CROWN®

THE PROFESSIONAL AUDIO DIVISION OF CROWN INTERNATIONAL, INC.




# IQ-P.I.P.

***An IQ System® Programmable Input Processor for Crown P.I.P.-compatible Power Amplifiers***

# OWNER'S MANUAL

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P.O. Box 1000, Elkhart, IN 46515
Telephone: 219-294-8000

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# THREE YEAR FULL WARRANTY

## WORLDWIDE

### SUMMARY OF WARRANTY

The Crown Audio Division of Crown International, Inc., 1718 West Mishawaka Road, Elkhart, Indiana 46517-4095 U.S.A. warrants to you, the ORIGINAL PURCHASER and ANY SUBSEQUENT OWNER of each NEW Crown[1] product, for a period of three (3) years from the date of purchase by the original purchaser (the "warranty period") that the new Crown product is free of defects in materials and workmanship, and we further warrant the new Crown product regardless of the reason for failure, except as excluded in this Crown Warranty.

[1] *Note: If your unit bears the name "Amcron," please substitute it for the name "Crown" in this warranty.*

### ITEMS EXCLUDED FROM THIS CROWN WARRANTY

This Crown Warranty is in effect only for failure of a new Crown product which occurred within the Warranty Period. It does not cover any product which has been damaged because of any intentional misuse, accident, negligence, or loss which is covered under any of your insurance contracts. This Crown Warranty also does not extend to the new Crown product if the serial number has been defaced, altered, or removed.

### WHAT THE WARRANTOR WILL DO

We will remedy any defect, regardless of the reason for failure (except as excluded), by repair, replacement, or refund. We may not elect refund unless you agree, or unless we are unable to provide replacement, and repair is not practical or cannot be timely made. If a refund is elected, then you must make the defective or malfunctioning product available to us free and clear of all liens or other encumbrances. The refund will be equal to the actual purchase price, not including interest, insurance, closing costs, and other finance charges less a reasonable depreciation on the product from the date of original purchase. Warranty work can only be performed at our authorized service centers. We will remedy the defect and ship the product from the service center within a reasonable time after receipt of the defective product at our authorized service center. All expenses in remedying the defect, including surface shipping costs to the nearest authorized service center, will be borne by us. (You must bear the expense of all taxes, duties and other customs fees when transporting the product.)

### HOW TO OBTAIN WARRANTY SERVICE

You must notify us of your need for warranty service not later than ninety (90) days after expiration of the warranty period. All components must be shipped in a factory pack. Corrective action will be taken within a reasonable time of the date of receipt of the defective product by our authorized service center. If the repairs made by our authorized service center are not satisfactory, notify our authorized service center immediately.

### DISCLAIMER OF CONSEQUENTIAL AND INCIDENTAL DAMAGES

YOU ARE NOT ENTITLED TO RECOVER FROM US ANY INCIDENTAL DAMAGES RESULTING FROM ANY DEFECT IN THE NEW CROWN PRODUCT. THIS INCLUDES ANY DAMAGE TO ANOTHER PRODUCT OR PRODUCTS RESULTING FROM SUCH A DEFECT.

### WARRANTY ALTERATIONS

No person has the authority to enlarge, amend, or modify this Crown Warranty. This Crown Warranty is not extended by the length of time which you are deprived of the use of the new Crown product. Repairs and replacement parts provided under the terms of this Crown Warranty shall carry only the unexpired portion of this Crown Warranty.

### DESIGN CHANGES

We reserve the right to change the design of any product from time to time without notice and with no obligation to make corresponding changes in products previously manufactured.

### LEGAL REMEDIES OF PURCHASER

No action to enforce this Crown Warranty shall be commenced later than ninety (90) days after expiration of the warranty period.

**THIS STATEMENT OF WARRANTY SUPERSEDES ANY OTHERS CONTAINED IN THIS MANUAL FOR CROWN PRODUCTS.**

*Telephone: 219-294-8200. Facsimile: 219-294-8301* 9/90

## NORTH AMERICA

### SUMMARY OF WARRANTY

The Crown Audio Division of Crown International, Inc., 1718 West Mishawaka Road, Elkhart, Indiana 46517-4095 U.S.A. warrants to you, the ORIGINAL PURCHASER and ANY SUBSEQUENT OWNER of each NEW Crown product, for a period of three (3) years from the date of purchase by the original purchaser (the "warranty period") that the new Crown product is free of defects in materials and workmanship, and we further warrant the new Crown product regardless of the reason for failure, except as excluded in this Crown Warranty.

### ITEMS EXCLUDED FROM THIS CROWN WARRANTY

This Crown Warranty is in effect only for failure of a new Crown product which occurred within the Warranty Period. It does not cover any product which has been damaged because of any intentional misuse, accident, negligence, or loss which is covered under any of your insurance contracts. This Crown Warranty also does not extend to the new Crown product if the serial number has been defaced, altered, or removed.

### WHAT THE WARRANTOR WILL DO

We will remedy any defect, regardless of the reason for failure (except as excluded), by repair, replacement, or refund. We may not elect refund unless you agree, or unless we are unable to provide replacement, and repair is not practical or cannot be timely made. If a refund is elected, then you must make the defective or malfunctioning product available to us free and clear of all liens or other encumbrances. The refund will be equal to the actual purchase price, not including interest, insurance, closing costs, and other finance charges less a reasonable depreciation on the product from the date of original purchase. Warranty work can only be performed at our authorized service centers or at the factory. We will remedy the defect and ship the product from the service center or our factory within a reasonable time after receipt of the defective product at our authorized service center or our factory. All expenses in remedying the defect, including surface shipping costs in the United States, will be borne by us. (You must bear the expense of shipping the product between any foreign country and the port of entry in the United States and all taxes, duties, and other customs fees for such foreign shipments.)

### HOW TO OBTAIN WARRANTY SERVICE

You must notify us of your need for warranty service not later than ninety (90) days after expiration of the warranty period. All components must be shipped in a factory pack, which, if needed, may be obtained from us free of charge. Corrective action will be taken within a reasonable time of the date of receipt of the defective product by us or our authorized service center. If the repairs made by us or our authorized service center are not satisfactory, notify us or our authorized service center immediately.

### DISCLAIMER OF CONSEQUENTIAL AND INCIDENTAL DAMAGES

YOU ARE NOT ENTITLED TO RECOVER FROM US ANY INCIDENTAL DAMAGES RESULTING FROM ANY DEFECT IN THE NEW CROWN PRODUCT. THIS INCLUDES ANY DAMAGE TO ANOTHER PRODUCT OR PRODUCTS RESULTING FROM SUCH A DEFECT. **SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.**

### WARRANTY ALTERATIONS

No person has the authority to enlarge, amend, or modify this Crown Warranty. This Crown Warranty is not extended by the length of time which you are deprived of the use of the new Crown product. Repairs and replacement parts provided under the terms of this Crown Warranty shall carry only the unexpired portion of this Crown Warranty.

### DESIGN CHANGES

We reserve the right to change the design of any product from time to time without notice and with no obligation to make corresponding changes in products previously manufactured.

### LEGAL REMEDIES OF PURCHASER

THIS CROWN WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. No action to enforce this Crown Warranty shall be commenced later than ninety (90) days after expiration of the warranty period.

**THIS STATEMENT OF WARRANTY SUPERSEDES ANY OTHERS CONTAINED IN THIS MANUAL FOR CROWN PRODUCTS.**

*Telephone: 219-294-8200. Facsimile: 219-294-8301* 9/90

The information furnished in this manual does not include all of the details of design, production, or variations of the equipment. Nor does it cover every possible situation which may arise during installation, operation or maintenance. If your unit bears the name "Amcron," please substitute it for the name "Crown" in this manual. If you need special assistance beyond the scope of this manual, please contact our Technical Support Group.

**Crown Audio Division Technical Support Group**
57620 C.R. 105, Elkhart, Indiana 46517 U.S.A.
Phone: **800-342-6939** (U.S.A.) or 219-294-8200 Fax: 219-294-8301

## IMPORTANT

The standard *IQ–P.I.P.* (without battery back-up) is a very versatile programmable input processor for Crown *P.I.P.*-compatible power amplifiers. With it, a host computer in an *IQ System* can control many vital functions of the amplifier—including input attenuation in 1 dB steps. However, these input attenuators are not intended for controlling the maximum sound level of the sound system. This is explained below:

The attenuator settings in the standard *IQ–P.I.P.* module are not remembered when the unit does not have power. Therefore, the ***IQ–P.I.P.* will come back on at full volume after a power failure** or internal shut-down.

The proper way to set the maximum possible sound level of a sound system (the loudest one would ever operate the system under ANY circumstances) is with the fixed level controls on the power amplifier(s). This protects the audience and loudspeakers from excessive sound pressure levels. Remember, Crown cannot be held liable for damage due to overpowering a sound system.

An *IQ–P.I.P.* with battery back-up of all IQ settings (IQ–P.I.P.BB or *Smart Amp*™ *IQ-P.I.P.*) is also available. Contact an Amcron or Crown representative for full details.



## WARNING

**TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE!**

## FCC COMPLIANCE NOTICE

This equipment has been tested and found to comply with the limits for a Class A digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

"The user is cautioned that any changes or modifications not expressly approved by Crown International could void the user's authority to operate the equipment."

