 2) on two BNC connectors on the rear panel. Each output can be strapped for 0Ω or 75Ω source impedance (jumper-selectable), and can drive up to 8.8V peak-to-peak into 75Ω in parallel with up to $0.047\mu\text{F}$ (100ft/30m of RG-59/U cable) before any noticeable performance degradation occurs. (The 8218 is shipped from the factory with 0Ω source impedance.)

Level control of each output is via a separate screwdriver control accessible from the front panel.

A ground lift switch is available on the rear panel. This can prevent ground loops between the 8218 and the transmitter.

The Composite meter on the 8218 shows composite output levels as a 10-segment bar graph (5% to 110%). The sensitivity of this meter changes when the Overshoot Control Limiter is activated. If the Overshoot Control Limiter is defeated, applying a sinewave equally to both left and right inputs such that the two input meters read 100% will cause the Composite meter to read 100%, provided that the pilot tone is ON and set to 9% injection. Activating the Overshoot Control Limiter reduces the sensitivity of the Composite meter by 4%, allowing a margin such that the Overshoot Control Limiter meter will normally read 100% on program peaks.

The Overshoot Control Limiter has a slight residual overshoot (less than 0.5dB) because, unlike a simple clipper, it controls its output spectrum very tightly. The non-linear filtering necessary to accomplish this causes a small amount of uncertainty in the peak output level. While the Overshoot Control Limiter uses lookahead techniques to minimize this uncertainty, these techniques cannot entirely eliminate it without introducing some audible gain pumping, which we considered unacceptable. We therefore designed the circuit for maximum audible transparency at the cost of a small amount of overshoot.

You ordinarily adjust the 8218's output level so that 100% corresponds to $\pm 75\text{kHz}$ carrier deviation. Note that if you apply subcarriers (SCAs) to the rear panel subcarrier input, the meter will read higher than 100%. For example, in the U.S.A., if two subcarriers are used, the meter will usually read peaks of 110%, corresponding to $\pm 82.5\text{kHz}$ deviation.

Subcarriers

The 8218 has two unbalanced $10\text{k}\Omega$ subcarrier (SCA) inputs with Rear-panel BNC connectors to accept any subcarrier at or above 23kHz. The subcarrier will be mixed into each composite output, and its level will be affected by the composite level control for that output.

The gain is scaled so that 0.8V peak-to-peak at the subcarrier input produces 10% subcarrier injection with reference to 100% deviation of the FM carrier.

A 19kHz TTL-level square wave is available on pin 24 of the remote interface, located on the rear panel of the unit. This provides a means for synchronizing an external subcarrier generator, like an RDS (Radio Data Systems) subcarrier, to the 19kHz pilot tone.

AES/EBU Error Alarm Function

An “alarm” function monitors the received AES/EBU bitstream, indicating if there is a parity error, a bi-phase coding violation, a receiver PLL not locked condition or if the AES transmitter set the validity bit. Upon detection of any of these errors, the 8218 continues to look for subsequent error activity within the next 250msec. If the flag remains active within that time frame, a +15V strobe is sent to the 8218 rear panel Remote Connector pin 10, and the front panel “digital” LED flashes at a 4 per second rate (to differentiate this from the 2 per second rate indicating a loss of digital input, e.g. PLL not locked, forcing the unit to switch to use the analog input). The +15V strobe and flashing LED remain for 4 seconds following the last detection of an error condition, after which pin 10 goes back to its normal -15V state, and the “digital” LED reverts to its previous state. The $\pm 15V$ strobe is capable of delivering 10mA.

Remote Control Interface

The Remote Control Interface is a set of seven optically-isolated inputs and two outputs on a DB-25 connector that can be activated by 5-12VDC or AC 50/60Hz signals.

The seven inputs allow you to select between various functions of the 8218:

- Analog/Digital Input.
- Pre-Emphasis On/Off.
- Operation Mode (Stereo, Mono From Left, or Mono From Right).

The two outputs on the Remote Control Interface are a Digital Pilot Reference Output Clock and the AES/EBU error alarm function.

Location of 8218

Optimal Control of Peak Modulation Levels

The audio processing circuitry in most modern audio processors produces a signal that is pre-emphasized to either the 50 μ s or 75 μ s standard curve, is precisely and absolutely high frequency-controlled and peak-controlled to prevent over-modulation, and is filtered at 15kHz to prevent distortion caused by aliasing-related non-linear crosstalk in FM stereo systems.

If this signal is fed directly into the 8218, peak modulation levels on the air will be precisely controlled. But if the audio processor's signal is fed to the 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 average modulation level must therefore be reduced to accommodate the larger peaks. Reduced average modulation level will result in reduced loudness, and a poorer signal-to-noise ratio at the receiver. To prevent this, the 8218 has a built-in, defeatable Overshoot Control Limiter that can reduce overshoots of up to 9dB to less than 0.5dB. While this circuit introduces very few (or no) audible artifacts for reasonable amounts of input overshoot (2-3dB with relatively low duty cycle), nevertheless it is best to minimize the need for overshoot compensation in the first place, so the amount of overshoot at the 8218's input should be minimized by the techniques described below. The Overshoot Control Limiter is not designed to be used as an audio processor, and should not be used to apply more clipping to an already processed signal. Use it only to remove STL-induced overshoot from a processed signal.

Frequency response errors and non-constant group delay are typically introduced by land/post-line equalizers, transformers, and digital links that use lossy data rate reduction algorithms.

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 low-pass filters are present, this may require the use of delay equalization. The deviation from linear phase must not exceed $\pm 10^\circ$ from 30-15,000Hz.
- 2) The low-frequency -3dB 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 pre-emphasis used in the audio transmission system prior to the transmitter or stereo encoder must be canceled by a precisely complementary de-emphasis: Every pole and zero in the pre-emphasis filter must be complemented by a zero and pole of identical complex frequency in the de-emphasis network (an all-pole de-emphasis network is not appropriate).

