



Special Applications
Merlin ISP-100 Integrated Signal Processor
for Electro-Voice X-Array™ Install Loudspeakers

OWNERS MANUAL

Rev-A

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1. INTRODUCTION

This manual describes the use of the Merlin™ ISP-100 Integrated Signal Processor for use as an audio signal processing device for the Electro-Voice X-Array™ fixed installation systems (X-Array Install™). The Merlin ISP-100 is a general-purpose one-rack-height DSP-based device which provides capabilities for crossovers, filters, equalization, compressors/limiters, monitoring, gain setting, signal routing, and speaker excursion protection, among others. The Merlin ISP-100 is controlled by an attached PC connected to the ISP-100 through a serial connection. No Macintosh Software is available (or planned) at this time (Aug. 1998).

2. DESCRIPTION of X-ARRAY INSTALL SYSTEMS

Electro-Voice's X-Array Install™ series is a family of sound-reinforcement speakers based on EV's X-Array™ touring speaker systems. The X-Array Install systems are intended for small-to-medium sized array configurations and fixed installations of any size.

All the Electro-Voice X-Array Install loudspeaker systems can be controlled by the Merlin ISP-100. Various ISP-100 QuickMAPs™, projects, and associated QuickSETS™ (see the glossary section of the ISP-100 Software Guide for definitions of these terms) have been created to support each of the X-Array Install loudspeaker systems. In addition to normal crossover functions, the ISP-100 can provide driver overexcursion protection and amplifier clipping protection. These systems include models: Xi-1122/85, Xi-1152/64, Xi-1152/94, Xi-1153/64, Xi-1183/64, Xi-2153/64, Xi-2183/64, and Xi-1191.

These systems are described as follows:

2.1. X-Array Install Two-Way Systems

The X-Array Install two-way systems include models Xi-1122/85, Xi-1152/64, and Xi-1152/94. The two-way systems all have direct-radiator vented-box low-frequency enclosures. The smaller Xi-1122/85 uses a 12-inch woofer, while the larger Xi-1152/64 and Xi-1152/94 systems use a 15-inch woofer.

The Xi-1152 systems are offered in two different versions that offer either 60° (Xi-1152/64) or 90° horizontal coverage (Xi-1152/94). All the two-way systems have narrower HF vertical coverage (55° for the Xi-1122/85, and 40° for the Xi-1152/64, Xi-1152/94). All are crossed over at 1500 Hz.

The two-way systems are described as follows:

2.1.1. Xi-1122/85:

A 12-inch woofer two-way system with 80° x 55° constant-directivity HF horn and vented-box direct-radiator low end. Rated frequency response of 60 to 20,000 Hz.

Dimensions: 584 mm (23.00 in.) High (H), 375 mm (14.75 in.) Wide (W) (front), 199 mm (7.84 in.) W (back), 356 mm (14.00 in.) Deep (D).
Net weight: 31.3 kg (69 lb).

2.1.2. Xi-1152/64:

A 15-inch woofer two-way system with 60° x 40° rotatable constant-directivity HF horn and vented-box direct-radiator low end. Rated frequency response of 50 to 20,000 Hz.

Dimensions: 759 mm (29.88 in.) H, 450 mm (17.73 in.) W (front), 248 mm (9.75 in.) W (back), 413 mm (16.28 in.) D.

Net weight 40.8 kg (90 lb).

2.1.3. Xi-1152/94:

A 15-inch woofer two-way system with 90° x 40° rotatable constant-directivity HF horn and vented-box direct-radiator low end. Rated frequency response of 50 to 20,000 Hz. This system is identical to the previous Xi-1152/64 system but with wider horizontal coverage.

Dimensions: 759 mm (29.88 in.) H, 450 mm (17.73 in.) W (front), 248 mm (9.75 in.) W (back), 413 mm (16.28 in.) D.

Net weight 40.8 kg (90 lb).

2.2. X-Array Install Three-Way Systems

The X-Array Install three-way systems include models Xi-1153/64, Xi-1183/64, Xi-2153/64, and Xi-2183/64. All the three-way systems utilize the same mid-high module composed of a 12-inch-driver mid-bass horn and a coaxially mounted high-frequency horn coupled to a large-format compression driver.

The systems are offered in two different bass configurations: single woofer (Xi-1153/64, Xi-1183/64), and dual woofer (Xi-2153/64, and Xi-2183/64). The dual-woofer versions have the bass drivers located on opposite ends of the cabinet straddling the mid-high module.

The systems are further differentiated by the size of the woofer: 15 inch (Xi-1153/64, Xi-2153/64) and 18 inch (Xi-1183/64, Xi-2183/64). Note that the respective 15-inch- and 18-inch-woofer systems are exactly the same size and shape, i.e. the Xi-1153/64 and Xi-1183/64, or the 2153/64, and Xi-2183/64 look exactly the same from the outside. The systems only differ in woofer driver size and the details for mounting the drivers. The only way you can tell the difference between the systems from the outside is either by looking at the input panel label or by physically sticking your hand in the bass output slot and touching the drivers.

All the three-way systems have identical horizontal coverage. In addition above 800 Hz, all the three-way systems provide identical 60° (H) x 40° (V) coverage. Below 800 Hz, the vertical coverage of the three-way systems depends on the specific

system and the crossover used to drive it. The Merlin ISP-100 provides processing that allows the vertical coverage of the systems to be narrowed in the upper bass and lower midrange (see the following section on overlap versus non-overlap configurations for details).

The three-way systems are described as follows:

2.2.1. Xi-1153/64:

A 15-inch woofer three-way system with a 12-inch horn-loaded midrange driver and 60° x 40° rotatable constant-directivity HF horn. Rated frequency response of 50 to 20,000 Hz.

Dimensions: 914 mm (36.00 in.) H, 586 mm (23.07 in.) W (front), 354 mm (13.93 in.) W (back), 759 mm (29.88 in.) D.

Net weight 93.0 kg (205 lb).

2.2.2. Xi-1183/64:

An 18-inch woofer three-way system with a 12-inch horn-loaded midrange driver and 60° x 40° rotatable constant-directivity HF horn. Rated frequency response of 40 to 20,000 Hz.

Dimensions: 914 mm (36.00 in.) H, 586 mm (23.07 in.) W (front), 354 mm (13.93 in.) W (back), 759 mm (29.88 in.) D.

Net weight 93.0 kg (205 lb).

2.2.3. Xi-2153/64:

A dual 15-inch woofer three-way system with a 12-inch horn-loaded midrange driver and 60° x 40° rotatable constant-directivity HF horn. Rated frequency response of 40 to 20,000 Hz.

Dimensions: 1233 mm (48.54 in.) H, 586 mm (23.07 in.) W (front), 354 mm (13.93 in.) W (back), 759 mm (29.88 in.) D.

Net weight 113.4 kg (250 lb).

2.2.4. Xi-2183/64:

A dual 18-inch woofer three-way system with a 12-inch horn-loaded midrange driver and 60° x 40° rotatable constant-directivity HF horn. Rated frequency response of 40 to 20,000 Hz.

Dimensions: 1233 mm (48.54 in.) H, 586 mm (23.07 in.) W (front), 354 mm (13.93 in.) W (back), 759 mm (29.88 in.) D.