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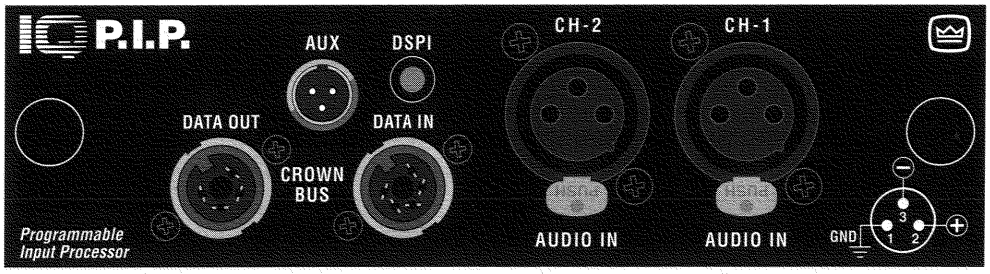



*Fig. 1.1 IQ–P.I.P.*

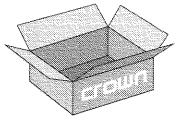
# 1 Welcome

The *IQ–P.I.P.* is a programmable input processor or *P.I.P.*® module. As a component of the *IQ System*® it connects a *P.I.P.*-compatible Crown amplifier to the Crown Bus of an *IQ System* so the amplifier can be controlled and monitored. The module is powered by the amplifier and includes its own Crown Bus drivers. A micro-processor in the module executes the commands of the *IQ System* and reports back the status of the amplifier.

The standard *IQ–P.I.P.* can monitor numerous functions of itself and the amplifier, including the on/off status of each channel, the audio input attenuator setting, the audio signal level at both the amplifier input (balanced gain stage) and amplifier output, the signal polarity status, the *IOC*® status, the *ODEP*® status, the amplifier rail voltage presence, the auxiliary control line status, and the DSPI (Data Signal Presence Indicator) status. The module can turn the high voltage supplies of each channel on or off independently, increase or decrease the audio input attenuation of each channel in 1 dB steps, invert the audio signal polarity, mute the audio signal, turn any devices connected to the AUX connector on or off, and turn the DSPI on or off. Two versions of the *IQ–P.I.P.* are also available with battery backup—the *IQ–P.I.P.* and the *Smart Amp*™ *IQ–P.I.P.* In addition, the *Smart Amp IQ–P.I.P.* can be trained to operate automatically outside of an *IQ System*.

Each *IQ–P.I.P.* is easy to install and includes an IQ address switch so the unit will have a unique address on the Crown Bus. Its error-tolerant design enables it to automatically reset itself if noise "spikes" or other disturbances are encountered.

This manual will help you successfully install and use this new module. We strongly recommend you read all the instructions, warnings and cautions contained within. Also for your protection, please send in the warranty registration card today and save the bill of sale since it is your **official proof of purchase**.



## 1.1 Unpacking

The *IQ–P.I.P.* is shipped in a protective anti-static bag.

**CAUTION: STATIC ELECTRICITY MAY DAMAGE THE *IQ–P.I.P.* MODULE.** Use caution when handling the unit. Carefully ground yourself BEFORE touching the *IQ–P.I.P.* module. For added safety, touch the backside of the *IQ–P.I.P.* "Serial In" connector where the black ground wire is attached (see Figure 2.1). The front panel of the module is NOT grounded. Avoid unnecessarily touching the components or edge connector.

Please unpack and inspect the new module for any damage that may have occurred during transit. If damage is found, notify the transportation company immediately. Only you, the consignee, may initiate a claim with the carrier for damage resulting during shipment. Crown will be happy to cooperate fully as needed. Save the shipping carton as evidence of damage for the shipper's inspection.

Even if the unit arrived in perfect condition, as most do, save all packing materials. **NEVER SHIP THE UNIT WITHOUT THE FACTORY PACK.**

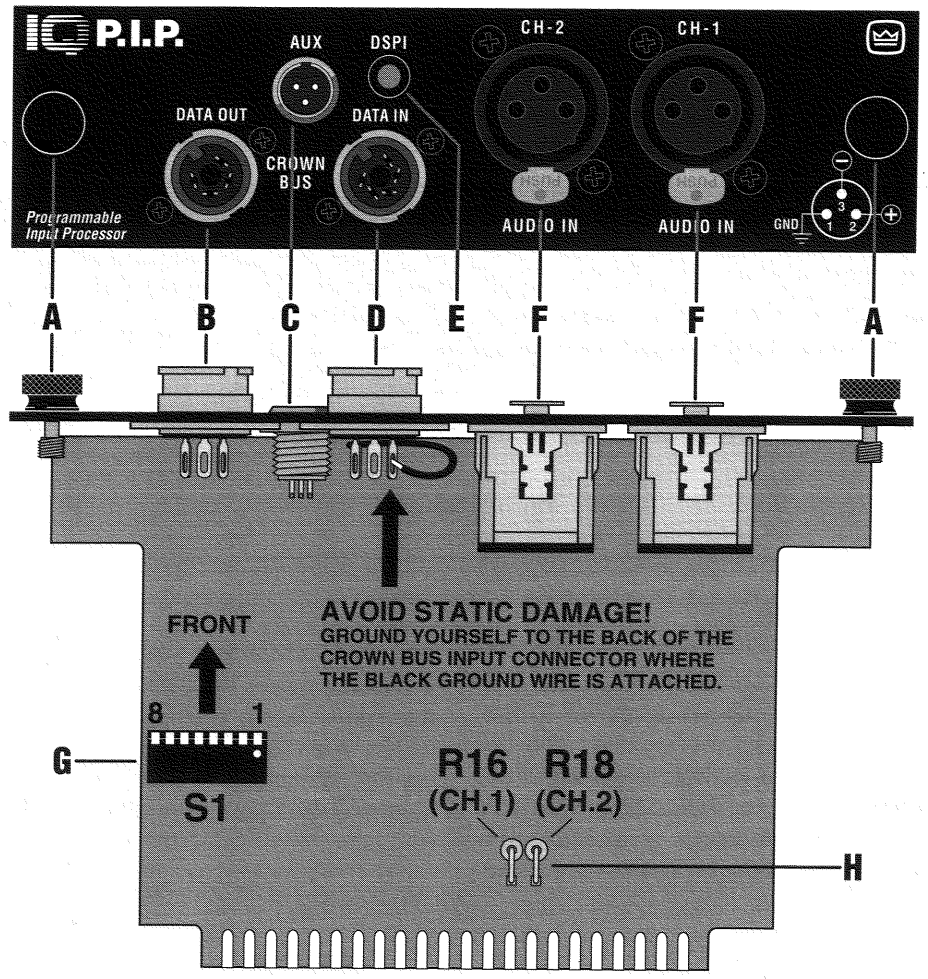



*Fig. 2.1 The IQ–P.I.P. Facilities*

# 2 Facilities

## A. Thumb Screw

The *IQ–P.I.P.* is secured to the back panel of the amplifier with two convenient thumb screws.

## B. Crown Bus Output Connector

A lockable 4-pin female DIN connector is used for output connection to the Crown Bus. A mating Switchcraft 502 series connector can be ordered from Crown (part C 7777-3). Pin 1 is ground (gnd) and pin 2 is positive (+). Pins 3 and 4 are not used. *Note: If shielded twisted-pair wire is used for the Crown Bus, the shield should be connected only to pin 3 of the input connector.*

## C. AUX Connector

A 3-pin male mini XLR connector is provided to control auxiliary equipment. When the AUX feature is turned on, +15 VDC is provided across pin 1 (gnd) and pin 3 (+). A maximum of 15 mA of current is available.

## D. Crown Bus Input Connector

A lockable 5-pin female DIN connector is provided for input connection to the Crown Bus. A mating Switchcraft 502 series connector can be ordered from Crown (part C 7776-5). Pin 1 is negative (–), pin 2 is positive (+), and pin 3 is ground (gnd). Pins 4 and 5 are not used. *Note: If shielded twisted-pair wire is used for the Crown Bus, the shield should be connected only to pin 3 of the input connector.*

## E. DSPI

The DSPI is a Data Signal Presence Indicator which flashes whenever a valid IQ command has been received. The indicator can also be forced to stay on to aid rapid troubleshooting of the Crown Bus wiring.

## F. Balanced Audio Input

A 3-pin female XLR connector is provided for balanced

audio input to each channel of the amplifier. Pin 1 is ground (gnd); pin 2 is not inverted (+); and pin 3 is inverted (–). *Do not use the Ch.2 input if the amplifier is configured in either Bridge or Parallel-Mono mode.*

### G. IQ Address Switch (S1)

An 8-section DIP switch is used to set the IQ address of the unit (see page 8). Each IQ component on a Crown Bus is given a unique IQ address so it can be independently controlled and monitored. Two or more IQ components of the same type should NEVER have the same address on the same Crown Bus loop.

### H. Scaling Resistors (R16, R18)

A scaling resistor is required for each channel. R16 is used for Channel 1 and R18 is used for Channel 2. Each amplifier requires a specific value (see Section 3.1 below). The unit comes from the factory with 54.9 kohm scaling resistors—the value required for a *Macro-Tech® 1200* amplifier.

