DDL 11
Digital Delay Line

operation manual

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INTRODUCTION

The Advantage DDL 11 Digital Delay Line utilizes DSP technology to provide a one input/one output, single-tap delay for time alignment of remote and under-balcony speaker systems. The DDL 11 is simple to operate, includes a security cover to prevent tampering, and is covered by an Advantage Five-Year "Gold Seal" Warranty.

DDL 11 features include:

- single rack space, 1-in/1-out, single-tap digital delay line
- new digital design technology provides CD quality audio
- DSP technology with 16 bit Sigma-Delta A/D conversion
- 48kHz sampling rate utilizing 64x oversampling
- delay time selectable from 0 to 1.023 seconds
- delay time selectable in 1 milli-second increments
- short delay mode selectable for speaker driver alignment
- bypass mode selectable for direct/delay comparisons
- balanced input and output on barrier strip connectors
- signal present and peak indicators on front panel
- screwdriver adjustable input and output level controls
- delay time selectable with front panel DIP switches
- see-through security cover protects controls from tampering
- covered by Advantage Five-Year "Gold Seal" Warranty
- CE marked and UL / C-UL listed power source

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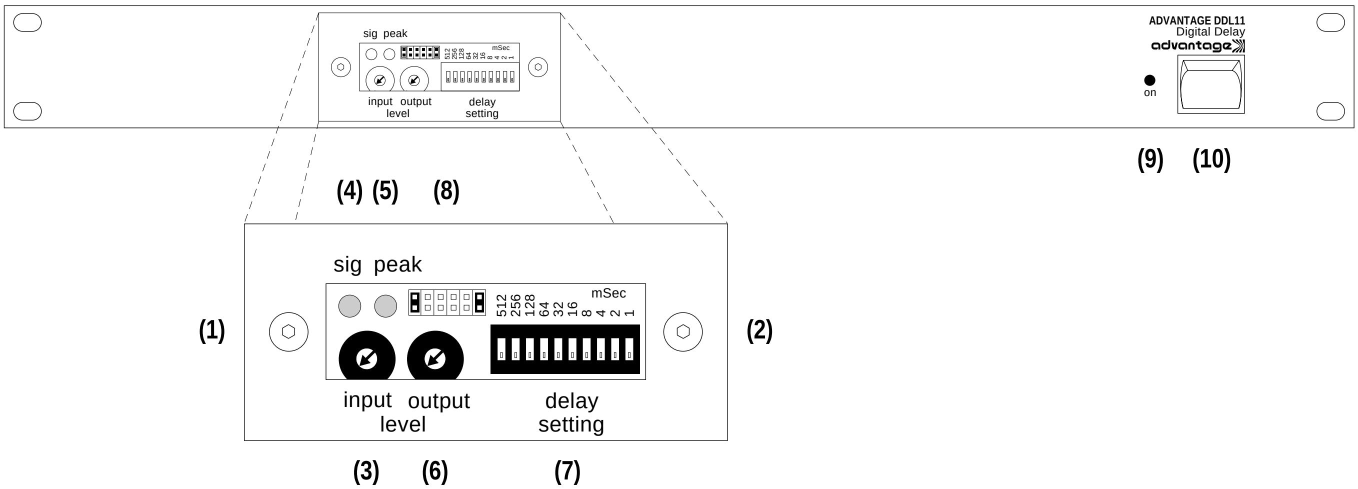
After reading this manual, if you have any questions or need technical assistance, please call Biamp Systems toll-free (1-800-826-1457).

FRONT PANEL FEATURES



(1)(2) Security Cover Mounting Screws: These two hex screws fasten the see-through security cover to the front panel. The security cover must be removed to adjust any of the front panel controls. A 5/64" allen wrench is provided.

(3) Input Level Control: This screwdriver adjustable control sets the input level (-60dB to +6dB of gain), to compensate for different input signal levels. The Input Level Control should be adjusted so the internal A/D converter is working full-scale, providing the best signal-to-noise without distortion. Proper adjustment of input level is achieved by turning this control up (clockwise) until the Peak Indicator (5) begins to flash. Then turn the control down (counter-clockwise) *only slightly*, until the Peak Indicator no longer flashes.

(4) Signal Present (Sig) Indicator: This green LED indicates signal is present at the input. Once the Input Level Control is properly adjusted, the Signal Present Indicator will remain lit whenever signal levels of -24dB or greater reach the A/D converter. If this indicator does not light, please check signal connections and Input Level Control adjustment.