Net weight 113.4 kg (250 lb).

2.3. X-Array Install Subwoofer

2.3.1. Xi-1191:

A single 18-inch woofer vented-box subwoofer system. Rated frequency response of 37 to 160 Hz (normal mode) or 28 to 160 Hz (step-down mode).

Dimensions: 914 mm (36.00 in.) H, 586 mm (23.07 in.) W (front), 354 mm (13.93 in.) W (back), 759 mm (29.88 in.) D.

Net weight 72.1 kg (159 lb).

3. OVERLAP vs. NON-OVERLAP CONFIGURATIONS: A METHOD TO INCREASE DIRECTIVITY

3.1. Description

The three-way systems (Xi-1153/64, Xi-1183/64, Xi-2153/64, and Xi-2183/64) can be operated in standard three-way or overlap three-way configurations. Overlapping increases the system's directivity and decreases the vertical beamwidth in the important upper bass and lower midrange. It does this by overlapping the operating ranges of the woofer and midrange in the two-octave range between 125 and 500 Hz. This directivity increase much improves the lower-midrange punch of the system in reverberant and semireverberant environments.

Currently, the overlap configuration is offered only for the 15-inch woofer three-way systems (Xi-1153/64 and Xi-2153/64). A future release may include support for the 18-inch woofer three-way systems (Xi-1183/64 and Xi-2183/64).

As compared to the usual standard (non-overlap) three-way configuration where the systems woofer(s) is crossed over to the midrange at about 125 Hz, the overlap configuration lets the woofer(s) operate two-octaves higher in frequency up to about 500 Hz. This lets the woofer(s) and midrange both operate in the 125 to 500 Hz range at the same acoustical level and in phase with each other. This significantly narrows the vertical coverage of the system and increases the overall directivity because the effective acoustic source size is larger. The in-phase condition is very important because this minimizes lobing error and keeps the directional lobe faced straight ahead in the overlapped frequency region. The Merlin ISP-100's capability to provide all-pass filters greatly contributed to attaining this in-phase condition between the woofer and midrange.

3.2. Examples

The following graphs show the beamwidth versus frequency and directivity versus frequency data for the three-way systems operated in standard three-way and overlap three-way modes. These measurements were taken in EV's large anechoic chamber using an automated computer-operated polar measurement setup.

3.2.1. Xi-1153/64 and Xi-1183/64 Normal Three-way vs Overlap (Dipole) Three-way Operation

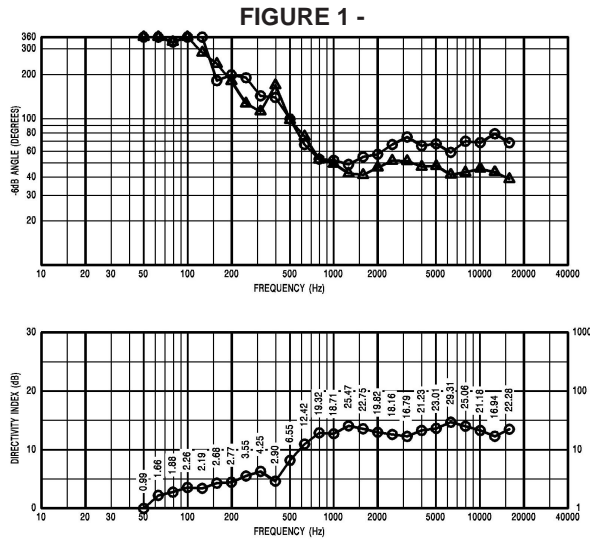
Figure 1 shows the beamwidth and directivity of the single-woofer three-way systems operating in the normal three-way configuration.

Figure 2 shows the data for the same systems operating in overlap mode.

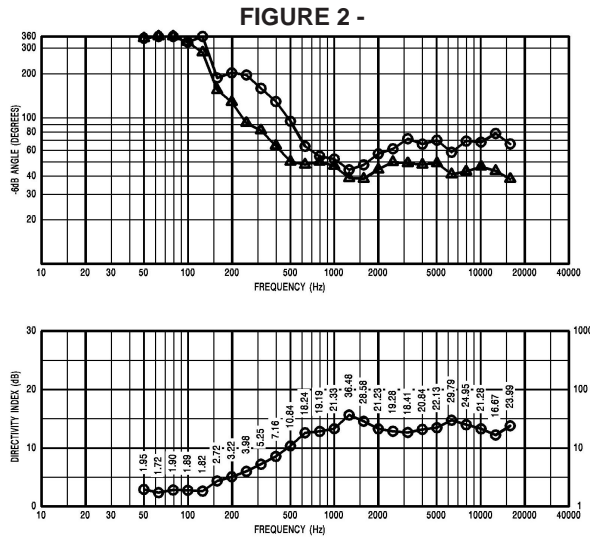
Discounting slight variations due to measurement repeatability, **Figures 1** and **2** show that the horizontal beamwidth is essentially the same for

○ = HORIZONTAL
 △ = VERTICAL

Xi-1153/64 & Xi-1183/64 3-Way Beamwidth & Directivity

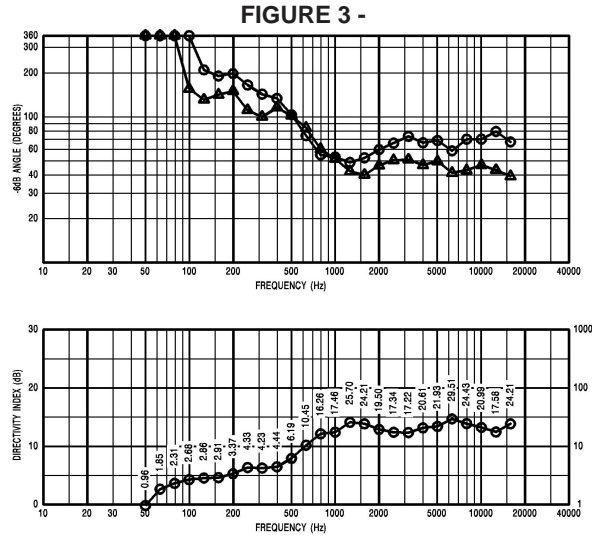


Xi-1153/64 & Xi-1183/64 Dipole Beamwidth & Directivity

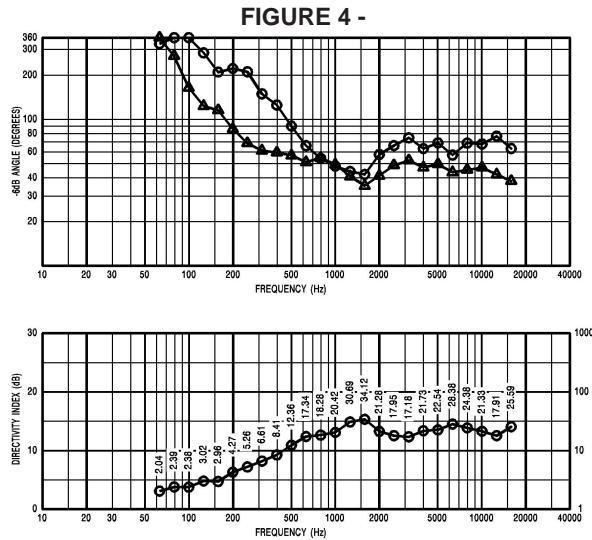


As with the previous data, no significant difference is noted in horizontal beamwidth. The vertical beamwidth however, decreases significantly between 160 and 800 Hz, reaching nearly 2 to 1 at 400 Hz. Some reduction in beamwidth is actually noted at 80 Hz. Directivity increases by nearly 3 dB between 315 to 630 Hz for the overlap mode.