# 3 Installation

Before installing the *IQ–P.I.P.* into an amplifier it must be given the appropriate scaling resistors and IQ address. The following instructions explain the installation procedure. Before beginning, please carefully note:

**CAUTION: STATIC ELECTRICITY MAY DAMAGE THE *IQ–P.I.P.* MODULE.** Use caution when handling the unit. Carefully ground yourself BEFORE touching the *IQ–P.I.P.* module. For added safety, touch the backside of the *IQ–P.I.P.* "Serial In" connector where the black ground wire is attached (see Figure 2.1). This discharges any static electricity safely through the ground plane of the module. The front panel of the module is NOT grounded. Avoid unnecessarily touching the components or edge connector.

## 3.1 Installing Scaling Resistors

The *IQ–P.I.P.* is designed to work with any Crown *P.I.P.*-compatible amplifier, yet each model produces different power levels. The scaling resistors scale the amplifier audio signal level to a reference level which the *IQ–P.I.P.* can use to report accurate information to the *IQ System.*

There is a scaling resistor for each channel. R16 is used to scale Channel 1. R18 is used to scale Channel 2. (See Figure 2.1.) The resistors are installed in sockets for easy removal and installation. Figure 3.1 shows how to properly bend the leads on the resistors:

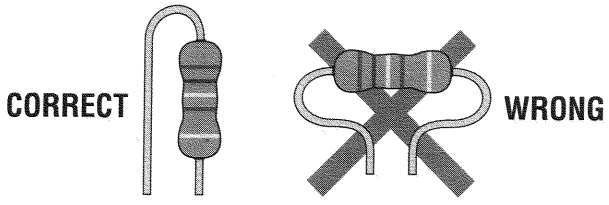



*Fig. 3.1 How to Bend the Leads on Scaling Resistors*

| AMPLIFIER | RESISTOR VALUE | COLOR CODE |
|---|---|---|
| MA-600 | 62.0 K 5% | BLU-RED-ORG-GOLD |
| MA-1200 | 54.9 K 1% | GRN-YEL-WHT-RED-BRN |
| MA-2400 | 34.0 K 1% | ORG-YEL-BLK-RED-BRN |
| MA-24x6 CH-1<br>CH-2 | 34.0 K 1%<br>62.0 K 5% | ORG-YEL-BLK-RED-BRN<br>BLU-RED-ORG-GOLD |
| MA-3600VZ | 16.9 K 1% | BRN-BLU-WHT-RED-BRN |
| MA-36x12 CH-1<br>CH-2 | 16.9 K 1%<br>54.9 K 1% | BRN-BLU-WHT-RED-BRN<br>GRN-YEL-WHT-RED-BRN |
| MA-5000VZ | -- NONE -- | -- REMOVE RESISTERS -- |
| MA-10000 | 24.0 K 5% | RED-YEL-ORG-GOLD |
| Macro Reference | 20.0 K 1% | RED-BLK-ORG-BRN |
| CT-200 @ 8/4 Ω | 100.0 K 1% | BRN-BLK-BLK-ORG-BRN |
| CT-400 @ 8/4 Ω | 66.5 K 1% | BLU-BLU-GRN-RED-BRN |
| CT-800 @ 8/4 Ω | 49.9 K 1% | YEL-WHT-WHT-RED-BRN |
| CT-1600 @ 8/4 Ω | 36.0 K 5% | ORG-BLU-ORG-GOLD |
| ALL CT @ 70-V | 34.0 K 1% | ORG-YEL-BLK-RED-BRN |

*Fig. 3.2 Scaling Resistor (R16, R18) Values*

Each *IQ–P.I.P.* is shipped from the factory with 54.9 kohm scaling resistors (R16, R18). These are the values for a *Macro-Tech 1200* amplifier. The table above shows the correct values to use for other amplifiers.

Normally, an amplifier should have the same resistors installed in both R16 and R18. The exceptions are the *Macro-Tech 24x6* and *36x12*, which have unequal channels, and *Com-Tech®* amplifiers switched for unequal output modes.

*Com-Tech* amplifiers are unique in that one channel can be independently configured for 70-V output and the other for 8/4-ohm output. A different scaling resistor must be used for each channel when they are configured differently. A *Com-Tech 800* configured with Channel 1 in 8/4-ohm mode and Channel 2 in 70-volt mode will require a 49.9 kohm resistor for Channel 1 (R16) and a 34.0 kohm resistor for Channel 2 (R18). If both channels are ever set the same, the resistors must also be set the same.

## 3.2 Setting the IQ Address

By giving each IQ component a unique address, it can be individually controlled and monitored. Whenever the *IQ System* wants to send a command to just one IQ component, it first sends its address and then the command down the Crown Bus.

The 8-segment DIP switch (S1) shown in Figures 2.1 and 3.3 is used to set the IQ address of the *IQ–P.I.P.* No two IQ components of the same type which are connected to the same Crown Bus can have the same address. Suppose, for example, an *IQ System* has two Crown Bus loops, 1 and 2, and this *IQ–P.I.P.* is to be installed into Crown Bus loop 1 and given an address of 77. No other *IQ–P.I.P.* can be given the same address in Crown Bus loop 1. However, an *IQ–P.I.P.* in Crown Bus loop 2 can have the same address.

Different IQ components in the same Crown Bus loop can have the same address. For example, a *SMX-6* mixer with address 77 and an *IQ–P.I.P.* with address 77 can be in the same loop.

A valid IQ address is any number from 1 to 250. **Do not use a number higher than 250** since they are reserved for special use. An address of "0" (zero) should never be used except to put the *IQ–P.I.P.* into a stand-alone mode where it is invisible to the *IQ System* and acts as a "dumb" balanced audio input.

Please notice that switch S1 points toward the front of the *P.I.P.* card (away from the edge connector). It has eight segments because it actually contains eight tiny switches inside. There is a white dot on the top of S1 nearest the first of these switches. Below them are numbers corresponding to their order. Each switch is off when it is up and on when it is down.

Each of the eight switches in S1 has a decimal value. They are binary coded in base-2. This simply means the value of each higher switch is double that of the previous switch. For example switch 1 has a value of 1; switch 2 has a value of 2; switch 3 has a value of 4; switch 4 has a value of 8 and so on.

The address is determined by adding the values of all switches which are turned on. In the example in Figure 3.3 switches 1, 3, 4 and 7 are on. Simply add the values to find the address: 1+4+8+64=77.

Determining which switches to turn on and which ones to turn off to set a certain address is just the opposite. Subtract the values of the switches from the address until zero is reached. Suppose you want to set the address to 55. First, find the highest value switch which can be subtracted from 55. The answer is switch 6

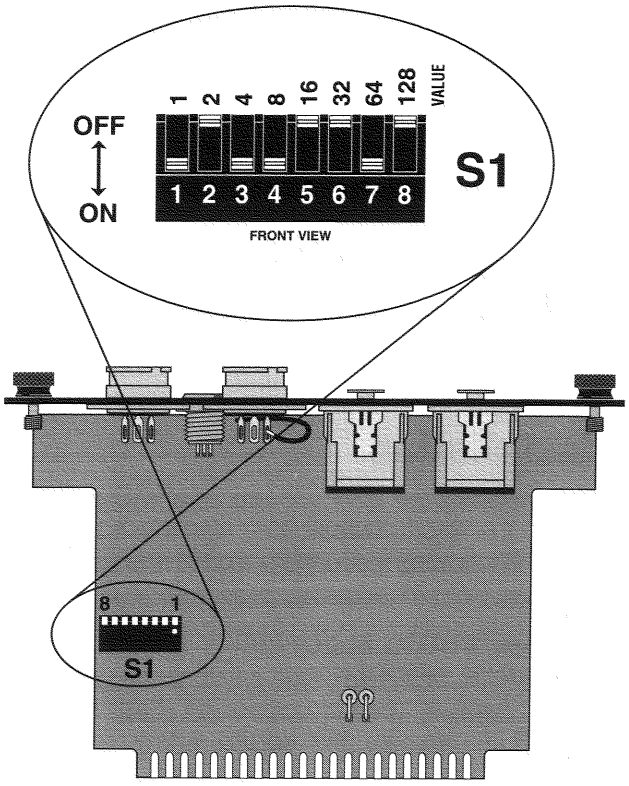



*Fig. 3.3 IQ Address Switch (S1)*

which has a value of 32. Subtract 32 from 55 and 23 will be left. What is the highest value switch that will fit into 23? The answer is switch 5 which has a value of 16. Subtract 16 from 23 and 7 will be left. The next switch which will fit into 7 is switch 3 which has a value of 4. Subtract 4 from 7 and 3 will be left. Switch 2 fits into 3 leaving 1. The last switch to fit is switch 1. The switches to turn on to set the address to 55 are switches 1, 2, 3, 5, and 6. All the other switches should be off.

*Note: A convenient series of IQ address tables are included in Appendix A at the end of this manual. The tables show the switch settings for all 250 addresses.*

## 3.3 Installing the *IQ–P.I.P.* in an Amplifier

Once the correct scaling resistors have been installed and the IQ address has been set it is at last time to install the *IQ–P.I.P.* into the amplifier. The procedure follows. **Remember to use care when handling the *IQ–P.I.P.* to avoid damage from static electricity.**

1. Turn down the level controls (full counterclockwise) and turn off the amplifier.
2. Unplug the power cord of the amplifier from the AC mains.
3. Remove the existing *P.I.P.* module or cover panel

from the back panel of the amplifier (two screws).