Low-pass filters (including anti-aliasing filters in digital links), high-pass filters, transformers, distribution amplifiers, and long transmission lines can all cause the above criteria to be violated, and must be tested and qualified.

The 8218 can be located at the studio or transmitter, depending on the requirements of your system. In the most common application, the 8218 will be located at the transmitter, receiving left and right processed, pre-emphasized digitized audio via digital microwave, or land/post-line and directly driving the FM Exciter/Transmitter.

If the 8218 is located at the studio, its composite output will be passed to a transmitter site through a composite microwave analog STL or through a composite digital STL such as the QEI "Cat-Link."

Transmission from Studio to Transmitter

There are four types of studio-to-transmitter links (STLs) in common use in FM stereo service that can feed a transmitter-located 8218: digital STLs, video STLs with PCM adapters, analog land line (telephone/ line), and dual microwave.

All these links carry the left and right channels. These links are normally fed the pre-emphasized, peak-controlled left and right outputs of an appropriate FM stereo audio processor like Orban's OPTIMOD-FM 8200.

Digital links

There are several types of digital links presently available. They pass the audio in left and right form, and may apply lossy data-rate-reduction processing to the signal to reduce the number of bits per second required for transmission through the digital link. Such processing will almost certainly distort peak levels, and use of such links will therefore require use of the 8218 stereo encoder's Overshoot Control Limiter to prevent over-deviation of the transmitter. For example, ISO/MPEG Layer 2 with dual-mono coding at 384kb/S typically adds approximately 1dB of peak level. Lower rates rapidly increase the overshoot, with joint stereo encoding at 192kb/S adding as much as 4dB overshoot. No station wishing to maintain audio quality competitive with uncompressed STLs should use data rates of less than 384kb/S.

Other links may use straightforward PCM (pulse-code modulation) without data rate reduction. These can be completely transparent provided that they have AES/EBU digital I/O. If these other links have only analog inputs and outputs, their input anti-aliasing filters and output reconstruction filters must be rigorously designed to achieve constant group delay over the frequency range that contains significant program energy. This is not particularly difficult to do with modern over-sampled converter technology.

Older-technology converters with analog inputs and outputs usually exhibit rapid changes in group delay around cut-off because their analog filters are ordinarily not group-delay equalized. Additionally, they may exhibit quantization distortion unless they have been correctly dithered. The installing engineer should be aware of all of these potential problems when designing a transmission system.

Note that most modern audio processors (in particular, Orban's 8200) have virtually no power in their output spectrum above 16kHz. Therefore the input anti-alias filters in older-technology converters can be bypassed; the audio processor protects against aliasing. Note, however, that the link receiver's output reconstruction filters cannot be bypassed; these must have constant group delay.

NICAM is a sort of hybrid between PCM and data-rate-reduced systems. It uses a block-companded floating-point representation of the signal with J.17 pre-emphasis. If equipped with the optional advanced digital I/O card (8200D/SRC), the Orban 8200 can supply an AES/EBU output that has been pre-emphasized to J.17. (The NICAM encoder must take this PCM data stream and convert it to the NICAM representation.)

The 8218 has the ability to apply J.17 de-emphasis to its AES/EBU digital input, and can thus accept the pre-emphasized output of a NICAM receiver, provided that the receiver has

decoded the NICAM signal and converted it to PCM in AES/EBU form. (See Chapter 2 for a complete discussion of the 8218s extensive pre-emphasis switching capabilities.)

Video microwave STLs with PCM adapter

The video STLs in use typically operate above 20GHz, with consumer PCM adapters (from Sony or dbx, for example) to encode left and right audio into a video-like signal. The quality of signal received at the transmitter through this type of STL is high. However, the high carrier frequencies make these links subject to rain fading. Other potential problems include very sharp high-frequency cut-off, rapid changes in group delay around cut-off, and quantization distortion. These problems can only be alleviated by use of digital I/O. To the best of our knowledge, of these various units only the Sony PCM-601 has a suitable digital I/O, which is SPDIF. (The 8218's AES/EBU input will often lock to a SPDIF signal without difficulty, although we cannot guarantee this for all cases.)

The Sony F-1-series units (including the above mentioned PCM-601) ordinarily operate at a sampling frequency of 44.056kHz. In our experience, most (but not all) of these units will lock to a 44.1kHz signal. This will vary from one individual unit to the next. If you plan to use a PCM-601 with an Orban 8200, you must use the 8200's 8200D/SRC advanced digital I/O card and set the 8200 to provide a 44.1kHz digital output. You must then verify that the particular pair of PCM-601s you are planning to use will lock reliably to 44.1kHz over temperature.

The Sony and dbx encoders are no longer manufactured, but may be found on the used market.

Analog land line (PTT/post office line)

Analog land line quality is extremely variable. Even the best land lines will have slight frequency response irregularities and non-constant group delay, which will cause overshoots at their outputs. This will increase the peak-to-average ratio and will thus require use of the 8218's Overshoot Control Limiter. In competitive environments these lines are never suitable because of this overshoot. (see Optimal Control of Peak Modulation Levels on page 1-7).

Dual microwave STLs

Dual microwave STLs can provide satisfactory results if carefully designed. Otherwise they can introduce non-constant group delay in the audio spectrum, distorting peak levels and requiring use of the 8218's Overshoot Control Limiter.