(5) Peak Indicator: This red LED indicates the internal A/D converter is working full-scale (+4dB max.). Use this indicator only as an aid in adjusting the Input Level Control. If the Peak Indicator flashes on normal signal levels, then the Input Level Control should be properly re-adjusted to avoid distortion.

(6) Output Level Control: This screwdriver adjustable control sets the output level (-50dB to +18dB of gain), to provide proper level to the sound system. Once the Input Level Control is properly adjusted, set the Output Level Control for the desired system level. To aid in adjustment of the Output Level Control, comparison of input level to output level may be made by turning power off. When power is turned off, an internal relay passes input signal directly through to the output. When power is then turned on, the Output Level Control can be adjusted for an equivalent level (unity gain).

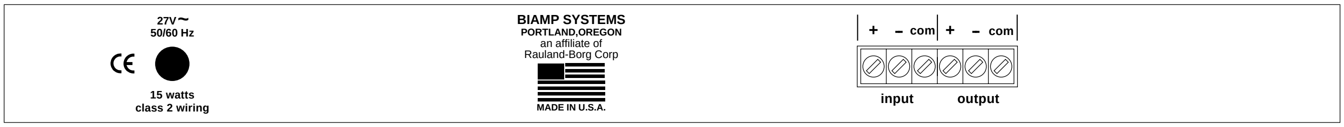
(7) Delay DIP Switches: These ten DIP switches are used to select the desired delay time (see Calculating Delay Times on page 4). To select a delay time, raise the corresponding switch(es) using a small screwdriver or other implement. The Delay DIP Switches provide an *additive* delay time. Raising multiple switches will provide a delay time which is the sum of all switches selected. For example, raising the "1mSec", "2mSec", and "4mSec" switches provides a delay time of 7mSec. Likewise, raising all switches provides the maximum delay time of 1.023 seconds. Standard minimum delay time increments are 1 milli-second (see Short Delay Jumper below).

(8) Bypass & Short Delay Jumpers: Two movable jumpers are provided on the front panel. These jumpers may be removed using needle-nose pliers. When removed, Jumper #1 (far left) provides a delay bypass. This allows comparison of the direct signal and the delayed signal. After comparisons, always make sure this jumper is properly re-installed. When removed, Jumper #6 (far right) provides shorter minimum delay time increments (20.8 micro-seconds). This allows shorter *and more precise* delay time adjustments for speaker driver alignment applications. However, when using the short delay mode, it should be noted that the minimum delay time (all switches down) is still 764 micro-seconds. The Delay DIP switches are still operational, but are based on delay time increments of 20.8 micro-seconds. For example, raising the "1mSec" switch provides a delay time of 784.8 micro-seconds. Likewise, raising all switches provides a maximum delay time of 22.0424 milli-seconds.

(9) On Indicator: This red LED indicates power is turned on

(10) Power Switch: When turned on, this switch applies power to the unit. When this switch is turned off, an internal relay passes input signal directly through to the output. Turning power off may be used to compare direct and delayed signals. However, with power off, the Input & Output Level Controls will have no effect (causing level differences). In unity gain systems, this approach may be used to set proper output level.

REAR PANEL FEATURES



(1) (2) (3)

(1) AC Power Cord: The external power transformer provides 27 Volts AC to the DDL11, and is detachable via a 5-pin DIN connector. The DDL11 has two internal 1 amp normal blow (1A NB) fuses. If these fuses should require replacement, use same value and type fuses only.

(2) Input Terminals: These three screw terminals are for connection of balanced signals from line level devices, such as mixers, distribution amplifiers, etc. If unbalanced input is desired, connect signal to (+) and ground to both (-) & (com). This input will accept either -10dBu or +4dBu nominal levels. Input Impedance is 20kΩ. Maximum input level is +24dBu.

(3) Output Terminals: These three screw terminals are for connection of balanced signals to line level devices, such as equalizers, amplifiers, etc. If unbalanced output is desired, connect signal to (+) and ground to both (-) & (com). This output will provide either -10dBu or +4dBu nominal levels. Output Impedance is 200Ω. Maximum Output is +18dBu.