4. Carefully ground yourself to the amplifier chassis before installing the *IQ–P.I.P.* It is a good idea to maintain ground contact between yourself and the amplifier while inserting the module into the *P.I.P.* card rails in the next step.
5. Align the edges of the *IQ–P.I.P.* in the *P.I.P.* card rails and firmly push the module in all the way until it is seated against the mounting bracket (see Figure 3.4).

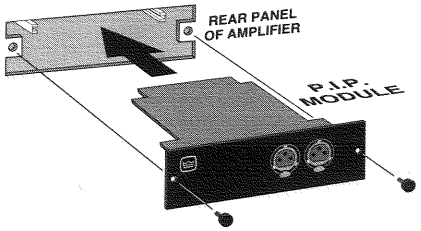



*Fig. 3.4 Installing an IQ–P.I.P. in an Amplifier*

6. Tighten the two thumb screws until the module is secured against the back panel of the amplifier.
7. Plug the power cord back into the AC receptacle.
8. Carefully adjust the level controls of the amplifier until the maximum desired level is achieved. **Important:** Unless an IQ–P.I.P.BB or *Smart Amp IQ–P.I.P.* with battery backup is used, do NOT rely upon the attenuators on the P.I.P. to set the maximum sound level because the attenuation settings are not remembered when there is no power.

## 3.4 Connecting to the Crown Bus

The *IQ–P.I.P.* must be connected to a Crown Bus loop in order for the *IQ System* to control or monitor it. The Crown Bus is a serial communication loop designed to transmit IQ commands and data. As implemented in the *IQ–P.I.P.*, it is a 20 milliamp current loop operating at a BAUD rate of 38.4 K. The loop must be unbroken to function properly.

If the system includes an *IQ Interface* it can accept eight different Crown Bus loops or zones. Dividing the sound system into different zones, each with its own Crown Bus loop, can have several advantages. The following list contrasts those advantages with those of a system having one single loop:

*Multiloop Advantages*

- A break in communication in one loop does not affect other loops.
- Over 250 IQ components of the same type can be used in a system.
- The same IQ address can be used more than once (once per loop per model).

*Single Loop Advantages*

- The *IQ System* can send and retrieve data faster in a single loop.
- "Real time" level display of a greater number of units is possible.

The *IQ–P.I.P.* can be connected to the Crown Bus with inexpensive twisted-pair wiring. If fiber optic wiring is required contact the Crown Technical Support Group. The phone numbers are listed on page 12.

Here are some guidelines for twisted-pair wiring:

- **Use shielded twisted-pair wire** at least 26 AWG in size. The wire should be of good quality and should NOT have high capacitance (30 picofarads/foot or less is good). Shielded wire is recommended for situations where interference is a problem. (West Penn 452 or an equivalent wire works well.) The shield serves two purposes: First, it helps prevent the IQ data signal from transmitting to nearby audio wiring. Second, it helps prevent outside RF from interfering with the data signal. However, in most cases interference is not a problem and, since unshielded wire has lower capacitance, it is a better choice.
- If shielded wire is used, **connect the shield only to the input connector**.
- **Add an IQ Repeater** for very long loops—greater than 1,000 feet (305 m)—or when required by high-capacitance wire. Although we recommend adding a repeater for loops longer than 1,000 feet, it is often possible to go 2,000 feet (610 m) or more. The most significant characteristic of the wire is its capacitance. The lower the capacitance, the longer the loop can be. Unshielded wire typically has less capacitance.
- **Never use the ground wire in a mic snake line.** It may sometimes be convenient to run Crown Bus data signals to and from stage monitor amplifiers along unused wire pairs in a mic snake. If this is done, do not use the ground wire which is normally connected to pin 1 on an XLR connector or data noise will be added to the audio lines. Use only the signal lines which normally connect to pins 2 and 3 of the XLRs. *Note: Because typical mic cables have high capacitance, the maximum possible Crown Bus loop distance will be less.*

Outside RF interference is seldom a problem for a Crown Bus loop—especially if shielded twisted-pair wire

is used. However, there are extreme situations when fiber optic wiring is recommended. For example, locating a Crown Bus loop next to an AM radio transmission line may require fiber optic cabling. An extremely long Crown Bus loop distance (greater than 10 miles) may also require fiber optic cabling.

The IQ components of each Crown Bus loop are wired in series. The output of one IQ component "loops" to the input of the next and so on as shown below.

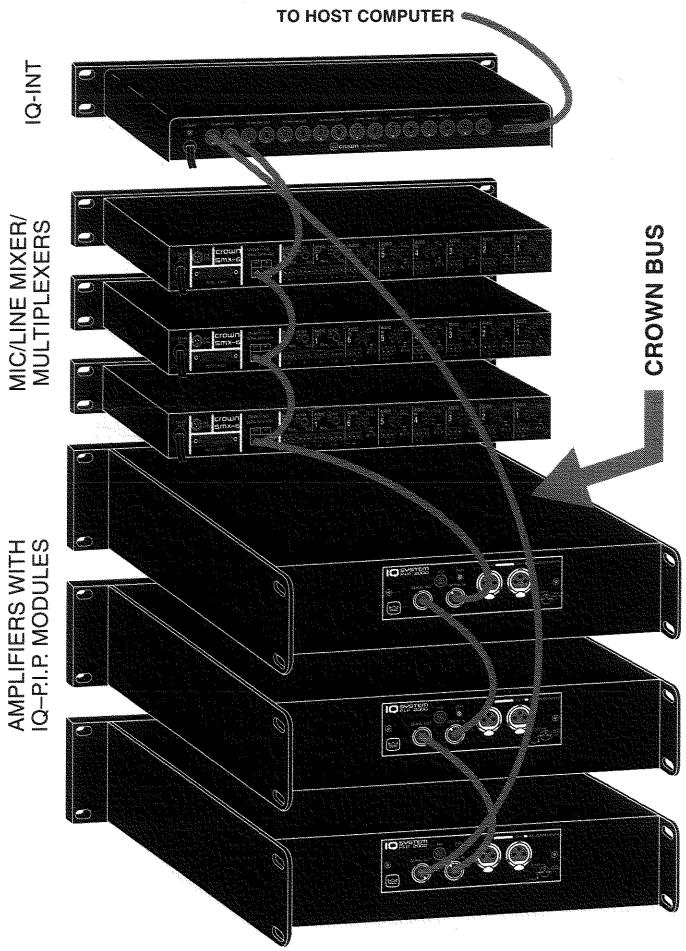



*Fig. 3.5 Crown Bus Wiring "Loops" from Output to Input of Each IQ Component*

Some examples of twisted pair wiring follow. Figure 3.6 shows point-to-point wiring for the Crown Bus using 4-pin output and 5-pin input DIN connectors.

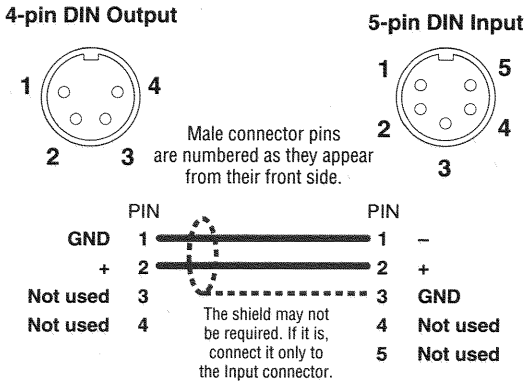



*Figure 3.6 Crown Bus Wiring for DIN Input and Output*

Some IQ components use a single 4-pin removable barrier block connector for both Crown Bus input and output wiring. This is shown in Figures 3.7 and 3.8.

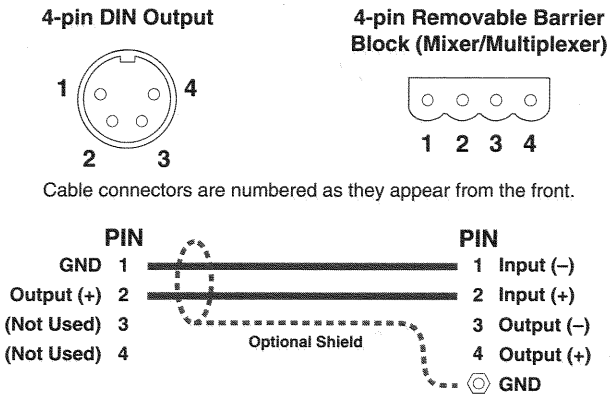



*Figure 3.7 Crown Bus Wiring for Barrier Block Input*

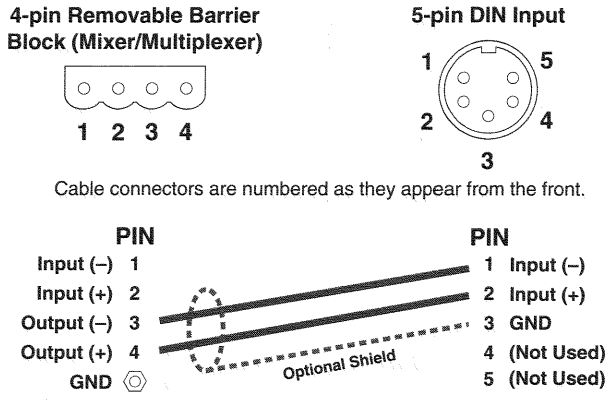



*Figure 3.8 Crown Bus Wiring for Barrier Block Output*

## 3.5 Connecting the Audio Signal

Balanced 3-pin female XLR connectors are provided for audio connection. The audio cables should be wired in one of the following manners:

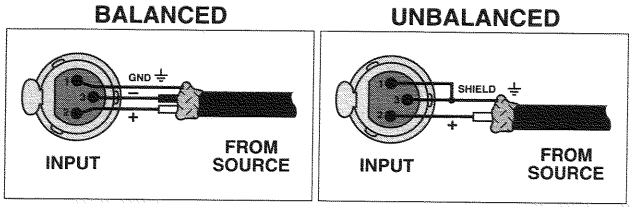



*Fig. 3.9 Audio Input Wiring*

We strongly recommend that balanced wiring be used if possible. Some important guidelines follow:

- Always use shielded wire. The higher the density of the shield (the outer conductor), the better. Spiral wrapped shield is not recommended.
- When using unbalanced lines, keep the cables as short as possible. Avoid lengths greater than 10 feet (3 meters).
- Do not run audio input cables together with high-level wiring such as loudspeaker wires or AC cords. (This lessens the chance of hum or noise being induced into the input cables.)
- Do not connect audio and data grounds together. For example, do not connect the audio ground to the Crown Bus ground.
- Turn the entire sound system off before changing any connections and turn the level controls all the way down before powering the system back up. Crown is not liable for damage incurred when any transducer or component is overdriven.