Some dual microwave links may be modified to meet the specification for frequency response and phase linearity stated in Optimal Control of Peak Modulation Levels on page 1-7. Many such links have been designed to be easily configured at the factory for composite operation, where the entire FM stereo baseband is passed, including the pilot tone and stereo subchannel. The requirements for maintaining stereo separation in composite operation are similar to the requirements for high waveform fidelity with low overshoot. Therefore, most links have the potential for excellent waveform fidelity if they are configured for composite operation (even if a composite FM stereo signal is not actually being applied to the link).

If the STL microwave uses pre-emphasis, its input pre-emphasis network will probably introduce overshoots that will increase peak modulation without any increases in average modulation. We strongly recommend that you defeat the microwave STL's transmitter pre-emphasis and receiver de-emphasis. Perform pre-emphasis in the audio processing system driving the link (like the Orban 8200). This reduces potential overshoot.

Line-Up Facilities

Left/Right Input Level

The Left/Right meter on the 8218 shows left/right input levels as a 10-segment bar graph (5% to 110%), absolute instantaneous peak-indicating. 100% is the threshold of the Overshoot Control Limiter (when activated).

Composite Output Level

Composite modulation is indicated in percent modulation, absolute instantaneous peak indicating. You ordinarily adjust the 8218's output attenuators to make 100% on the meter correspond to $\pm 75\text{kHz}$ carrier deviation. Note that if subcarriers (SCAs) are applied to the 8218's subcarrier input, the meter will ordinarily read higher than 100%. For example, in the U.S.A., if two subcarriers are used, the meter will usually read peaks of 110%, corresponding to $\pm 82.5\text{kHz}$ deviation.

The composite output meter indicates the sum of the encoded stereo baseband and the stereo pilot tone. The composite meter may read lower than the Left/Right meters for three reasons. First, if a 100% audio peak does not coincide with the peak instantaneous value of the pilot tone waveform, the composite meter will read below 100%. Nevertheless, it is accurately showing the instantaneous peak modulation. Second, a small effect called "pilot interleaving" will reduce the composite modulation by 2.8% as the ratio of L-R to L+R increases from zero to unity, even though the peak levels of the left and right audio have not changed. Third, the sensitivity of the composite meter is reduced by 4% to accommodate operating margin when the Overshoot Control Limiter is activated.

Pilot Injection Metering

You can switch the lower meter to read pilot injection in percent modulation. Most government authorities require pilot injection to be between 8% and 10%. 9% is the value customarily used.

About the 8218's J.17 De-emphasis

When the Orban 8200 is set for "pre-emphasized" output (at 50 μs or 75 μs) the 8200D/SRC digital I/O card in the Orban 8200 scales the gain of its optionally applied J.17 pre-emphasis so that the J.17 pre-emphasis gain at 15kHz is 0dB.

When the 8200 is set for "flat" output (that is, the output of the audio processing receives 50 μs or 75 μs de-emphasis before the audio is applied to the 8200D/SRC digital I/O card), then the 8200D/SRC card scales the gain of its optionally-applied J.17 pre-emphasis so that

the J.17 pre-emphasis gain at 15kHz is +6.9dB (when the audio processor is operating on a 50 μ s pre-emphasis curve) or +8.85dB (when the audio processor is operating on a 75 μ s pre-emphasis curve.) The 8200D/SRC card adds this gain to make best use of the headroom of the transmission channel it is driving.

These gains were determined by observing a large amount of program material and adjusting the gain so that the output level went as close to digital full-scale as possible without exceeding it.

The 8218's J.17 de-emphasis operates in an exactly complementary way. When the 8218 is set for pre-emphasis off (PRE-E OFF), it scales the gain of its J.17 de-emphasis so that the J.17 de-emphasis gain at 15kHz is 0dB. When the 8218 is set for PRE-E ON, it scales the filter gain of its J.17 de-emphasis at 15kHz to -6.9dB (50 μ s pre-emphasis) or -8.85dB (75 μ s pre-emphasis) The diagram below shows the situation for 75 μ s PRE-E ON.