CALCULATING DELAY TIMES

NOTE: *PC Control Software is available from Biamp Systems, which includes a program for calculating delay times and switch settings.*

Before calculating a delay time, you should begin with some preliminary calculations. First, determine the typical (or average) air Temperature for the location. Using this air temperature, you can then accurately calculate the Velocity (speed) of sound. Next you have determined the Distance between the direct and delayed sound sources. An accurate delay Time can then be calculated. The following tables show the actual mathematic equations needed to calculate delay time.

AMERICAN SYSTEM		METRIC SYSTEM	
Temperature (Fahrenheit) = °F	Velocity (feet/second) = V	Temperature (Celsius) = °C	Velocity (meters/second) = V
Distance (feet) = D	Time (milli-seconds) = T	Distance (meters) = D	Time (milli-seconds) = T
$V = 49 \times \sqrt{459.4 + °F}$	$T = D \div V$	$V = 20.06 \times \sqrt{273 + °C}$	$T = D \div V$

Some additional factors must be considered before actually making delay settings:

1) For best accuracy, Distance should be calculated as the *difference* between the direct and delayed sound sources, with respect to the listener (i.e...direct source to listener = 200 feet; delayed source to listener = 20 feet; Distance = 200'-20' = 180 feet).

2) When sounds from the direct source and the delayed source reach the listener at roughly the same volume level, additional delay of approximately 20 milli-seconds may be added to the delay time calculation. This added delay time will produce what is known as the Haas Effect. The Haas Effect will give the listener the impression that all sound is eminating from the direct sound source (i.e...calculated delay time = 159 milli-seconds; Haas Effect = 20 milli-seconds; delay time setting = 179 milli-seconds).

3) Calculations are necessary to determine proper delay time settings. However, it should be remembered that they are only accurate for a specific listening position (distance), and at specific temperature/velocity. Therefore, "fine tuning" the delay setting by ear is often times the best final adjustment. It may also be acceptable (in some applications) to make calculations assuming a Temperature of approximately 72°F (23°C) and, therefore, Velocity of 1130 feet/second (345 m/sec).

For more information on calculating delay times, see Sound System Engineering by Don Davis & Carolyn Davis, Howard W. Sams & Co.

The following examples include a description of an application, delay time calculations, and actual delay settings.

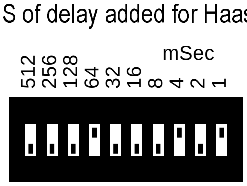
EXAMPLE #1

Application: A church with reinforcement near the front and under-balcony speakers towards the rear (see Applications on page 6).

Calculations:

American:	°F = 72° (approx.)	V = 1130 ft/sec (approx.)	D = (60 – 5) = 55ft	T = (55 ÷ 1130) = 49mS
Metric:	°C = 23° (approx.)	V = 345 m/sec (approx.)	D = (18.3 – 1.5) = 16.8m	T = (16.8 ÷ 345) = 49mS

Settings: Delay time settings include approximately 20mS of delay added for Haas Effect. T = (49mS + 20mS) = 69mS.



CALCULATING DELAY TIMES

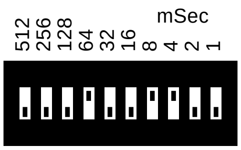
EXAMPLE #2

Application: A large banquet room with low ceilings, having reinforcement both towards the front and rear (see Applications on page 7).

Calculations:

American:	°F = 75° (estimated)	$V = 49 \times \sqrt{459.4+75} = 1132.7$ ft/sec	D = (75 – 12) = 63ft	T = (63 ÷ 1132.7) = 56mS
Metric:	°C = 24° (estimated)	$V = 20.06 \times \sqrt{273+24} = 345.7$ m/sec	D = (22.9 – 3.7) = 19.2m	T = (19.2 ÷ 345.7) = 56mS

Settings: Delay time settings include approximately 20mS of delay added for Haas Effect. T = (56mS + 20mS) = **76mS**.



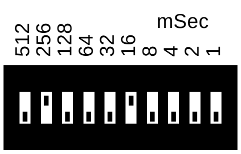
EXAMPLE #3

Application: An outdoor sports field, with reinforcement for bleachers on both sides of field (see Applications on page 8).

Calculations:

American:	°F = 55° (average)	$V = 49 \times \sqrt{459.4+55} = 1111.3$ ft/sec	D = (360 – 80) = 280ft	T = (280 ÷ 1111.3) = 252mS
Metric:	°C = 13° (average)	$V = 20.06 \times \sqrt{273+13} = 339.3$ m/sec	D = (109.7 – 24.4) = 85.3m	T = (85.3 ÷ 339.3) = 252mS

Settings: Delay time settings include approximately 20mS of delay added for Haas Effect. T = (252mS + 20mS) = **272mS**.