**IMPORTANT:** Do not feed a signal into the phone jack audio inputs on the back panel of the amplifier when an *IQ–P.I.P.* is installed. The phone jacks are wired in parallel with the output of the *P.I.P.* connector inside the amplifier. Any audio signal fed into the phone jacks could feed back into the output of the *IQ–P.I.P.* and generate a distorted input signal. The phone jacks can be used to "daisy chain" the post-processed signal from the *IQ–P.I.P.* to the inputs of other amplifiers.

DO NOT USE THE CHANNEL 2 INPUT if the amplifier is used in either Bridge-Mono or Parallel-Mono mode.

For additional information on audio input connection please refer to the *Owner's Manual* which came with the amplifier. It contains helpful information on preventing unwanted subsonic frequencies, radio frequency interference, ground loops, and feedback oscillation.

## 3.6 Using the AUX Connector

The *IQ System* offers tremendous flexibility and the auxiliary feature connector provides a means of tapping into it. It can be used to turn something on or off. It can also be used to signal to a peripheral component.

The AUX connector is a 3-pin male mini XLR connector. Only pins 1 and 3 are used in the implementation provided in the *IQ–P.I.P.* When the auxiliary feature is turned on by the *IQ System* software +15 VDC is supplied across pins 1 (ground) and 3 (+). A total of 15 milliamps of current is available. An internal 1000 ohm resistor protects against shorts. See Figure 3.10 below:

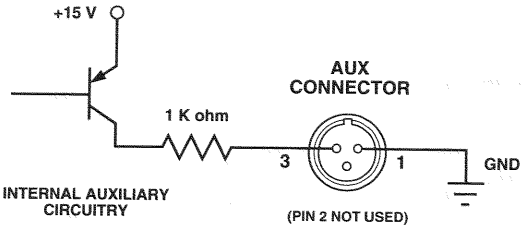



*Fig. 3.10 The Internal AUX Connector Circuit*

There are many possible uses for the AUX connector, limited only by imagination. For example, it can be used to turn on auxiliary cooling fans. To do this the AUX connector would be used to close a relay. The relay would then turn the fans on or off. This is shown in Figure 3.11 below. Note that a Crown part number is provided for a suitable solid-state relay (C 7308-7).

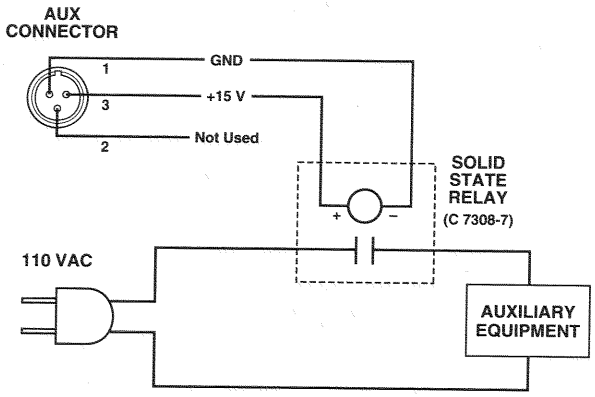



*Fig. 3.11 A Sample AUX Circuit*

By monitoring the operating condition of the amplifiers with the *IQ System* software the need for additional cooling will be apparent. The same software could then be used to turn on the appropriate AUX connector. (For more information about turning the auxiliary feature on or off, consult the IQ software *User's Manual*.)

# 4 Operation

The *IQ–P.I.P.* is operated from IQ software running on a host computer. Please refer to the IQ software *User's Manual* for instructions in its use. There is one very important thing to know when using a standard *IQ–P.I.P.*:

**IMPORTANT:** Because the standard *IQ–P.I.P.* does not have battery back-up it will not remember any settings when there is no power. This means the attenuator settings will be forgotten if power is lost, causing the *IQ–P.I.P.* to come back on at full volume when the power is restored.

For this reason, **the *IQ–P.I.P.* attenuators should NOT be used to set the maximum level of the sound system**. Instead, use the level controls of the power amplifier(s). By setting the maximum level with the level controls of the amplifier(s), the loudspeakers and audience are protected from excessive sound pressure levels. Remember, Crown cannot be held liable for damage due to overpowering the sound system.

For those who want battery back-up an *IQ–P.I.P.BB* or *Smart Amp IQ–P.I.P.* is available. Contact your representative for full details.

# 5 Service

This unit has very sophisticated circuitry which should only be serviced by a fully trained technician. This is one reason why each unit bears the following label:

**CAUTION: TO PREVENT ELECTRIC SHOCK DO NOT REMOVE COVERS. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO A QUALIFIED TECHNICIAN.**

## 5.1 Worldwide Service

Service may be obtained from an authorized service center. (Contact your local Crown/Amcron representative or our office for a list of authorized service centers.) To obtain service, simply present the bill of sale as proof of purchase along with the defective unit to an authorized service center. They will handle the necessary paperwork and repair.

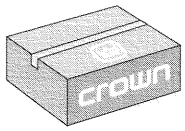
Remember to transport your unit in the original factory pack. We will pay the surface shipping costs both ways **for warranty service** to the authorized service center nearest you after receiving copies of all shipping receipts. You must bear the expense of all taxes, duties, and customs fees when transporting the unit.

## 5.2 North American Service

Service may be obtained in one of two ways: from an authorized service center or from the factory. You may choose either. It is important that you have your copy of the bill of sale as your proof of purchase.

### 5.2.1 Service at a North American Service Center

This method usually saves the most time and effort. Simply present your bill of sale along with the defective unit to an authorized service center to obtain service. They will handle the necessary paperwork and repair. Remember to transport the unit in the original factory pack. A list of authorized service centers in your area can be obtained from our Technical Support Group.




**Always use the original factory pack to transport the unit.**

### 5.2.2 Factory Service

To obtain factory service, fill out the *Service Information Card* in the back of this manual and send it along with proof of purchase and the defective unit to the Crown factory. Enclose a letter explaining the nature of the problem and what service you would like. Include your return shipping address and telephone number.

**The unit must be shipped in the original factory pack.** If you don't have the original shipping container, contact us and a replacement will be sent promptly.

We will pay ground shipping costs both ways in the United States **for warranty service** after receiving copies of all shipping receipts. Shipments should be sent "UPS ground." (If the unit is under warranty, you may send it C.O.D. for the cost of freight via UPS ground.) The factory will return the unit via UPS ground. Please contact us for other arrangements.

**Crown Audio Division**
Tech. Support / Factory Service
57620 C.R. 105
Elkhart, Indiana 46517 U.S.A.

Phone: 1-219-294-8200
U.S.A.: 1-800-342-6939
Fax: 1-219-294-8301

# 6 Technical Information

The purpose of the *IQ–P.I.P.* is to provide a means for the *IQ System* to control and monitor the vital functions of a *P.I.P.*-compatible amplifier. In doing this, the *IQ–P.I.P.* interfaces the amplifier to a Crown Bus serial loop.

The *IQ–P.I.P.* has the ability to turn on or off a channel of the amplifier, adjust the level of the audio input attenuators, invert the audio signal polarity, selectively scan the input data, turn on or off the DSPI (Data Signal Presence Indicator) LED, and turn on or off the power of an auxiliary feature connector.

The exact state of each of the above control functions can be monitored as well as the *IOC* (Input/Output Comparator) error signal, *ODEP* (Output Device Emulation Protection) signal, the presence of rail voltage, and the audio signal at both the amplifier input (balanced gain stage) and output. (Please refer to the amplifier *Owner's Manual* for an explanation of the *IOC* and *ODEP* signals.)

Figure 5.1 shows a block diagram of a typical *IQ–P.I.P.* module. The input selector selects the input from the amplifier (one at a time) and sends the data from it to the precision full-wave rectifier for conversion to a unipolar signal. Next the signal is converted to a binary word by the analog-to-digital converter (A/D). The signal can now be used by the microprocessor which changes the data signal to serial data and sends it to the output line driver for transmission to the Crown Bus. Since the microprocessor controls both input data selection and command execution, it is the heart of the system.

Instructions from the host computer of the *IQ System* follow a similar path to the microprocessor via the Crown Bus input line receiver.