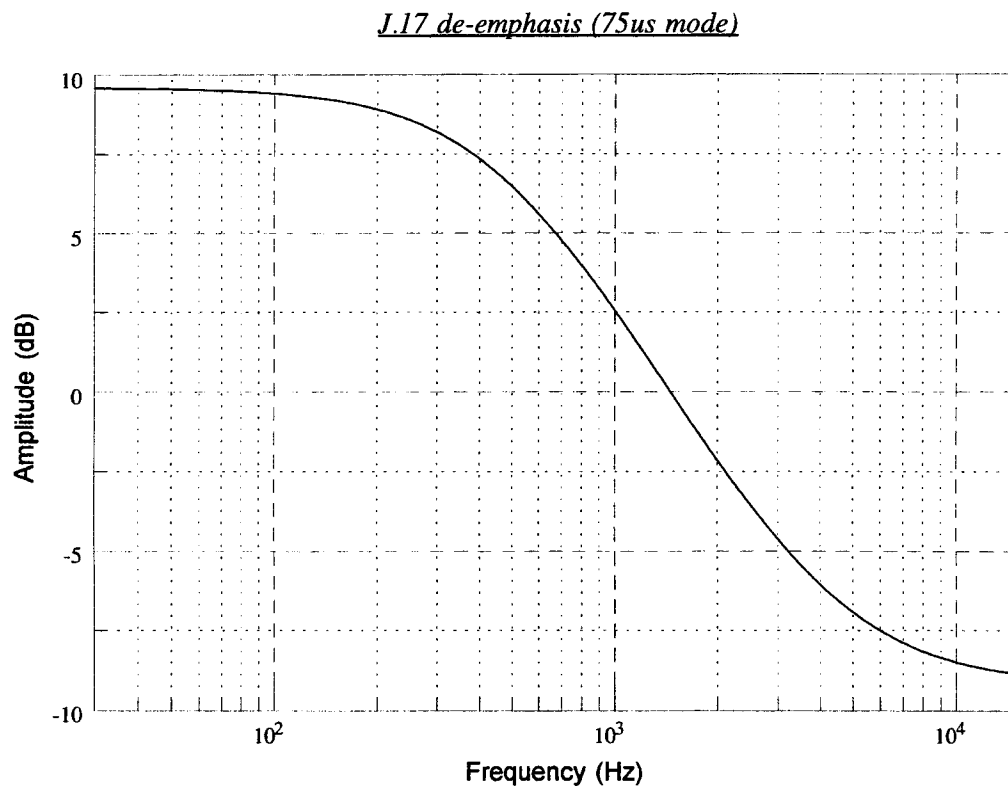


Figure 1-2: J.17 De-Emphasis Curve

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Section 2

Installation

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2-2	Installation of 8218
2-2	Figure 2-1: Composite Output Impedance Jumpers
2-3	Figure 2-1: Composite Output Impedance Jumpers
2-8	Figure 2-2: AC Line Cord Wire Standard
2-9	Figure 2-3: Wiring the 25-pin Optically-isolated
2-18	System Setup



CAUTION

The installation and servicing instructions in this manual are for use by qualified personnel only. To avoid electric shock, do not perform any servicing other than that contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

Installation of 8218

Allow about 2 hours for installation.

Installation consists of: (1) unpacking and inspecting the 8218, (2) optional resetting of jumpers for composite output impedance, (3) checking the line voltage setting, fuses and power cord, (4) setting the ground lift switch, (5) setting the rear-panel DIP switches as appropriate for your installation, (6) mounting the 8218 in a rack, (7) connecting inputs, outputs and power, (8) and optional connecting of remote control leads.

1. Unpack and inspect.

If you note obvious physical damage, contact the carrier immediately to make a damage claim. Packed with the 8218 are:

- | | |
|---|--|
| 1 | Operating Manual (includes Registration Card) |
| 1 | Line Cord |
| 2 | Fuses (F1 = $\frac{1}{2}$ A or 250mA) |
| 4 | Rack-mounting screws, 10-32 x $\frac{1}{2}$
— with washers, #10 |
| 1 | Orban green screwdriver (Xcelite R3323) |

A *Save all packing materials!* If you should ever have to ship the 8218 (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.

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

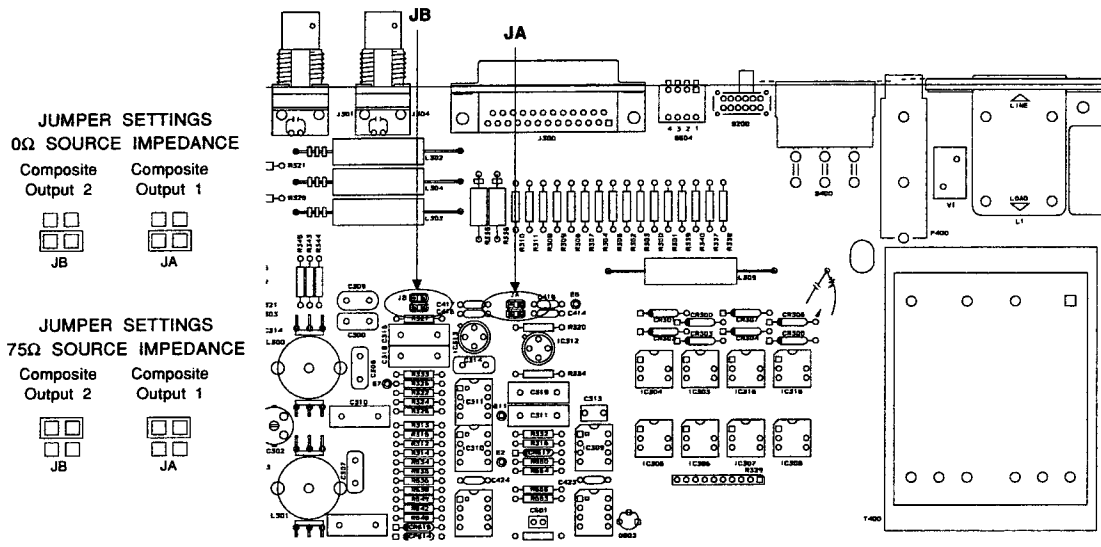
The Registration Card enables us to inform you of new applications, performance improvements, and service aids that may be developed, and it helps us respond promptly to claims under warranty without our having to request a copy of your bill of sale or other proof of purchase. Please fill in the Registration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

We do not sell our customer's names to anyone.

2. Set stereo encoder composite output impedance.

[Skip this step if your installation does not need 75Ω source impedance.]

The stereo encoder is shipped from the factory with 0Ω source impedance. This is correct for virtually all installations. However, the 8218 stereo encoder can be changed to 75Ω source impedance if desired.



**Figure 2-1: Composite Output Impedance Jumpers
Jumpers JA and JB**

The frequencies in the stereo baseband are low by comparison to RF or video, and the characteristic impedance of coaxial cable is not 75Ω at lower frequencies, so the transmission system will have more accurate amplitude and phase response (and thus, better stereo separation) if the cable is driven by a very low source impedance (0Ω) and is terminated with greater than 1kΩ at the exciter.

However, a few broadcast organizations require that FM composite be transmitted in impedance-matched coaxial cable with 75Ω source and load impedances.

To change the source impedance of one or both of the composite outputs:

Make sure that power is off before removing the cover.

To change the source impedance of composite output #1, move jumper JA to the “75Ω” position. To change the source impedance of composite output #2, move jumper JB to the “75Ω” position. Then replace the cover and close the chassis.