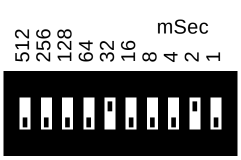
EXAMPLE #4

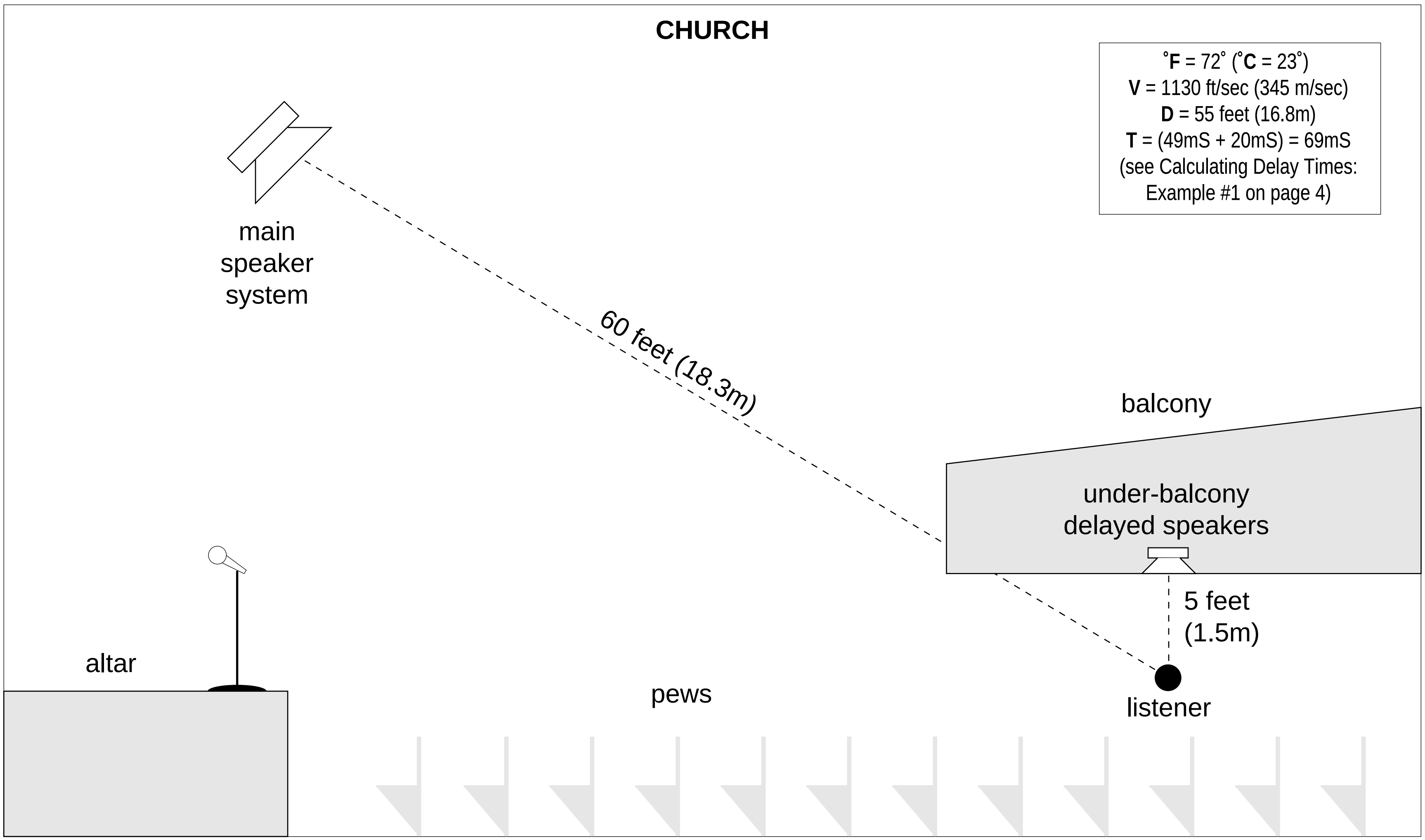
Application: Driver alignment in a two-way speaker system, utilizing the "short delay" mode (see Applications on page 9).