Xi-2153/64 & Xi-2183/64 3-Way Beamwidth & Directivity



Xi-2153/64 & Xi-2183/64 Tripole Beamwidth & Directivity



both operating modes. The main effect of the overlap is a significant reduction in beamwidth between 160 and 800 Hz. Maximum reduction occurs between 250 and 500 Hz, where the beamwidth decreases by factors of about 1.4 to 2. Correspondingly, an increase in directivity ranging from 0.5 to 2.5 dB is noted over the same range for the overlap condition.

3.2.2. Xi-2153/64 and Xi-2183/64 Normal Three-way vs Overlap (Tripole) Three-way Operation

Figure 3 shows the beamwidth and directivity of the dual-woofer three-way systems operating in the normal three-way configuration. **Figure 4** shows the same systems operating in overlap mode.

4. QUICKMAPS

The QuickMAP defines the basic block structure, connectivity, and processing capability of the ISP-100 software and hardware. Note that the QuickMAP does not specify the individual parameters and settings of each of the blocks in the QuickMAP. These parameters are set by the user after a project is created that uses a specific QuickMAP. The parameters and settings are stored in various QuickSETs which are included with a specific project. In the next major section,

individual projects are defined that utilize the QuickMAPs described here.

Two QuickMAPs were created to support the X-Array Install systems, one for the two-way systems, and one for the three-way systems. The two-way QuickMAP includes capability for excursion protection of the compression driver, woofer and subwoofer drivers (see later section on Driver Excursion Protection). Due to resource limitations in the ISP-100, the three-way QuickMAP does not include excursion protection capability. However, broad-band limiters are provided on each output that do not specifically include side chain excursion filters. These broadband limiters do provide some excursion protection. In addition, all high-frequency outputs include look-ahead delays for their limiters that minimize the effects of short high-level transients. Separate delays for component offsets are also included on all high-frequency outputs.

Note that both QuickMAPs implement the crossovers with inline filters rather than using the ISP-100's QuickMAP native crossover block. This was done because this method uses fewer DSP resources and allows additional capabilities to be included in the QuickMAP.

4.1. Stereo Two-Way System with Dual Subwoofers

QuickMAP Name: XI-2WAY.QMS

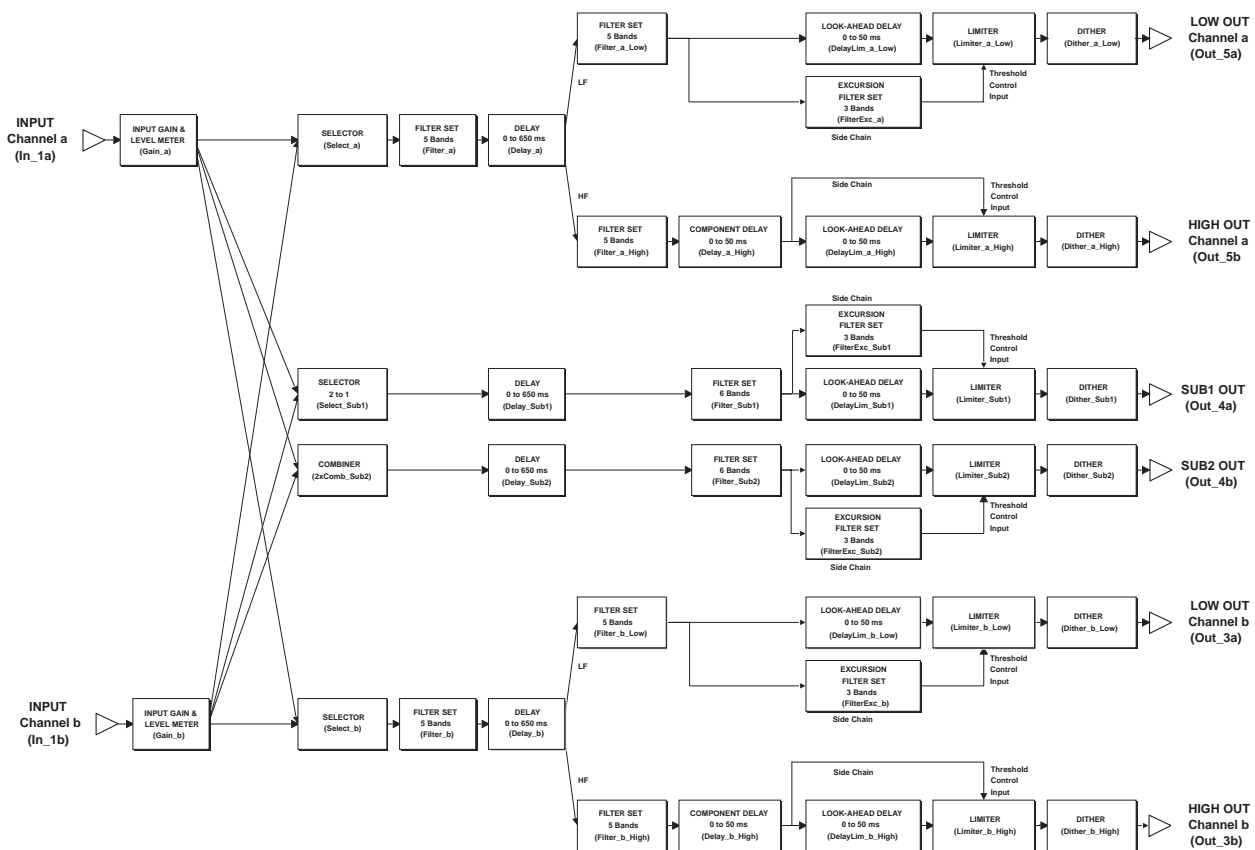
Figure 5 shows the two-way QuickMAP with all blocks and their capabilities indicated.

This QuickMAP contains two inputs and six outputs divided into a stereo-pair of two-way processing paths and two identical subwoofer paths (except for input selection). Although the latter paths are dedicated to subwoofers, they may be also be used as full-range paths with appropriate parameter changes. The dual two-way channels contain selectors to assign the channel to the right or left input.

A 0- to 650-ms delay and a five-band filter set are located before the crossover. This filter set is used for two purposes. The first is to provide a high-pass filter for the low-frequency woofer in the full-range system - which may function as a subsonic filter or a crossover filter when used with subwoofers. The second purpose is to provide equalization filters for tuning the loudspeaker system to the room.

The high-frequency channel contains a five-band filter, a 0- to 50-ms component offset delay, a 0- to 50-ms look-ahead delay, and a limiter.

FIGURE 5 - 2-Way Quick Map



The combination of the look-ahead delay and limiter provides excursion protection and reduction of short high-level peaks, but does not require side-chain equalization.