8218 Rear Panel

Fuse: Values can be changed to support 115V or 230V operation. Fuse F1 must be 3AG Slow-Blow, 1/2-amp for 115V, or 1/4-amp (250mA) "T" type for 230V.

Power Cord is detachable and is terminated in a "U-ground" plug (USA standard), or CEE7/7 plug (Continental Europe), as appropriate to your 8218's Model Number.

Remote Control Interface is provided to connect the 8218 to your existing transmitter remote control. The 8218 remote control accepts a DB-25 connector and supports the following inputs and two outputs (Digital Pilot Reference Output Clock and AES/EBU error Alarm).

The remote inputs are defined as follows:

- Remote 1 = analog input
- Remote 2 = digital input
- Remote 3 = stereo
- Remote 4 = mono from left
- Remote 5 = mono from right
- Remote 6 = pre-emphasis off
- Remote 7 = pre-emphasis on
- Remote 8 = reserved

A valid remote signal is a momentary transition from no-current to current flowing through the particular remote signal pins. Current must flow for at least 50mS for the signal to be interpreted as valid. It is acceptable to apply current continuously to an input, DC or AC. Do not exceed 12 volts unless you use an external current-limiting resistor that limits current to 10mA.

The Digital Pilot Reference Output Clock is a 19kHz TTL-level square wave, phase-locked to the stereo pilot tone. It is suitable for serving as a reference for an RDS or RBDS encoder. This output is available on pin 24 of the remote interface connector.

The AES/EBU Input error alarm indicates if there was a parity error, a bi-phase coding violation, a receiver PLL not locked condition or if the transmitter set the validity bit. If this occurs, a +15V strobe is sent to the 8218 rear panel Remote Connector pin 10, and the front panel "digital" LED flashes at a 4 per second rate. The +15V strobe and flashing LED remain for 4 seconds following detection of the AES/EBU fault, after which pin 10 goes back to its normal -15V state, and the "digital" LED reverts to its previous state. The +/-15V strobe is capable of delivering 10mA.

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

Digital AES/EBU Input is provided to support two-channel AES/EBU-standard digital audio signals through an XLR-type connector.

Two SCA Inputs are provided for stations that use additional subcarriers (SCAs). Each SCA input uses a BNC connector.

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

Pilot Reference Output is provided on remote control interface DB-25 connector.

Voltage Selector can be set to 115V (for 98-132V operation) or 230V (for 196-264V operation).

Rear Panel DIP Switch

AES DETERMINES EMPH Switch: When the AES DETERMINES EMPH switch is set to YES, and when the input source is Digital, the 8218 applies pre-emphasis to a valid AES/EBU digital audio input according to the status bits in the AES/EBU bitstream:

Byte 0 bits 2-4	AES/EBU definition	8218 interpretation	8218 Response
000	not indicated	not emphasized	8218 applies FM pre-emph
001	undefined	undefined	8218 doesn't alter emphasis
010	undefined	undefined	8218 doesn't alter emphasis
011	undefined	undefined	8218 doesn't alter emphasis
100	no emphasis	not emphasized	8218 applies FM pre-emph
101	undefined	J.17+FM pre-e	8218 applies J.17 de-emph
110	50/15 uSec	FM pre-e	8218 doesn't alter emphasis
111	J.17	J.17	8218 applies J.17 de-emph + FM pre-emph

If the AES status bits indicate that the digital audio input is not pre-emphasized, then 50 μ s or 75 μ s pre-emphasis is applied according to the setting of the PRE-E 50/75 DIP switch. If the AES status bits indicate that the digital audio input is J.17 pre-emphasized (which would be likely if it were being received from a NICAM STL), then J.17 de-emphasis is applied to this input. If a valid AES/EBU digital audio signal is not present at the input, the 8218 will process the analog inputs. The pre-emphasis and de-emphasis status is then determined as if AES DETERMINES EMPH is NO.

When AES DETERMINES EMPH is NO, the three DIP switches (PRE-E ON/OFF, PRE-E 50/75, and J.17 DE-EMP ON/OFF) and the remote interface (PRE-EMPH ON and PRE-EMPH OFF) determine the pre-emphasis and de-emphasis applied by the 8218. If DIP switch PRE-E ON/OFF and the signals received from remote interface controls PRE-EMPH ON and PRE-EMPH OFF disagree: (1) the 8218 will follow DIP switch PRE-E ON/OFF if it changed more recently than last valid remote control signal on the PRE-EMPH ON or PRE-EMPH OFF remote inputs; (2) the 8218 will follow remote control signals on the PRE-EMPH ON or PRE-EMPH OFF remote inputs if a remote signal is received on either of these remote inputs more recently than a change to DIP switch PRE-E ON/OFF.

PRE-E ON/OFF Switch: Determines whether 50 μ s or 75 μ s pre-emphasis (as set by the PRE-E 50/75 switch) is applied to the incoming audio. This function is independent of the J.17 DE-EMP switch, and is overridden by AES status bits when AES DETERMINES EMPH is ON, input is Digital, and a valid AES/EBU digital audio signal is present at the digital input.

PRE-E 50/75 Switch: The PRE-E 50/75 switch determines the type of pre-emphasis to apply, 50 μ s or 75 μ s, to the input audio. Whether or not any pre-emphasis is applied to the input audio is determined by the state of the front panel Input select (Analog/Digital), AES DETERMINES EMPH and PRE-E ON/OFF DIP switches and remote signals PRE-EMPH ON or PRE-EMPH OFF. See description of AES DETERMINES EMPH switch, above.