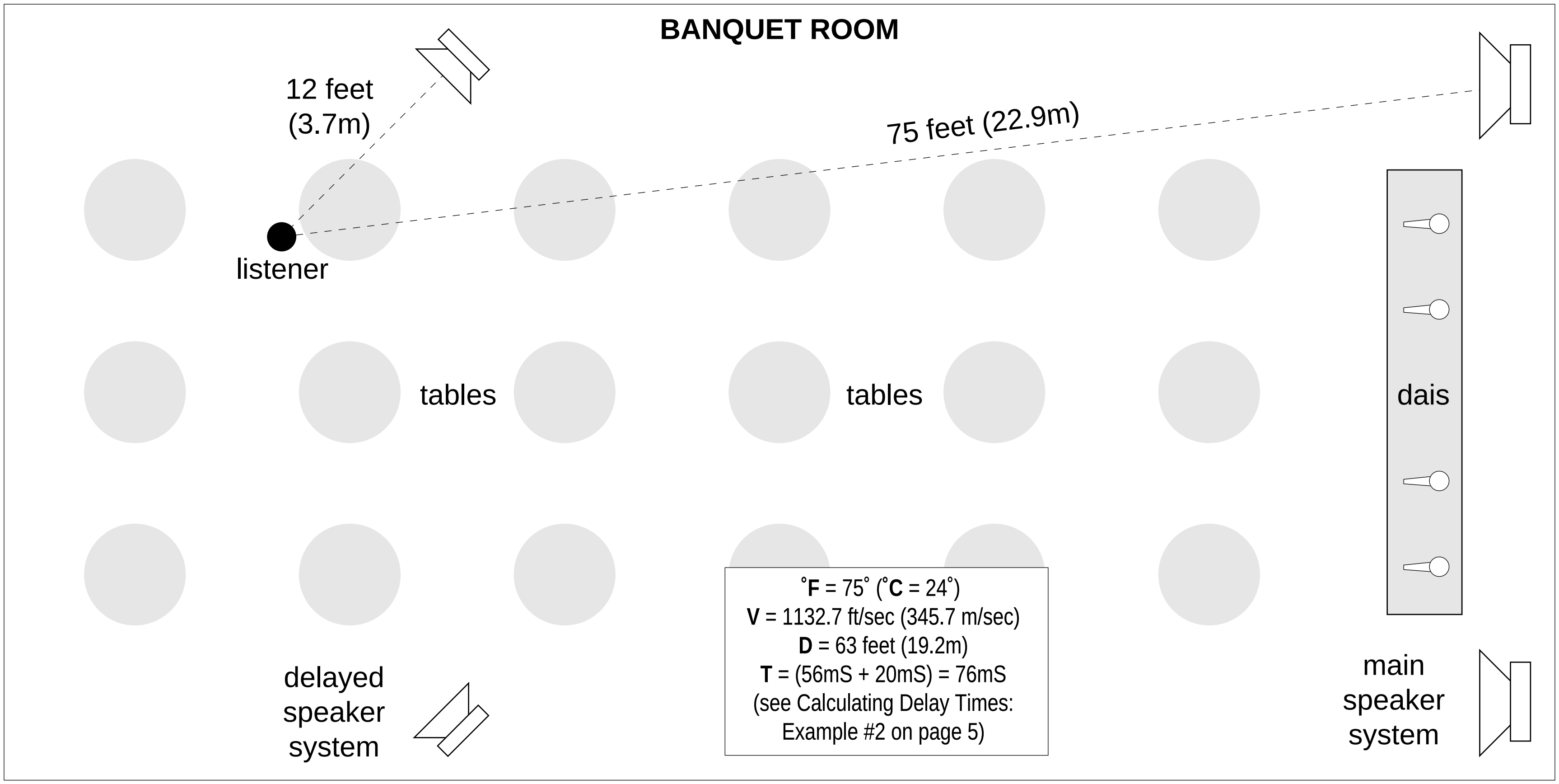
Calculations:

American:	°F = 80°	$V = 49 \times \sqrt{459.4+80} = 1138$ ft/sec	D = 1.666ft	T = (1.666 ÷ 1138) = 1464µS
Metric:	°C = 27°	$V = 20.06 \times \sqrt{273+27} = 347$ m/sec	D = .508m	T = (.508 ÷ 347) = 1464µS