The LF channel contains a five-band filter set driving an excursion protection circuit. The excursion protection circuit includes a 0- to 50-ms look-ahead delay driving a limiter, which is connected to a 3-band side-chain excursion emulation filter (see the section on driver excursion protection for more information).

One of the subwoofer channels contains a two-to-one combiner to create an optional mono subwoofer feed. The other sub channel contains a selector to choose either right or left inputs. Both sub paths contain a 0- to 650-ms delay, a six-band filter, and excursion limiting circuit. This filter set is used to provide an infrasonic high-pass filter, a low-pass crossover filter, equalization and phase alignment for the subwoofers.

All outputs of the QuickMAP contain dither blocks to select the amount of dithering.

CAUTION: As with a conventional digital crossover/controller, the user may make minor adjustments to the factory QuickMAP parameters in the audio-path equalization filters and digital-output levels with minimal risk to the loudspeaker system. However, changing parameters in any of the protection-related blocks from the factory QuickSET values may result in driver failures. These include the limiter blocks, the side-chain filter blocks, and the look-ahead delay blocks.

4.2. Stereo Three-Way System with Dual Subwoofers

QuickMAP Name: XI-3WAY.QMS

Figure 6 shows this three-way QuickMAP with all blocks and their capabilities indicated.

This QuickMAP contains two inputs and eight outputs divided into a stereo-pair of three-way processing channels and two identical subwoofer paths (except for input selection). As with the two-way systems, the blocks prior to the crossover include a two-way selector, a 6-band filter set, and a 0- to 1350-ms delay. The filter block prior to the crossover is used to provide a high-pass filter for the low-frequency woofer in the full-range system - which may function as a subsonic filter or a crossover filter when used with subwoofers, and to provide equalization filters for tuning the loudspeaker system to the room.

The low- and mid-frequency channels contain eight-band filters, while the high-frequency channel contains a seven-band filter. All output channels contain broad-band limiters but no specific excursion protection blocks. The high-frequency path of each three-way channel also contains a

0- to 50-ms component offset delay and a 0- to 50-ms look-ahead delay (which provides look ahead capability for the following limiter). As pointed out before, the combination of the look-ahead delay and limiter provides some measure of excursion protection and also reduces short-term high-level peaks.

As with the two-way QuickMAP, the sub channels may also be used as full-range paths. As in the two-way systems, the filter block in the subwoofer channel is used to provide a subsonic high-pass filter, a low-pass crossover filter, equalization and phase alignment for the subwoofers. As before, one subwoofer channel contains a two-to-one combiner for optional mono bass, and the other a selector to choose either right or left inputs. Both subwoofer paths also contain a 0- to-1350 ms delay block, and a six-band filter.

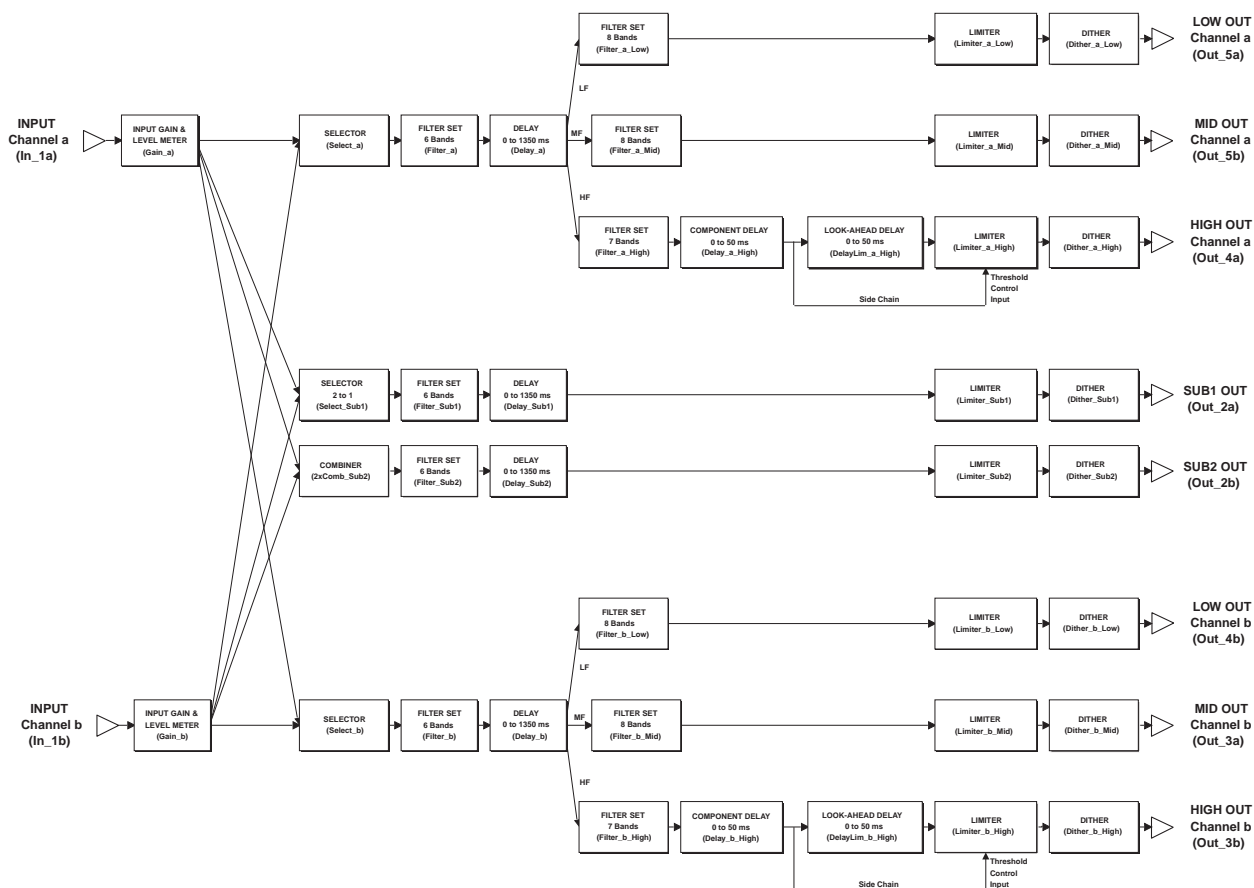
CAUTION: When using the three-way systems with a conventional three-way crossover (i.e., no overlap between the low and mid sections) the user may make minor adjustments to the factory QuickMAP parameters in the audio-path equalization and digital-output levels in any of the frequency bands with minimal risk to the loudspeaker system. When using the three-way systems with the overlap three-way crossover (i.e., where the low and mid sections overlap for increased directivity), the user must not make any changes to any of the factory QuickMAP parameters (crossover, level, equalization, phase) in the low and mid channels because it will upset the acoustic summation in the overlap region. Minor changes may be made, however, in the parameters in the audio-path equalization and digital-output levels in the subwoofer and high channels. In either the overlap or non-overlap configurations, changing limiter protection parameters (including limiter block, and look-ahead delay block) from the factory QuickSET values may result in driver failures.