The Crown Bus serial communications requirements allow for serial lines to be up to 1000 feet in length (or more, depending upon wire capacitance) and operate at 38400 BAUD. The data must be able to loop from one IQ component to the next while at the same time keeping each component in the loop isolated. Both the Crown Bus serial line driver and line receiver are designed to not only meet, but exceed, all of the above requirements. Using an optical isolator, they are able to drive a 20 milliamp current loop over common twisted-pair wire.

The *IQ–P.I.P.* module is also equipped with an auto reset feature. This feature provides both a reliable power-on reset for the microprocessor and an automatic "warm" reset in case it loses control due to a noise pulse, etc.

The balanced audio signals of each channel first enter a balanced input stage where they are converted to unbalanced signals. Next they enter the digital attenuator control circuit which receives binary gain commands from port 3 of the microprocessor.

Finally, the audio passes through the logic-controlled inverters which are controlled by port 2 of the microprocessor. Using them, the micro can invert the audio signal polarity.

A signal LED, labeled the DSPI (Data Signal Presence Indicator), flashes whenever the *IQ–P.I.P.* card receives and acknowledges valid IQ commands. It can also be forced on by the *IQ System* software when a break in communication is suspected to facilitate rapid cable troubleshooting.

The *IQ–P.I.P.* module requires +5 and ±15 volts to operate. This is derived, using four voltage regulators, from the ±24 volts provided by the amplifier at the *P.I.P.* edge connector. Because of this, the amplifier front-panel power switch must remain on.

Two special versions, the IQ–P.I.P.BB and *Smart Amp IQ–P.I.P.* also include a lithium battery to back up all microprocessor settings.

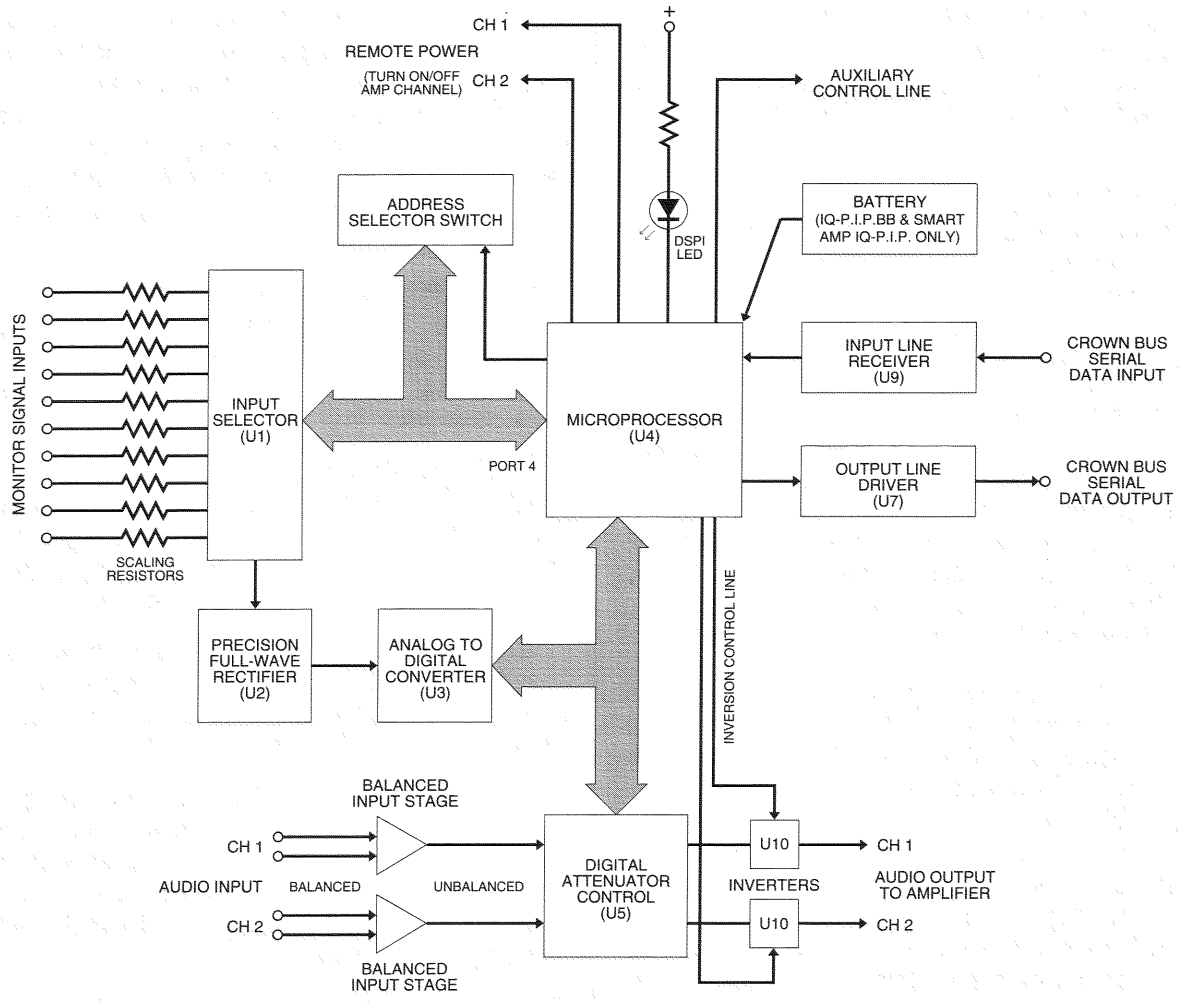



*Fig. 6.1 IQ–P.I.P. Circuit Block Diagram*

# 7 Specifications

## General

**Internal Controls:** An 8-segment DIP switch is used to set the IQ address (decimal range: 1–250). Note: If address "0" is selected, the *IQ–P.I.P.* will operate in stand-alone mode.

**Connectors:** Crown Bus Input: Locking 5-pin female DIN connector. Crown Bus Output: Locking 4-pin female DIN connector. Audio Input: Balanced 3-pin female XLR connector for each channel. AUX: A 3-pin male mini connector.

**Indicators:** A yellow DSPI (Data Signal Presence Indicator) flashes when a valid IQ command is received from the *IQ System* via the Crown Bus. The DSPI can be forced on to facilitate rapid troubleshooting of Crown Bus wiring.

**Auxiliary Feature:** +15 VDC is supplied across pins 1 (ground) and 3 (+) of the AUX connector when turned on by the *IQ System* software.

**Power Requirements:** When installed into a Crown *P.I.P.*-compatible amplifier, the unit receives ±24 VDC.

**Battery (IQ–P.I.P.BB and *Smart Amp IQ–P.I.P.* only):** A 3.6 V lithium battery is provided to back up all microprocessor settings when no power is available. It should be replaced approximately every five years.

## Crown Bus Data Communication

**Protection:** If communication is lost, the unit will continue to function with the last commands received. An auto reset feature is also provided for a reliable power-on reset for the microprocessor and an automatic "warm" reset if the microprocessor ever loses control due to a noise pulse, etc.

**Data Rate:** 38.4 K BAUD.

**Data Format:** Serial, binary, asynchronous; 1 start bit; 1 stop bit; 8 data bits; no parity.

**Interface Type:** Isolated 20 milliamp serial loop.

**Operation:** Half duplex.

**Intelligence:** 8-bit microprocessor with 4 K byte control program.

**Transmission Distance:** Variable from 200 to 3,000 feet (61 to 914 m), depending upon wire capacitance and BAUD rate. Typically 1,000 feet (305 M) using shielded twisted-pair wire, #26 AWG or larger. Can be extended with an IQ Repeater.

## Audio

Please note: The audio specifications are referenced to 0.775 V. Measurements were made at the output of the *IQ–P.I.P.* module, itself.

**Signal-to-Noise Ratio:** >88 dB from 20 Hz to 20 kHz.

**Frequency Response:** ±0.1 dB from 20 Hz to 20 kHz.

**Crosstalk Ratio:** >75 dB at 1 kHz. >65 dB at 20 kHz.

**Common Mode Rejection (CMR):** >70 dB at 1 kHz. >60 dB at 20 kHz.

**Harmonic Distortion (THD):** <0.05% from 20 Hz to 20 kHz.

# Appendix A

This Appendix contains look-up tables for every valid IQ address. The valid address are 1 to 250. Remember that address "0" (zero) will put the *IQ–P.I.P.* into a stand-alone mode where it is invisible to the *IQ System* and acts like a "dumb" balanced audio input. **Do not use an address number higher than 250!** Addresses above 250 are reserved for special system use.