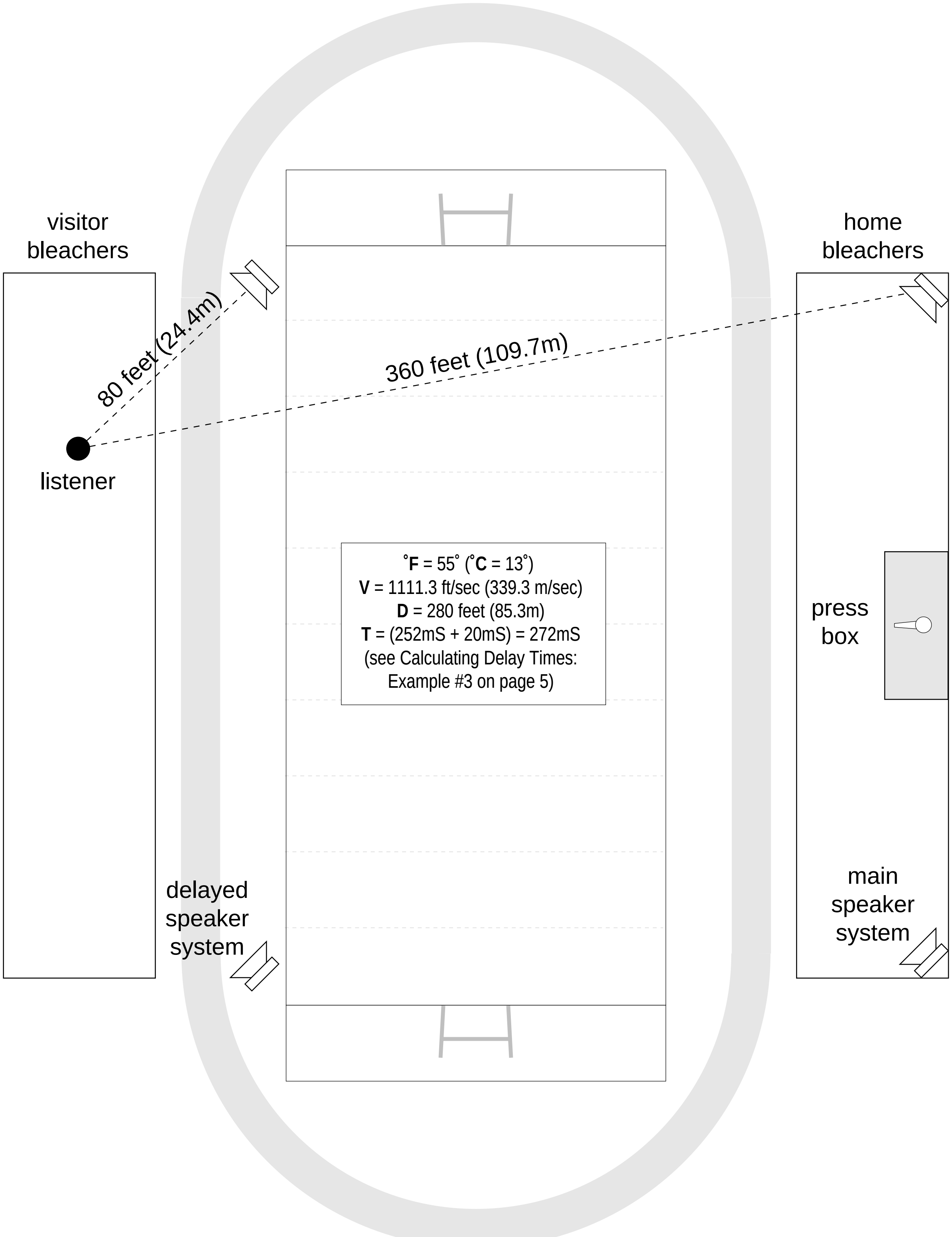
Settings: Delay times in "short delay" mode are set in increments of 20.8µS (above the 764µS decimation delay). Therefore, the calculated delay time (minus 764µS) should be divided by 20.8, to determine the number of increments to select via the DIP switches.
T = (1464 – 764) ÷ 20.8 = (700 ÷ 20.8) = **34 increments**.