4.3. QuickMAP Timing, System Synchronization, and Latency

Because of the digital nature of the ISP-100, the processor contains inherent delays, both fixed and user adjustable, which must be accounted for in speaker system and array setup and alignment. These delays are not only significant for woofer, midrange, and horn acoustic alignment in one specific system, but particularly important to consider when combining different types of systems such as two-way plus three-way, or woofers plus subwoofers, etc.

If these delays are not properly accounted for and/or properly set, it can have a quite detrimental impact on system frequency response and directional characteristics. Each of the QuickMAP

FIGURE 6 - 3-Way Quick Map



channels contain an inline delay before the crossover which can be varied over wide limits to compensate for speaker position, speaker characteristics, and other system parameters.

Each output of the QuickMAP also includes inherent delays which depend on the amount of processing that resulted in that particular output. Ideally, the inherent delays are the same on all the outputs, but sometimes they can not be made equal.

All outputs of the two-way QuickMAP have a latent delay of 10 sample periods (about 208 us).

Unavoidably however, the three-way QuickMAP has unequal latent output delays which are listed as follows:

1. Outputs a_Low, a_Mid, b_Mid, Sub1, and Sub2: 10 sample periods (about 208 us at the 48 kHz sample rate);
2. Outputs a_High and b_High: 12 sample periods (exactly 250 us);
3. Output b_Low: 13 sample periods (about 271 us).

To compensate for the additional delay on the high-frequency outputs, the component offset delay block settings have been reduced by two sample periods. The additional three-sample delay

in the low-frequency path of the “b” channel is uncompensated, but adds a negligible amount of delay to the woofer.

4.4. QuickMAP Input and Output Assignments

The inputs of both the two-way and three-way QuickMAPs have been assigned to module #1 of the ISP-100. Where possible, the remaining outputs follow the Merlin ISP-100 convention of assigning outputs in low- to high-frequency order, high- to low-number module order, and letter “a” to “b” order. When looking at the ISP-100 from the rear, this conveniently places the low-frequency outputs on the left and the remaining higher-frequency outputs proceeding left to right.

Both sub-channel outputs have been assigned to the same output module in each of the two QuickMAPs (module #4 for the two-way QuickMAP and module #2 for the three-way). If subwoofers are not used, these modules may be left out of the ISP-100, and need not be ordered. Note that gaps will exist in the module lineup if the sub channels module is not installed.

5. PROJECTS AND QUICKSETS

Individual ISP-100 projects for each of the X-Array Install systems were created that utilize the two previously mentioned QuickMAPs. Each of these projects contain one or more QuickSETS which define the individual parameters and settings of each of the blocks in the QuickMAP. This section shows each of these projects and the associated QuickSET parameters for each of the X-Array Install systems.

QuickSETS are included for each system for several different modes and combinations including:

1. without subwoofer,
2. with Xi-1191 subwoofer in both normal and step-down modes, and
3. conventional three-way and overlap three-way modes between woofer and midrange for the 15-inch woofer three-way projects (Xi-1153/64 and Xi-2153/64).

Future QuickSETS may contain overlap parameters for the 18-inch woofer three-way projects and also for overlapping the subwoofer with the two- and three-way projects. Refer to a previous section for more information on overlapping and its effects.

CAUTION: Although any or all of the parameter settings of each block may be easily modified, we highly suggest keeping the original factory-supplied settings intact so that the X-Array Install systems perform at their best. This is particularly true for the limiter/protection blocks (see additional cautions in the previous section).

The name of each QuickSET contains a four-letter code which indicates which of four alternate configurations are included. Each letter of the code can be either "Y" or "N", for yes or no. These alternate configurations include:

1. woofer-midrange overlap, which applies only to the three-way systems (first letter),
2. subwoofer-woofer overlap (second letter),
3. subwoofer step-down status (third letter), and
4. subwoofer in use (fourth letter).

Note that if a subwoofer is not being used, the woofer(s) of the two- or three-way system will be used down to their natural limits, rather than being high-passed at a higher frequency.

Although subwoofer-woofer overlap naming capability is included, QuickSETS for this operation are reserved for future release, and are not included here.

5.1 Two-Way Projects

These projects use QuickMAP: XI-2WAY.QMS

5.1.1. Stereo Xi-1122/85 with Dual Xi-1191 Subs

Project name: Xi-1122/85

5.1.1.1. *QuickSET for conventional two-way configuration with subwoofers having normal tuning*

QuickSET name: Xi-1122/85 NNNY

5.1.1.2. *QuickSET for conventional two-way configuration with subwoofers having step-down tuning*

QuickSET name: Xi-1122/85 NNYY

5.1.1.3. *QuickSET for conventional two-way configuration **without** subwoofers*

QuickSET name: Xi-1122/85 NNNN

5.1.2. Stereo Xi-1152/64 with Dual Xi-1191 Subs

Project name: Xi-1152/64

5.1.2.1. *QuickSET for conventional two-way configuration with subwoofers having normal tuning*

QuickSET name: Xi-1152/64 NNNY

5.1.2.2. *QuickSET for conventional two-way configuration with subwoofers having step-down tuning*

QuickSET name: Xi-1152/64 NNYY

5.1.2.3. *QuickSET for conventional two-way configuration **without** subwoofers*

QuickSET name: Xi-1152/64 NNNN

5.1.3. Stereo Xi-1152/94 with Dual Xi-1191 Subs

Project name: Xi-1152/94

5.1.3.1. *QuickSET for conventional two-way configuration with subwoofers having normal tuning*

QuickSET name: Xi-1152/94 NNNY

5.1.3.2. *QuickSET for conventional two-way configuration with subwoofers having step-down tuning*

QuickSET name: Xi-1152/94 NNYY

5.1.3.3. *QuickSET for conventional two-way configuration **without** subwoofers*

QuickSET name: Xi-1152/94 NNNN

5.2. Three-Way Projects

These projects use QuickMAP: XI-3WAY.QMS

5.2.1. Stereo Xi-1153/64 with Dual Xi-1191 Subs

Project name: Xi-1153/64

5.2.1.1. *QuickSET for conventional three-way configuration with subwoofers having normal tuning*

QuickSET name: Xi-1153/64 NNNY

5.2.1.2. *QuickSET for conventional three-way configuration with subwoofers having step-down tuning*

QuickSET name: Xi-1153/64 NNYY

5.2.1.3. *QuickSET for conventional three-way configuration **without** subwoofers*

QuickSET name: Xi-1153/64 NNNN

5.2.1.4. *QuickSET for mid overlap three-way configuration with subwoofers having normal tuning*

QuickSET name: Xi-1153/64 YNNY

5.2.1.5. *QuickSET for mid overlap three-way configuration with subwoofers having step-down tuning*

QuickSET name: Xi-1153/64 YNYY

5.2.1.6. *QuickSET for mid overlap three-way configuration **without** subwoofers*

QuickSET name: Xi-1153/64 YNNN

5.2.2. Stereo Xi-1183/64 with Dual Xi-1191 Subs

Project name: Xi-1183/64

5.2.2.1. *QuickSET for conventional three-way configuration with subwoofers having normal tuning*

QuickSET name: Xi-1183/64 NNNY

5.2.2.2. *QuickSET for conventional three-way configuration with subwoofers having step-down tuning*

QuickSET name: Xi-1183/64 NNYY

5.2.2.3. *QuickSET for conventional three-way configuration **without** subwoofers*

QuickSET name: Xi-1183/64 NNNN

5.2.2.4. *QuickSET for mid overlap three-way configuration with subwoofers having normal tuning*

QuickSET name: Xi-1183/64 YNNY

This QuickSET is not supplied at this time.