J.17 DE-EMP Switch: Determines if J.17 de-emphasis is applied to the incoming audio. This function is independent of the 50 μ s or 75 μ s pre-emphasis. It is only needed if the audio from the STL driving the 8218 has been pre-emphasized to J.17 at the STL transmitter.

Overshoot Control Limiter Switch: Determines if the Overshoot Control Limiter is active or defeated. Since it is transparent to signals below 100% (as indicated on the Left and Right Input Meters), it can be left active at all times with no effect on overshoot-free input signals. Note that under this circumstance the Composite meter will read 4% low because its sensitivity is reduced by 4% when the Overshoot Control Limiter is activated. To make the Composite meter read correctly, turn the Overshoot Control Limiter Switch OFF.

Digital Input Range Switches (5dB and 10dB): The "Digital Drive" front panel potentiometer control provides DSP gain adjustment for the AES/EBU Digital Input over a 6dB range (in 0.1dB steps). A switch on the rear-panel DIP increases the gain to the Digital Input by 5dB. A second switch increases gain by 10dB. These two switches can be used in any combination to increase the gain 0, 5, 10, or 15dB, providing a total of 4 ranges, each with a resolution of 0.1dB. The switches are usually set for no gain increase, so that the range of the front-panel control is 100% modulation = 0dBFS to -6dBFS.

Front Panel Switches, Rear Panel Remote Controls and DIP Switch Settings

Front panel and remote interface operation are treated as equals, neither having priority over the other.

8218 will respond to the most recent front panel or remote operation. Since front panel controls are momentary and since response to remote signals is defined to be momentary, they should never conflict. It is possible for a continuous remote signal to disagree with the actual operational status of the 8218. Since the 8218 will respond to the most recent front panel or remote operation, this should not pose a problem unless you are using AC to excite the remote. In this case, each cycle of the AC waveform will re-trigger the remote.

Rear panel DIP switches and remote interface are treated as equals, neither having priority over the other.

The 8218 will respond to the most recent rear panel switch setting or remote operation. This relationship is the same as described directly above, except that the DIP switches are not momentary switches. This means that a remote action can lead to the DIP switch being in a position that disagrees with the actual operational status of the 8218. Since the 8218 will respond to the most recent DIP switch or remote operation, this should not pose a problem.

The AES DEFINES EMPH DIP switch set to ON is a special case.

When the AES DEFINES EMPH DIP switch is placed in the ON position, the 8218 will set up emphasis based upon AES emphasis status bits and the 8218 will ignore the DIP switches PRE-E ON/OFF and J.17 ON/OFF. It will also ignore Remote 6 and Remote 7 for pre-emphasis off/on.

If power is interrupted to the 8218, the 8218 will turn on with the same status that it had when power was removed, provided no other external command changes are present. The following exception applies.

If the DIP switch settings have changed during a power interruption, the DIP switch changes will be activated.



3. Check the line voltage, fuse and power cord.

A *DO NOT connect power to the unit yet!*

B Check the VOLTAGE SELECTOR on the rear, or side panel of the 8218.

Model Numbers 8218/U and 8218/E are shipped configured for either 98-132V or 196-264V, 50Hz or 60Hz operation. To change the operating voltage, set the VOLTAGE SELECTOR to 115V (for 98-132V) or 230V (for 196-264V) as appropriate.

C Check the value of the fuse and change, if necessary.

For safety, fuse F1 must be Slow-Blow, 1/2-amp for 115V, or 1/4-amp (250mA) "T" type for 230V.

D Check 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 8218's Model Number. The green/yellow wire is connected directly to the 8218 chassis.

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

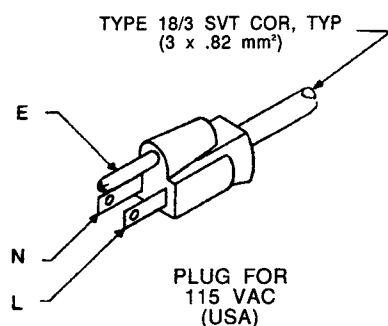
4. Set GROUND LIFT switch.

The GND LIFT (Ground Lift) switch is located on the rear panel.

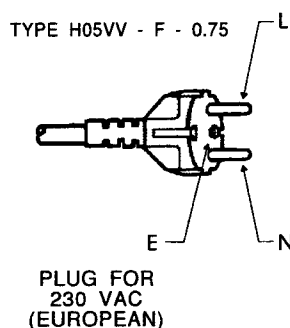
The GND LIFT switch is shipped from the factory set to the earth ground symbol (to connect the 8218's circuit ground to its chassis ground). This is appropriate if you are driving the 8218's composite output into a *balanced* exciter input. If you are driving the 8218's composite output into an *unbalanced* exciter input, set the GND LIFT switch to LIFT.

This will break a ground loop that could otherwise occur.

Unbalanced exciter inputs can cause hum and noise because it is difficult to control the system grounding. If hum or noise appears that cannot be cured by resetting the GND LIFT switch, we suggest that you install the optional Orban CIT25 Composite Isolation Transformer at the exciter's input to balance it. If you use the CIT25, set the 8218's GND LIFT switch to the earth ground symbol.



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 2-2: AC Line Cord Wire Standard

5. Mount the 8218 in a rack.

The 8218 requires one standard rack unit (1.75 inches/4.4 cm).

There should be a good ground connection between the rack and the 8218 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 $113^{\circ}\text{F}/45^{\circ}\text{C}$ when equipment is powered.

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

The shorter the baseband cable run from the 8218 to exciter, the less likely that ground loops or other noise problems will occur in the installation. If you require a long cable run, it is usually best to mount the RF exciter close to the 8218, and to make the long cable carry the RF output from the exciter to the transmitter's RF power amplifiers.