**Remember:** No two IQ components of the same type which are connected to the same Crown Bus can have the same address.

To use the IQ address tables, simply find the address you want and set the IQ address switch of the *IQ–P.I.P.* card as shown. For more information see Section 3.2.

| IQ Address | IQ Address Switch 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 0 | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| 1 | ON | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| 2 | OFF | ON | OFF | OFF | OFF | OFF | OFF | OFF |
| 3 | ON | ON | OFF | OFF | OFF | OFF | OFF | OFF |
| 4 | OFF | OFF | ON | OFF | OFF | OFF | OFF | OFF |
| 5 | ON | OFF | ON | OFF | OFF | OFF | OFF | OFF |
| 6 | OFF | ON | ON | OFF | OFF | OFF | OFF | OFF |
| 7 | ON | ON | ON | OFF | OFF | OFF | OFF | OFF |
| 8 | OFF | OFF | OFF | ON | OFF | OFF | OFF | OFF |
| 9 | ON | OFF | OFF | ON | OFF | OFF | OFF | OFF |
| 10 | OFF | ON | OFF | ON | OFF | OFF | OFF | OFF |
| 11 | ON | ON | OFF | ON | OFF | OFF | OFF | OFF |
| 12 | OFF | OFF | ON | ON | OFF | OFF | OFF | OFF |
| 13 | ON | OFF | ON | ON | OFF | OFF | OFF | OFF |
| 14 | OFF | ON | ON | ON | OFF | OFF | OFF | OFF |
| 15 | ON | ON | ON | ON | OFF | OFF | OFF | OFF |
| 16 | OFF | OFF | OFF | OFF | ON | OFF | OFF | OFF |
| 17 | ON | OFF | OFF | OFF | ON | OFF | OFF | OFF |
| 18 | OFF | ON | OFF | OFF | ON | OFF | OFF | OFF |
| 19 | ON | ON | OFF | OFF | ON | OFF | OFF | OFF |
| 20 | OFF | OFF | ON | OFF | ON | OFF | OFF | OFF |
| 21 | ON | OFF | ON | OFF | ON | OFF | OFF | OFF |
| 22 | OFF | ON | ON | OFF | ON | OFF | OFF | OFF |
| 23 | ON | ON | ON | OFF | ON | OFF | OFF | OFF |
| 24 | OFF | OFF | OFF | ON | ON | OFF | OFF | OFF |
| 25 | ON | OFF | OFF | ON | ON | OFF | OFF | OFF |
| 26 | OFF | ON | OFF | ON | ON | OFF | OFF | OFF |
| 27 | ON | ON | OFF | ON | ON | OFF | OFF | OFF |
| 28 | OFF | OFF | ON | ON | ON | OFF | OFF | OFF |
| 29 | ON | OFF | ON | ON | ON | OFF | OFF | OFF |
| 30 | OFF | ON | ON | ON | ON | OFF | OFF | OFF |
| 31 | ON | ON | ON | ON | ON | OFF | OFF | OFF |
| 32 | OFF | OFF | OFF | OFF | OFF | ON | OFF | OFF |
| 33 | ON | OFF | OFF | OFF | OFF | ON | OFF | OFF |
| 34 | OFF | ON | OFF | OFF | OFF | ON | OFF | OFF |
| 35 | ON | ON | OFF | OFF | OFF | ON | OFF | OFF |
| 36 | OFF | OFF | ON | OFF | OFF | ON | OFF | OFF |
| 37 | ON | OFF | ON | OFF | OFF | ON | OFF | OFF |
| 38 | OFF | ON | ON | OFF | OFF | ON | OFF | OFF |
| 39 | ON | ON | ON | OFF | OFF | ON | OFF | OFF |
| 40 | OFF | OFF | OFF | ON | OFF | ON | OFF | OFF |
| 41 | ON | OFF | OFF | ON | OFF | ON | OFF | OFF |
| 42 | OFF | ON | OFF | ON | OFF | ON | OFF | OFF |
| 43 | ON | ON | OFF | ON | OFF | ON | OFF | OFF |
| 44 | OFF | OFF | ON | ON | OFF | ON | OFF | OFF |
| 45 | ON | OFF | ON | ON | OFF | ON | OFF | OFF |
| 46 | OFF | ON | ON | ON | OFF | ON | OFF | OFF |
| 47 | ON | ON | ON | ON | OFF | ON | OFF | OFF |
| 48 | OFF | OFF | OFF | OFF | ON | ON | OFF | OFF |
| 49 | ON | OFF | OFF | OFF | ON | ON | OFF | OFF |
| 50 | OFF | ON | OFF | OFF | ON | ON | OFF | OFF |
| 51 | ON | ON | OFF | OFF | ON | ON | OFF | OFF |
| 52 | OFF | OFF | ON | OFF | ON | ON | OFF | OFF |
| 53 | ON | OFF | ON | OFF | ON | ON | OFF | OFF |
| 54 | OFF | ON | ON | OFF | ON | ON | OFF | OFF |
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| 60 | OFF | OFF | ON | ON | ON | ON | OFF | OFF |
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| 63 | ON | ON | ON | ON | ON | ON | OFF | OFF |
| 64 | OFF | OFF | OFF | OFF | OFF | OFF | ON | OFF |
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| 68 | OFF | OFF | ON | OFF | OFF | OFF | ON | OFF |
| 69 | ON | OFF | ON | OFF | OFF | OFF | ON | OFF |
| 70 | OFF | ON | ON | OFF | OFF | OFF | ON | OFF |
| 71 | ON | ON | ON | OFF | OFF | OFF | ON | OFF |
| 72 | OFF | OFF | OFF | ON | OFF | OFF | ON | OFF |
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| 76 | OFF | OFF | ON | ON | OFF | OFF | ON | OFF |
| 77 | ON | OFF | ON | ON | OFF | OFF | ON | OFF |
| 78 | OFF | ON | ON | ON | OFF | OFF | ON | OFF |
| 79 | ON | ON | ON | ON | OFF | OFF | ON | OFF |
| 80 | OFF | OFF | OFF | OFF | ON | OFF | ON | OFF |
| 81 | ON | OFF | OFF | OFF | ON | OFF | ON | OFF |
| 82 | OFF | ON | OFF | OFF | ON | OFF | ON | OFF |
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| 85 | ON | OFF | ON | OFF | ON | OFF | ON | OFF |
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| 87 | ON | ON | ON | OFF | ON | OFF | ON | OFF |
| 88 | OFF | OFF | OFF | ON | ON | OFF | ON | OFF |
| 89 | ON | OFF | OFF | ON | ON | OFF | ON | OFF |
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| 92 | OFF | OFF | ON | ON | ON | OFF | ON | OFF |
| 93 | ON | OFF | ON | ON | ON | OFF | ON | OFF |
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| 99 | ON | ON | OFF | OFF | OFF | ON | ON | OFF |
| 100 | OFF | OFF | ON | OFF | OFF | ON | ON | OFF |
| 101 | ON | OFF | ON | OFF | OFF | ON | ON | OFF |
| 102 | OFF | ON | ON | OFF | OFF | ON | ON | OFF |
| 103 | ON | ON | ON | OFF | OFF | ON | ON | OFF |
| 104 | OFF | OFF | OFF | ON | OFF | ON | ON | OFF |
| 105 | ON | OFF | OFF | ON | OFF | ON | ON | OFF |
| 106 | OFF | ON | OFF | ON | OFF | ON | ON | OFF |
| 107 | ON | ON | OFF | ON | OFF | ON | ON | OFF |
| 108 | OFF | OFF | ON | ON | OFF | ON | ON | OFF |
| 109 | ON | OFF | ON | ON | OFF | ON | ON | OFF |
| 110 | OFF | ON | ON | ON | OFF | ON | ON | OFF |
| 111 | ON | ON | ON | ON | OFF | ON | ON | OFF |
| 112 | OFF | OFF | OFF | OFF | ON | ON | ON | OFF |
| 113 | ON | OFF | OFF | OFF | ON | ON | ON | OFF |
| 114 | OFF | ON | OFF | OFF | ON | ON | ON | OFF |
| 115 | ON | ON | OFF | OFF | ON | ON | ON | OFF |
| 116 | OFF | OFF | ON | OFF | ON | ON | ON | OFF |
| 117 | ON | OFF | ON | OFF | ON | ON | ON | OFF |
| 118 | OFF | ON | ON | OFF | ON | ON | ON | OFF |
| 119 | ON | ON | ON | OFF | ON | ON | ON | OFF |
| 120 | OFF | OFF | OFF | ON | ON | ON | ON | OFF |
| 121 | ON | OFF | OFF | ON | ON | ON | ON | OFF |
| 122 | OFF | ON | OFF | ON | ON | ON | ON | OFF |
| 123 | ON | ON | OFF | ON | ON | ON | ON | OFF |
| 124 | OFF | OFF | ON | ON | ON | ON | ON | OFF |
| 125 | ON | OFF | ON | ON | ON | ON | ON | OFF |