5.2.2.5. *QuickSET for mid overlap three-way configuration with subwoofers having step-down tuning*

QuickSET name: Xi-1183/64 NNYY

This QuickSET is not supplied at this time.

5.2.2.6. *QuickSET for mid overlap three-way configuration **without** subwoofers*

QuickSET name: Xi-1183/64 NNYN

This QuickSET is not supplied at this time.

5.2.3. Stereo Xi-2153/64 with Dual Xi-1191 Subs

Project name: Xi-2153/64

5.2.3.1. *QuickSET for conventional three-way configuration with subwoofers having normal tuning*

QuickSET name: Xi-2153/64 NNNY

5.2.3.2. *QuickSET for conventional three-way configuration with subwoofers having step-down tuning*

QuickSET name: Xi-2153/64 NNYY

5.2.3.3. *QuickSET for conventional three-way configuration **without** subwoofers*

QuickSET name: Xi-2153/64 NNNN

5.2.3.4. *QuickSET for mid overlap three-way configuration with subwoofers having normal tuning*

QuickSET name: Xi-2153/64 YNNY

5.2.3.5. *QuickSET for mid overlap three-way configuration with subwoofers having step-down tuning*

QuickSET name: Xi-2153/64 YNYY

5.2.3.6. *QuickSET for mid overlap three-way configuration **without** subwoofers*

QuickSET name: Xi-2153/64 YNNN

5.2.4. Stereo Xi-2183/64 with Dual Xi-1191 Subs

Project name: Xi-2183/64

5.2.4.1. *QuickSET for conventional three-way configuration with subwoofers having normal tuning*

QuickSET name: Xi-2183/64 NNNY

5.2.4.2. *QuickSET for conventional three-way configuration with subwoofers having step-down tuning*

QuickSET name: Xi-2183/64 NNYY

5.2.4.3. *QuickSET for conventional three-way configuration **without** subwoofers*

QuickSET name: Xi-2183/64 NNNN

5.2.4.4. *QuickSET for mid overlap three-way configuration with subwoofers having normal tuning*

QuickSET name: Xi-2183/64 YNNY

This QuickSET is not supplied at this time.

5.2.4.5. *QuickSET for mid overlap three-way configuration with subwoofers having step-down tuning*

QuickSET name: Xi-2183/64 YNYY

This QuickSET is not supplied at this time.

5.2.4.6. *QuickSET for mid overlap three-way configuration **without** subwoofers*

QuickSET name: Xi-2183/64 YNNN

This QuickSET is not supplied at this time.

6. DRIVER EXCURSION PROTECTION

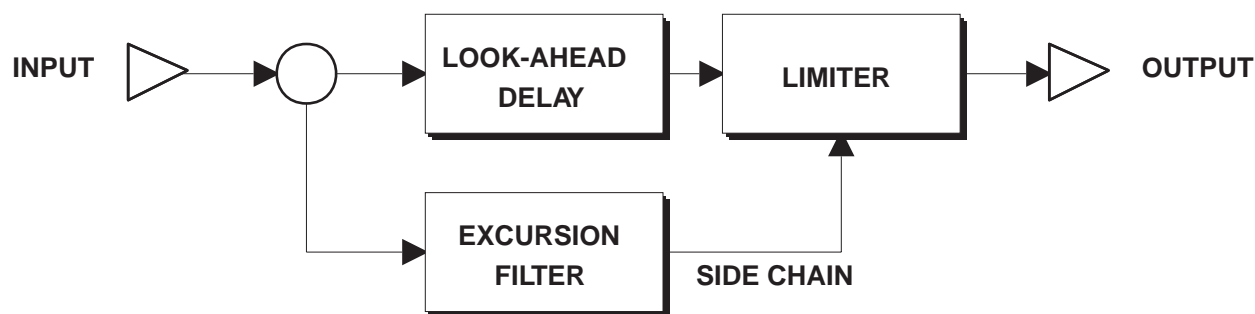
Driver excursion protection for the subwoofers and woofers is included in the two-way projects supplied here. Each two-way project's QuickSETs contain recommended excursion protection parameters to properly protect each driver. For proper protection, the power amplifier gain must be known in order to set the threshold levels of the protection limiters.

The protection method is explained in the following section.

6.1. Protection Method

Excursion protection is provided by an in-line limiter whose activation threshold is set by a side-chain excursion emulation filter. The excursion protection is provided by a combination of three

EXCURSION PROTECTION BLOCK DIAGRAM



blocks in the QuickMAP: a limiter, side-chain excursion filter and a look-ahead delay.

The blocks are connected as follows:

In the LF and subwoofer paths the limiter's threshold is controlled by the output of the side-chain excursion filter. This filter provides a model of the driver's excursion versus frequency (with a constant voltage sinewave applied), and is usually a second-order low-pass filter coupled with second-order boost-cut filters (PEQs). Effectively the limiter has a low limiting threshold at low frequencies (where the driver's excursion is high) and a high or non-existent threshold at high frequencies (where the excursion is low). A look-ahead delay is provided which optionally compensates for the delay of the excursion filter. This delay also helps the limiter to properly limit the first portion of any potential damaging waveform. The HF sections do not require a side-chain excursion filter set; effectively the excursion filter has a flat response.

6.2. Protection Parameters

This section describes the typical parameters for each of the blocks in the excursion protector block diagram.

6.2.1. Limiter

The limiter should be set for full peak limiting by setting the crest factor control to 1.0. Testing revealed that for best results, the limiter should be set to the fastest possible attack time of 0.02 ms, a fairly short release time of about 5 to 20 ms or less, and a soft knee.

The factory QuickSETs assume a power amplifier gain of 42 dB. Refer to the following section: "Setting the Limiter Threshold Level" for directions on setting the limiter threshold depending on the specific gain of your power amplifier.

CAUTION: Failure to properly set the limiter threshold level may result in driver failure.

6.2.2. Excursion Filter

The frequency response of the excursion filter is equal to the excursion versus frequency of the

speaker being protected when driven by a constant level sinewave. In general, the excursion filter is a second-order low-pass filter, with a corner frequency equal to the effective low-frequency limit of the speaker that is being protected. Excursion filters for vented-box enclosures have an additional cascaded high-Q PEQ dip filter centered at box resonance.

CAUTION: Changing these filter parameters from the factory QuickSET values may result in driver failure.

6.2.3. Look-Ahead Delay

The look-ahead delay roughly compensates for the delay of the low-pass filter portion of the excursion filter plus any additional delay required for best operation.

CAUTION: Changing these delay parameters from the factory QuickSET values may result in driver failure.