6. Connect remote control. (optional)

The 8218 has extensive remote control provisions, which are described on previous pages.

Optically-isolated remote control connections are terminated in a type DB-25 male connector located on the rear panel. It is wired according to Fig. 2-3. 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 1 to create a REMOTE COMMON. A current-limited +9VDC source is available on pin 25.

In a high-RF environment, remote control wires should be short and should be run through foil-shielded cable, with the shield connected to CHASSIS GROUND at both ends. This will prevent RF from entering the chassis through the remote control leads.

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. AES/EBU ALARM STROBE
- 11-13. N/C
- 14. REMOTE 1-
- 15. REMOTE 2-
- 16. REMOTE 3-
- 17. REMOTE 4-
- 18. REMOTE 5-
- 19. REMOTE 6-
- 20. REMOTE 7-
- 21. REMOTE 8-
- 22-23. N/C
- 24. PILOT REFERENCE
- 25. +9VDC

REMOTE INTERFACE

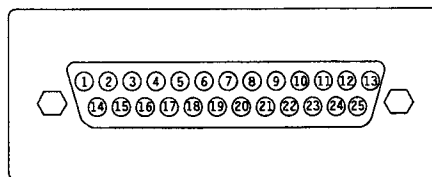


Figure 2-3: Wiring the 25-pin Remote Control Connector

7. Connect inputs and outputs.

See the hook-up and grounding information on the following pages.

Audio Input and Audio Output Connections	Page 2-11
Composite Output and Subcarrier Input	Page 2-12
AES/EBU Digital Input	Page 2-13
Grounding	Page 2-13

Audio Input and Output Connections

Cable

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

Connectors

- **Input connectors** are XLR-type female 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 one pin is considered LOW, the other pin is automatically HIGH.

Analog Audio Input

- The sensitivity of the 8218 can be adjusted using front panel Drive controls (Left, Right and Digital) so that input level between 0dBu and +15dBu will produce 100% modulation.
(0dBu = 0.775Vrms. For this application, the dBm @600Ω scale on voltmeters can be read as if it were calibrated in dBu.)
- The **electronically-balanced input** uses a full instrumentation amplifier topology 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), do not connect the cable shield at the 8218 input — it should be connected at the source end only. In **high RF fields** (like a transmitter site), also connect the shield to pin 1 of the male XLR-type connector at the 8218 input.
- If the output of the driving unit is unbalanced and does not have separate CHASSIS GROUND and (–) (or LO) output terminals, connect both the shield and the black wire to the common (–) or ground terminal of the driving unit.

Composite Output and Subcarrier Input

- There are two independent composite baseband outputs (containing the encoded stereo signal, the stereo pilot tone, and any subcarrier that may have been applied to the subcarrier input).

Each output has an independent output level control (Output Levels Comp 1 and Comp 2) and can be strapped for 0Ω or 75Ω source impedance. Each output can drive up to 8.8V peak-to-peak into 75Ω in parallel with up to $0.047\mu\text{F}$ in cable and input capacitance before any noticeable performance degradation occurs.

- Connect the 8218'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 with 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 8218 close to the exciter and limit the length of the composite cable to less than 6 feet (1.8m).

We do not recommend that the exciter input be terminated by 50Ω or 75Ω unless this is unavoidable. Because the frequencies in the stereo baseband are low by comparison to RF or video, and because the characteristic impedance of coaxial cable is not constant at very low frequencies, the transmission system tends to 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 with greater than $1\text{k}\Omega$ at the exciter end. This also eases thermal stresses on the output amplifier in the stereo encoder, and can thus increase equipment life.

If the Orban CIT25 Composite Isolation Transformer is used, the exciter *must* present a $1\text{k}\Omega$ or greater load to the transformer for proper transformer operation.

Designed to be installed adjacent to each exciter, the CIT25 Composite Isolation Transformer provides ground loop isolation between the 8218 composite output and the exciter's input, and presents the 8218 with a balanced floating load.

- The **subcarrier input** is provided for convenience in summing subcarriers into the baseband prior to its presentation to the FM RF exciter.

The subcarrier input will accept any subcarrier (or combination of subcarriers) above 23kHz. Below 20kHz, its sensitivity rolls off at 6dB/octave to suppress hum that might otherwise be introduced into the subcarrier input, which is unbalanced.

Connect the subcarrier generator to the 8218's subcarrier input with coaxial cable terminated with BNC connectors. Any 50Ω or 75Ω coaxial cable will do as long as it can accommodate BNC connectors.

The subcarrier input is 600Ω impedance and unbalanced. The gain is scaled so that 0.8V peak-to-peak at the subcarrier input produces 10% subcarrier injection with reference to 100% deviation of the FM carrier.

AES/EBU Digital Input

Per the AES/EBU standard, the digital input carries both the left and right stereo channels.

The front-panel Digital (Drive) control provides DSP gain adjustment for the AES/EBU Digital Input over a 6dB range (in 0.1dB steps). A switch on the rear-panel DIP increases the gain to the Digital Input by 5dB. A second switch increases gain by 10dB. These two switches can be used in any combination to increase the gain 0, 5, 10, or 15dB, providing a total of 4 ranges, each with a resolution of 0.1dB. They are normally operated with no gain increase, so that the range of the front-panel control is 100% modulation = 0dBFS to -6dBFS.

Grounding

Very often, grounding is approached in a “hit or miss” manner. But 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 8218 has balanced inputs. Its subcarrier inputs are unbalanced, but their 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.



Grounding (continued)

Power Ground

- Ground the 8218 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 to 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:

- Circuit and chassis ground should always be connected by setting the 8218's GND LIFT switch to the earth ground symbol, *except* when the 8218's composite output is driving an **unbalanced exciter input**. This is an unbalanced-to-unbalanced connection, so the ground loop that would otherwise occur must be broken by setting the 8218's GND LIFT switch to LIFT.