*Fig. A.1 IQ Address Switch (S1) Settings from 0 to 125*

| IQ Address | IQ Address Switch 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 126 | OFF | ON | ON | ON | ON | ON | ON | OFF |
| 127 | ON | ON | ON | ON | ON | ON | ON | OFF |
| 128 | OFF | OFF | OFF | OFF | OFF | OFF | OFF | ON |
| 129 | ON | OFF | OFF | OFF | OFF | OFF | OFF | ON |
| 130 | OFF | ON | OFF | OFF | OFF | OFF | OFF | ON |
| 131 | ON | ON | OFF | OFF | OFF | OFF | OFF | ON |
| 132 | OFF | OFF | ON | OFF | OFF | OFF | OFF | ON |
| 133 | ON | OFF | ON | OFF | OFF | OFF | OFF | ON |
| 134 | OFF | ON | ON | OFF | OFF | OFF | OFF | ON |
| 135 | ON | ON | ON | OFF | OFF | OFF | OFF | ON |
| 136 | OFF | OFF | OFF | ON | OFF | OFF | OFF | ON |
| 137 | ON | OFF | OFF | ON | OFF | OFF | OFF | ON |
| 138 | OFF | ON | OFF | ON | OFF | OFF | OFF | ON |
| 139 | ON | ON | OFF | ON | OFF | OFF | OFF | ON |
| 140 | OFF | OFF | ON | ON | OFF | OFF | OFF | ON |
| 141 | ON | OFF | ON | ON | OFF | OFF | OFF | ON |
| 142 | OFF | ON | ON | ON | OFF | OFF | OFF | ON |
| 143 | ON | ON | ON | ON | OFF | OFF | OFF | ON |
| 144 | OFF | OFF | OFF | OFF | ON | OFF | OFF | ON |
| 145 | ON | OFF | OFF | OFF | ON | OFF | OFF | ON |
| 146 | OFF | ON | OFF | OFF | ON | OFF | OFF | ON |
| 147 | ON | ON | OFF | OFF | ON | OFF | OFF | ON |
| 148 | OFF | OFF | ON | OFF | ON | OFF | OFF | ON |
| 149 | ON | OFF | ON | OFF | ON | OFF | OFF | ON |
| 150 | OFF | ON | ON | OFF | ON | OFF | OFF | ON |
| 151 | ON | ON | ON | OFF | ON | OFF | OFF | ON |
| 152 | OFF | OFF | OFF | ON | ON | OFF | OFF | ON |
| 153 | ON | OFF | OFF | ON | ON | OFF | OFF | ON |
| 154 | OFF | ON | OFF | ON | ON | OFF | OFF | ON |
| 155 | ON | ON | OFF | ON | ON | OFF | OFF | ON |
| 156 | OFF | OFF | ON | ON | ON | OFF | OFF | ON |
| 157 | ON | OFF | ON | ON | ON | OFF | OFF | ON |
| 158 | OFF | ON | ON | ON | ON | OFF | OFF | ON |
| 159 | ON | ON | ON | ON | ON | OFF | OFF | ON |
| 160 | OFF | OFF | OFF | OFF | OFF | ON | OFF | ON |
| 161 | ON | OFF | OFF | OFF | OFF | ON | OFF | ON |
| 162 | OFF | ON | OFF | OFF | OFF | ON | OFF | ON |
| 163 | ON | ON | OFF | OFF | OFF | ON | OFF | ON |
| 164 | OFF | OFF | ON | OFF | OFF | ON | OFF | ON |
| 165 | ON | OFF | ON | OFF | OFF | ON | OFF | ON |
| 166 | OFF | ON | ON | OFF | OFF | ON | OFF | ON |
| 167 | ON | ON | ON | OFF | OFF | ON | OFF | ON |
| 168 | OFF | OFF | OFF | ON | OFF | ON | OFF | ON |
| 169 | ON | OFF | OFF | ON | OFF | ON | OFF | ON |
| 170 | OFF | ON | OFF | ON | OFF | ON | OFF | ON |
| 171 | ON | ON | OFF | ON | OFF | ON | OFF | ON |
| 172 | OFF | OFF | ON | ON | OFF | ON | OFF | ON |
| 173 | ON | OFF | ON | ON | OFF | ON | OFF | ON |
| 174 | OFF | ON | ON | ON | OFF | ON | OFF | ON |
| 175 | ON | ON | ON | ON | OFF | ON | OFF | ON |
| 176 | OFF | OFF | OFF | OFF | ON | ON | OFF | ON |
| 177 | ON | OFF | OFF | OFF | ON | ON | OFF | ON |
| 178 | OFF | ON | OFF | OFF | ON | ON | OFF | ON |
| 179 | ON | ON | OFF | OFF | ON | ON | OFF | ON |
| 180 | OFF | OFF | ON | OFF | ON | ON | OFF | ON |
| 181 | ON | OFF | ON | OFF | ON | ON | OFF | ON |
| 182 | OFF | ON | ON | OFF | ON | ON | OFF | ON |
| 183 | ON | ON | ON | OFF | ON | ON | OFF | ON |
| 184 | OFF | OFF | OFF | ON | ON | ON | OFF | ON |
| 185 | ON | OFF | OFF | ON | ON | ON | OFF | ON |
| 186 | OFF | ON | OFF | ON | ON | ON | OFF | ON |
| 187 | ON | ON | OFF | ON | ON | ON | OFF | ON |
| 188 | OFF | OFF | ON | ON | ON | ON | OFF | ON |
| 189 | ON | OFF | ON | ON | ON | ON | OFF | ON |
| 190 | OFF | ON | ON | ON | ON | ON | OFF | ON |
| 191 | ON | ON | ON | ON | ON | ON | OFF | ON |
| 192 | OFF | OFF | OFF | OFF | OFF | OFF | ON | ON |
| 193 | ON | OFF | OFF | OFF | OFF | OFF | ON | ON |
| 194 | OFF | ON | OFF | OFF | OFF | OFF | ON | ON |
| 195 | ON | ON | OFF | OFF | OFF | OFF | ON | ON |
| 196 | OFF | OFF | ON | OFF | OFF | OFF | ON | ON |
| 197 | ON | OFF | ON | OFF | OFF | OFF | ON | ON |
| 198 | OFF | ON | ON | OFF | OFF | OFF | ON | ON |
| 199 | ON | ON | ON | OFF | OFF | OFF | ON | ON |
| 200 | OFF | OFF | OFF | ON | OFF | OFF | ON | ON |
| 201 | ON | OFF | OFF | ON | OFF | OFF | ON | ON |
| 202 | OFF | ON | OFF | ON | OFF | OFF | ON | ON |
| 203 | ON | ON | OFF | ON | OFF | OFF | ON | ON |
| 204 | OFF | OFF | ON | ON | OFF | OFF | ON | ON |
| 205 | ON | OFF | ON | ON | OFF | OFF | ON | ON |
| 206 | OFF | ON | ON | ON | OFF | OFF | ON | ON |
| 207 | ON | ON | ON | ON | OFF | OFF | ON | ON |
| 208 | OFF | OFF | OFF | OFF | ON | OFF | ON | ON |
| 209 | ON | OFF | OFF | OFF | ON | OFF | ON | ON |
| 210 | OFF | ON | OFF | OFF | ON | OFF | ON | ON |
| 211 | ON | ON | OFF | OFF | ON | OFF | ON | ON |
| 212 | OFF | OFF | ON | OFF | ON | OFF | ON | ON |
| 213 | ON | OFF | ON | OFF | ON | OFF | ON | ON |
| 214 | OFF | ON | ON | OFF | ON | OFF | ON | ON |
| 215 | ON | ON | ON | OFF | ON | OFF | ON | ON |
| 216 | OFF | OFF | OFF | ON | ON | OFF | ON | ON |
| 217 | ON | OFF | OFF | ON | ON | OFF | ON | ON |
| 218 | OFF | ON | OFF | ON | ON | OFF | ON | ON |
| 219 | ON | ON | OFF | ON | ON | OFF | ON | ON |
| 220 | OFF | OFF | ON | ON | ON | OFF | ON | ON |
| 221 | ON | OFF | ON | ON | ON | OFF | ON | ON |
| 222 | OFF | ON | ON | ON | ON | OFF | ON | ON |
| 223 | ON | ON | ON | ON | ON | OFF | ON | ON |
| 224 | OFF | OFF | OFF | OFF | OFF | ON | ON | ON |
| 225 | ON | OFF | OFF | OFF | OFF | ON | ON | ON |
| 226 | OFF | ON | OFF | OFF | OFF | ON | ON | ON |
| 227 | ON | ON | OFF | OFF | OFF | ON | ON | ON |
| 228 | OFF | OFF | ON | OFF | OFF | ON | ON | ON |
| 229 | ON | OFF | ON | OFF | OFF | ON | ON | ON |
| 230 | OFF | ON | ON | OFF | OFF | ON | ON | ON |
| 231 | ON | ON | ON | OFF | OFF | ON | ON | ON |
| 232 | OFF | OFF | OFF | ON | OFF | ON | ON | ON |
| 233 | ON | OFF | OFF | ON | OFF | ON | ON | ON |
| 234 | OFF | ON | OFF | ON | OFF | ON | ON | ON |
| 235 | ON | ON | OFF | ON | OFF | ON | ON | ON |
| 236 | OFF | OFF | ON | ON | OFF | ON | ON | ON |
| 237 | ON | OFF | ON | ON | OFF | ON | ON | ON |
| 238 | OFF | ON | ON | ON | OFF | ON | ON | ON |
| 239 | ON | ON | ON | ON | OFF | ON | ON | ON |
| 240 | OFF | OFF | OFF | OFF | ON | ON | ON | ON |
| 241 | ON | OFF | OFF | OFF | ON | ON | ON | ON |
| 242 | OFF | ON | OFF | OFF | ON | ON | ON | ON |
| 243 | ON | ON | OFF | OFF | ON | ON | ON | ON |
| 244 | OFF | OFF | ON | OFF | ON | ON | ON | ON |
| 245 | ON | OFF | ON | OFF | ON | ON | ON | ON |
| 246 | OFF | ON | ON | OFF | ON | ON | ON | ON |
| 247 | ON | ON | ON | OFF | ON | ON | ON | ON |
| 248 | OFF | OFF | OFF | ON | ON | ON | ON | ON |
| 249 | ON | OFF | OFF | ON | ON | ON | ON | ON |
| 250 | OFF | ON | OFF | ON | ON | ON | ON | ON |

*Fig. A.2 IQ Address Switch (S1) Settings from 126 to 250*