6.3. Gain Structure

The excursion protection is an open-loop method, i.e. it does not sense the output of the amplifier through any feedback scheme. Thus the gain structure from the Merlin ISP-100 through to the power amplifiers is extremely important for proper limiter protection operation. To properly set the excursion limiter threshold, the exact gain of the power amplifier must be known within ± 1 dB.

6.3.1. Power Amplifier Gain Setting

To prevent the ISP-100 from overloading before the speaker's limits are reached, the power amplifier must be set for high gain. This is done by setting the amplifier to its highest gain setting (usually its 0 dBU (0.775 V rms) for full output mode) and setting the amplifier's level control to a relatively high position. Note that the power amplifier's gain is only marginally high enough when it is set to the 26 dB gain setting. For a typical amplifier rated at about 500 watts per channel into 8 ohms, the gain in the 0-dBU mode is in the range of 38 to 42 dB with gain at the maximum position.

For proper driver protection, the power amplifier's gain must be known and the level controls not changed once the system is set up. Note that no harm will come from reducing the power amplifier's level below the set point, the limiters will only limit prematurely and thus reduce the available bass level. However if the gain is increased, you risk driver harm if high-level low-frequency energy is contained in the program material.

6.3.2. ISP-100 Output Gain Setting

The ISP-100 output gain should be left at its factory setting of 0 dB for proper operation of the limiter thresholds. Note! If the output gain is set to any other value, the gain difference must be taken into account when calculating the limiter threshold. For values lower than 0 dB, the limiter threshold must be increased by the same amount of decreased gain, and vice versa. For example: if the output gain is increased to 8 dB, the limiter threshold in that channel must be lowered by 8 dB.

6.4. Setting the Limiter Threshold Level

The new limiter threshold values may be determined in one of two ways:

1. by look-up table from the measured power amplifier output voltage with a known sinewave input, or
2. by calculation knowing the actual power amplifier gain in dB (known either by manufacturer's rating or by the measurement procedure that follows).

If the power amplifier gain is not known in advance, method one is somewhat easier because it does not require any calculation.

Note that all factory-supplied limiter thresholds are stored only in each system's Project QuickSETs. The values may be determined by loading a specific system's Project into the VUE-IT program and then single-clicking on a specific limiter.

CAUTION: The factory supplied limiter thresholds for each of the X-Array Install systems assume that the Merlin ISP-100 will be driving power amplifiers with a voltage gain of 42 dB (a voltage ratio of about 126). **Note that all limiter threshold values given in each of the system's QuickSETs assume a power amplifier gain of 42 dB.** This means that a just-out-of-the-box Merlin ISP-100, operating with the supplied Xi Install Projects, will properly protect the speakers in the Xi Install systems only when connected to a power amplifier with a gain of 42 dB! **All limiter thresholds must be readjusted if the ISP-100 drives an amplifier whose gain is not 42 dB.** If the amplifier's gain is less than 42 dB, it will not harm the drivers, it will only limit the maximum

output of the systems due to premature limiting. If the power amp gain is more than 42 dB, you risk driver failure.

These two methods are described in the following.

6.4.1. Threshold Determined by Lookup Table

The limiter threshold value may be determined by the following steps:

a. Set Power Amplifier Gain to Desired Setting:

Set the power amplifier to its highest gain setting (usually the 0 dBU for full output mode) with its level control at a high level. The power amplifier gain control should be set to halfway or higher so that the amplifier has enough gain (see comments in previous section). The highest gain settings may be undesirable due to amplification of noise and/or hum in the signal chain.

Note the position of the level control and the amplifier's input gain mode.

b. Apply Test Signal to Amplifier's Input:

Apply a sinewave signal of 0.100 V rms (100 mV) at 400 Hz to the amplifier's input. Any midband frequency in the range of 250 Hz to 1 kHz is OK as long as your measurement meter is accurate at the given frequency. For amplifier's with balanced inputs, make sure the measurement is taken across both the "+" and "-" inputs, and **not** from either "+" to ground or "-" to ground. If the measurement is taken at an XLR connector, this would be across pins 2 or 3 and **not** from pin 2 to pin 1 or pin 3 to pin 1.

We suggest using a high-quality battery operated digital voltmeter (DVM) or equivalent. This insures that the meter is effectively balanced and floating with respect to any grounds. Some inexpensive DVM's are notoriously inaccurate at low ac voltages or very high or low frequencies! Run the meter on its lowest most-sensitive ac scale, such as the 0- to 1.999-V or better the 0- to 0.1999-V scale, etc.

c. Measure Amplifier's Output Voltage:

Using the same meter you used in step 1, measure the power amplifiers output voltage. The speakers need not be connected or the amplifier loaded for this measurement (10 V ac into an X-Array Install system is loud!). Most modern amplifiers' output voltage will change very little with or without load at these levels.

Note this value.

d. Look Up Threshold in Table:

Using the measured amplifier output voltage determined in step 4, look up the threshold value in the following table by finding the intersection of the measured output voltage and the recommended threshold.

Merlin X-Array Install Manual

TABLE - LIMITER THRESHOLD SETTINGS

- DIRECTIONS:**
1. Set power amplifier gain to desired setting.
 2. Apply sinewave signal of 0.100 V rms (100 mV) at 400 Hz to amplifier input.
 3. Measure amplifier output voltage.
 4. Lookup new threshold in table:
 - a. Find your measured amplifier output voltage in the left column.
 - b. Locate the factory recommended threshold in the top row.
 - c. Find the new threshold at the intersection of the two values.
 5. Example: Assume the factory recommended threshold is -24 dB and you measure an output voltage of 6.3 V rms. The new threshold is then -18 dB (indicated in table).

MEASURED
AMPLIFIER
OUTPUT
VOLTAGE
V rms
(Down)

FACTORY RECOMENDED
THRESHOLD (Across)
dB →

	-50	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10
40.0	-60	-58	-56	-54	-52	-50	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20
35.7	-59	-57	-55	-53	-51	-49	-47	-45	-43	-41	-39	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19
31.8	-58	-56	-54	-52	-50	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18
28.3	-57	-55	-53	-51	-49	-47	-45	-43	-41	-39	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17
25.2	-56	-54	-52	-50	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16
22.5	-55	-53	-51	-49	-47	-45	-43	-41	-39	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15
20.0	-54	-52	-50	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14
17.9	-53	-51	-49	-47	-45	-43	-41	-39	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13
15.9	-52	-50	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12
14.2	-51	-49	-47	-45	-43	-41	-39	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11
12.6	-50	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10
11.3	-49	-47	-45	-43	-41	-39	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11	-9
10.0	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8
8.95	-47	-45	-43	-41	-39	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11	-9	-7
7.98	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6
7.11	-45	-43	-41	-39	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11	-9	-7	-5
6.34	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4
5.65	-43	-41	-39	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11	-9	-7	-5	-3
5.04	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2
4.49	-41	-39	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11	-9	-7	-5	-3	-1
4.00	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0
3.57	-39	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11	-9	-7	-5	-3	-1	
3.18	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	
2.83	-37	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11	-9	-7	-5	-3	-1		
2.52	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0		
2.25	-35	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11	-9	-7	-5	-3	-1			
2.00	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0			
1.79	-33	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11	-9	-7	-5	-3	-1				
1.59	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0				
1.42	-31	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11	-9	-7	-5	-3	-1					
1.26	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0					
1.13	-29	-27	-25	-23	-21	-19	-17	-15	-13	-11	-9	-7	-5	-3	-1						
1.00	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0						

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6.4.2. Threshold Calculation Given Amplifier Gain

The limiter threshold may be determined by direct calculation given the gain of the power amplifier in dB. The gain may be known by manufacturer's rating or by direct measurement using the following method.