Alternately, you can balance and float the exciter input with the Orban CIT25 Composite Isolation Transformer.

- *In high RF fields*, the system is usually grounded through the equipment rack in which the 8218 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.

8. Power up the 8218.

- Plug in the 8218's power cord.

You should see several LEDs light on the front panel. Which LEDs light depends on the status of the 8218 prior to power-down.

9. Physical installation is complete.

- Continue with SYSTEM SETUP on the following page.

System Setup

[Allow about 1 hour for system setup.]

1. Set pre-emphasis to your specification.

Most installations do not require remote control of pre-emphasis and are not using an STL with J.17 pre-emphasis. (In practice, only NICAM digital STLs are likely to use J.17 pre-emphasis.) If your installation fits this common description, setting pre-emphasis is very easy.

- A Set the PRE-E 50/75 DIP switch to the pre-emphasis standard used in your country.
- B If you are feeding the 8218 with a 50 μ s or 75 μ s pre-emphasized signal from your audio processor (recommended for best peak modulation control), set the PRE-E ON/OFF DIP switch to OFF. If you are feeding the 8218 with a flat signal, set the switch to ON.
- C Set the J.17 DE-EMP ON/OFF DIP switch to OFF.
- D Set the AES DETERMINES EMPH DIP switch to OFF.

[IF YOU HAVE MORE COMPLEX SYSTEM REQUIREMENTS, SEE THE EARLIER DETAILED DISCUSSION OF PRE-EMPHASIS AND REMOTE CONTROL, beginning on page 2-4.]

2. Adjust analog left/right input level.

- A For this step, set the Overshoot Control Limiter to OUT, on the rear panel DIP switch.
- B Apply a 100Hz line-up tone at 100% modulation to the analog inputs.

This frequency is minimally affected by pre-emphasis, and can therefore be used regardless of whether the 8218 is applying pre-emphasis to a flat input signal or is receiving a pre-emphasized signal. In the latter case, the frequency of the tone is unimportant; you can use any frequency between 50Hz and 15kHz. 400Hz to 1kHz is conventional.

If your STL has no overshoot, you can also use processed audio with peaks hitting 100% modulation. If your STL overshoots, you must use tone. Orban Digital Optimod-FM processors have built-in line-up tone generators to facilitate this adjustment.
- C Choose Analog Input from the front panel and adjust the Left and Right Drive controls to make the respective left and right LED meters read 100%. (These meters are true peak-reading.)

3. Adjust digital input level.

- A For this step, set the Overshoot Control Limiter to OUT, on the rear panel DIP switch.

- B Apply a line-up tone at 100% modulation to the digital AES/EBU input.

If your STL has no overshoot, you can also use processed audio with peaks hitting 100% modulation. If your STL overshoots, you must use tone.

Choose Digital Input from the front panel and adjust the Digital Drive control to make the Left and Right LED meters read 100% on peaks.

If you cannot achieve 100% within the available range of the control, you can change the range in 5dB steps with the 5dB and 10dB DIP switches on the rear panel. These switches can be used in any combination to add 0, 5, 10, or 15dB gain to the digital input.

This control adjusts the left and right channels simultaneously. If there is a channel imbalance in the system prior to the 8218, the left and right meters will indicate it. There is no channel balance control available on the 8218; you must correct channel balance at the source.

4. Adjust PILOT LEVEL (optional)

This control adjusts the injection of the 8218's 19kHz stereo pilot tone. Most countries require this injection to be from 8% to 10% modulation. As shipped from the factory, this level has been adjusted for 9% injection and usually requires no change.

- A If you wish to adjust pilot injection to a different level, switch the Meter to Pilot, and adjust the pilot level with the screwdriver-adjustable Pilot (Output Levels) control on the front panel.

- B Set the Meter to Composite.

5. Set composite output level.

- A If you wish to use the Overshoot Control Limiter, set the Limiter to IN, on the rear panel DIP switch.

- B Make sure that you are still applying a tone to the 8218 inputs (analog or digital) and that the Left and Right Input meters read 100%.

If the Overshoot Control Limiter is active, and you are feeding the 8218 from an overshoot the Composite meter should read 95%. If the Overshoot Control Limiter is defeated, the Composite meter should read 100%. (This usually corresponds to 75kHz carrier deviation.)

- C If the Overshoot Control Limiter is defeated, adjust the 8218's Comp 1 and Comp 2 level controls for 100% total modulation of your FM exciter, as indicated on a modulation monitor, or modulation indicator on your exciter.

- D If the Overshoot Control Limiter is active and you are feeding the 8218 from an overshooting STL, adjust the 8218's Comp 1 and Comp 2 level controls for 96% modulation of your FM exciter, as indicated on a modulation monitor, or modulation

indicator on your exciter. This allows 4% headroom for residual overshoots on program material.

- ε □ If the Overshoot Control Limiter is active and you are feeding the 8218 from a non-overshooting STL, adjust the control for 100% modulation.

In this case, the Overshoot Control Limiter will not affect the audio because all input peaks are below the Overshoot Control Limiter's threshold.

- ƒ □ If using a composite STL, adjust the 8218's Comp 1 and Comp 2 level control(s) for 96% or 100% total modulation of your composite STL transmitter (depending on the function of the Overshoot Control Limiter, as explained immediately above), as indicated on the STL's modulation indicator. Then adjust your STL's receiver output level control and/or FM exciter composite input level control for 96% or 100% total modulation of your FM exciter, as indicated on a modulation monitor, or modulation indicator on your exciter.

System Setup Completed.

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