6.4.2.1. Measuring Power Amplifier Gain

After setting the power amplifier gain control to the desired operating position, its gain must be measured accurately (see previous comments). The power amplifier gain may be measured by energizing the amplifier with sinewave signal (with frequency in the range of 250 Hz to 1 kHz) and then measuring the input and output voltages with an AC voltmeter (see previous meter comments). The gain is then determined by dividing the measured output voltage by the measured input voltage and then converting to dB. We suggest driving the amplifier with a signal 0.050 to 0.100 V rms (50 to 100 mV rms).

Example:

Assume that you measure an output voltage of 2.91 V rms when a signal of 0.05 V rms is applied. The gain is therefore 2.91 divided by 0.05 or 58.2. This may be converted to dB by taking the log and multiplying by 20 (using a scientific hand calculator or equivalent). A value of 35.3 dB results (20 times the log of 58.2).

6.4.2.2. Threshold Setting Determined from Power Amplifier Gain

Using the previously determined amplifier gain value in dB, the limiter's threshold may be calculated from the factory recommended values given in the QuickSETS described earlier. The given threshold values assume a power amplifier gain of 42 dB.

If your power amplifier gain is different from the assumed gain, a new threshold value must be calculated. If your amplifier gain is greater than the assumed value, the recommended threshold must be reduced by the exact amount of dBs that your amplifier exceeds the assumed gain, and vice versa.

Example:

The recommended limiting threshold is -25 dB and your measured amplifier gain is 45 dB. Because the measured gain is 3 dB higher than the assumed gain of 42 dB, the threshold must be reduced by 3 dB yielding -28 dB. Conversely, if your measured gain was only 28 dB, 14 dB lower than assumed 42 dB gain, the threshold must be increased by 14 dB yielding -11 dB.

7. SOFTWARE AVAILABILITY

The X-Array Install Merlin ISP-100 setup software and manual is available three different ways: 1.

direct from the factory, 2. by download from the INTERNET (with manual in PDF format), or 3. bundled with each new Merlin ISP-100. These methods are described as follows.

7.1. Direct from Factory

For current owners of the Merlin ISP-100, the disk and manual may be obtained by writing or faxing:

Technical Support Department
Electro-Voice X-Array Speaker Systems
Telex Communications, Inc.
128 E. Front St.
Buchanan, MI 49107
(800) 234-6831 (Voice)
(616) 695-6831 (Voice)
(616) 695-9626 (Fax)

7.2. Download from the INTERNET

The files may be downloaded from the INTERNET at www.electrovoice.com or www.eviaudio.com/merlin

7.3. Bundled with New Merlin ISP-100

The manual and software are included with each new Merlin ISP-100. To place an order for a new Merlin ISP-100 contact your local authorized Merlin sales representative.

8. INSTALLATION

After first installing the Merlin VUE-IT software following the instructions in the Merlin ISP-100 Software Guide and familiarizing yourself with its contents, the following steps describe how to load the X-Array Install Merlin ISP-100 QuickMAPS and Projects software:

8.1. Loading the Software

1. Close all programs before beginning installation.
2. Insert the disk labeled "ELECTRO-VOICE X-ARRAY INSTALL SOFTWARE FOR THE MERLIN ISP-100" into your 3.5-inch floppy disk drive.
3. Windows 95 users should click on the Start button and select Run.
4. Windows 3.1x users should click on File and select Run.
5. Type "A:\setup.exe" (Substitute the appropriate drive letter for the floppy drive for your system.)
6. Click on the OK button and follow the instructions as they appear on the screen.

This installation procedure will install the new QuickMAP files into your ISP-100 "Qmaps" folder (directory), and install all the new project files into your ISP-100 "Projects" folder. Please refer to the following section titled "VUE-IT File System" to find the default locations of these folders.

Merlin X-Array Install Manual

9. OPERATION

Assuming that the new X-Array Install Merlin ISP-100 Projects and QuickMaps have been properly installed as described in the previous section, the following procedure should be followed to start an appropriate project to configure the ISP-100 for an X-Array Install system on your PC (additional information is found in the ISP-100's hardware and software manuals):

1. Connections:

Connect the PC and Merlin ISP-100 together **with a serial cable. If you use the front serial port on the ISP-100, you will need a DB-9 Male to DB-9 Female cable.**

2. Start the Vue-It™ Program:

If you haven't created a short cut on your desktop, the Vue-It program may be typically found in the following directory: C:\PROGRAMS\ISP-100\VUE-IT\. Double click on the Vue-IT icon to start the program. The program should indicate that the ISP-100 is "On Line" in the lower right of the screen.

3. Open the Desired Project:

On the file menu select "Open Project". Navigate to the directory C:\PROGRAMS\ISP-100\VUE-IT\PROJECTS\ "Project Name". Where "Project Name" is the name of your project such as "Xi-1152" etc. Double click on the .VUE project name. When the project opens after about 30 seconds, you should hear the relays click in the ISP-100. The ISP-100 is now operational.

5. Connect Audio Inputs and Outputs

Connect the ISP-100's audio inputs and outputs to the appropriate auxiliary equipment. Refer to the previous QuickMAP section and figures to determine the appropriate XLR jacks on the rear of the ISO-100.

Refer to the ISP-100 manuals that came with your unit for more detailed information.

10. TECHNICAL SUPPORT

For applications assistance and/or technical information on the ISP-100 and its related hardware and/or software, write, fax, or call:

Customer Service Department - Merlin
Telex Communications, Inc.
9600 Aldrich Ave. South
Minneapolis, MN 55420

(612) 884-4051 (Voice)

(612) 884-0043 (Fax)

For applications assistance and/or information on the X-Array Install systems or the relevant information in this manual, write, fax, or call:

Technical Support Department
Electro-Voice X-Array Speaker Systems
Telex Communications, Inc.
128 E. Front St.
Buchanan, MI 49107
(800) 234-6831 (Voice)
(616) 695-6831 (Voice)
(616) 695-9626 (Fax)

11. VUE-IT File System

The following information is taken from the Merlin ISP-100 Software Guide and is provided for convenient reference.

11.1. Files Used by VUE-IT Projects

Project File: <File Name>.VUE
Project QuickMAP File: <File Name>.QMS
Project QuickSET File: <File Name>.QMO
Project GPI Settings: <File Name>.GPO

11.2. Location of Files

By default, the file structure used by VUE-IT is as follows:

QuickMAP Templates:

C:\PROGRAMS\VUE-IT\QMAPS\

Project Files:

C:\PROGRAMS\VUE-IT\PROJECTS\<Directory Name>\

11.3. Archiving Projects

To save a project for archival purposes, you must save the project folder (directory) that contains the four files named in the Files Used by VUE-IT Projects section. The <File name> and <Directory Name> will be the name you assigned to the project.

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