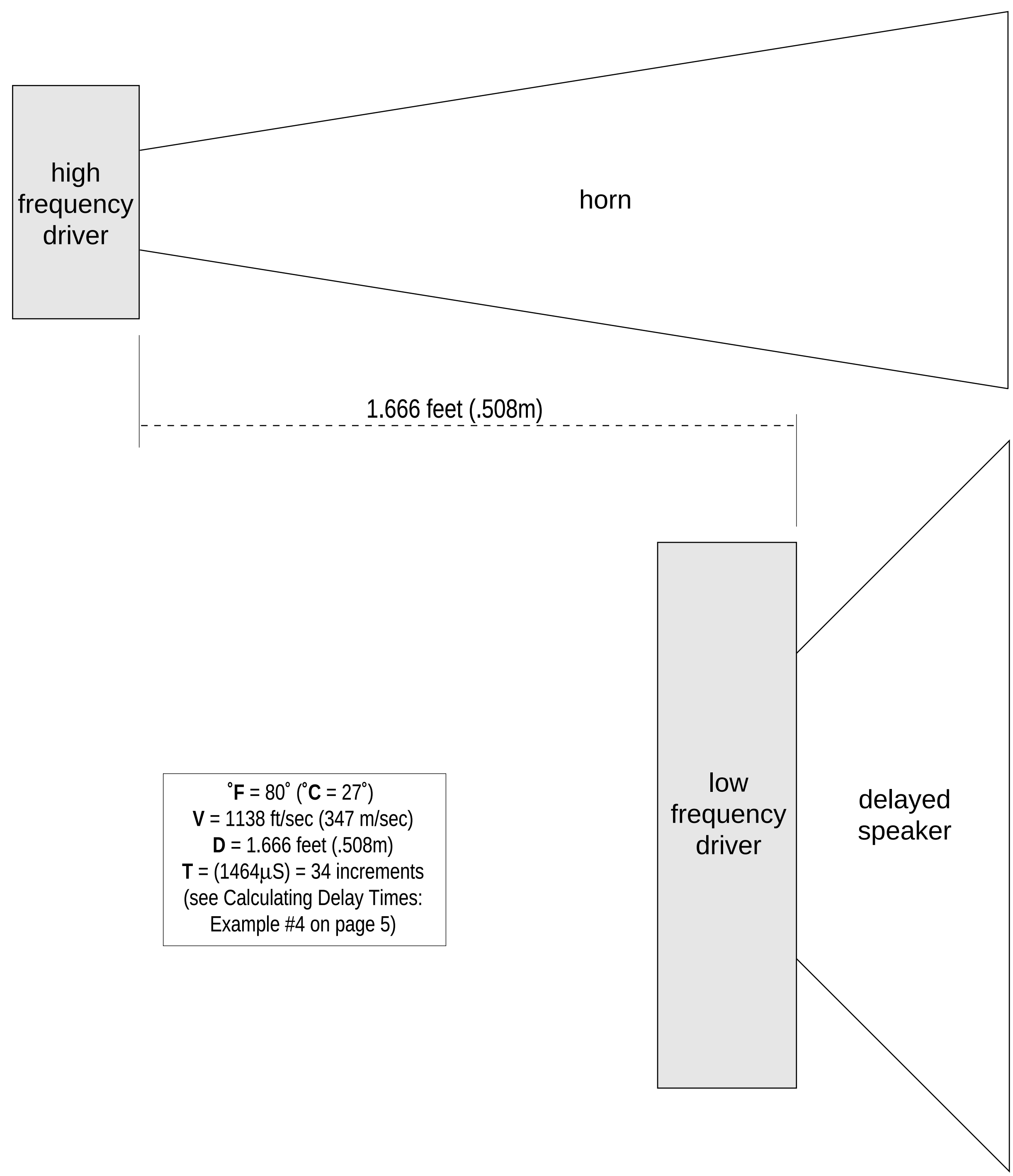

CHURCH
˚F = 72˚ (˚C = 23˚)
V = 1130 ft/sec (345 m/sec)
D = 55 feet (16.8m)
T = (49mS + 20mS) = 69mS
(see Calculating Delay Times: Example #1 on page 4)
main speaker system
60 feet (18.3m)
balcony
under-balcony delayed speakers
5 feet (1.5m)
altar
pews
listener


BANQUET ROOM
12 feet
(3.7m)
75 feet (22.9m)
listener
tables
tables
dais
delayed
speaker
system
main
speaker
system
˚F = 75˚ (˚C = 24˚)
V = 1132.7 ft/sec (345.7 m/sec)
D = 63 feet (19.2m)
T = (56mS + 20mS) = 76mS
(see Calculating Delay Times:
Example #2 on page 5)

SPORTS FIELD



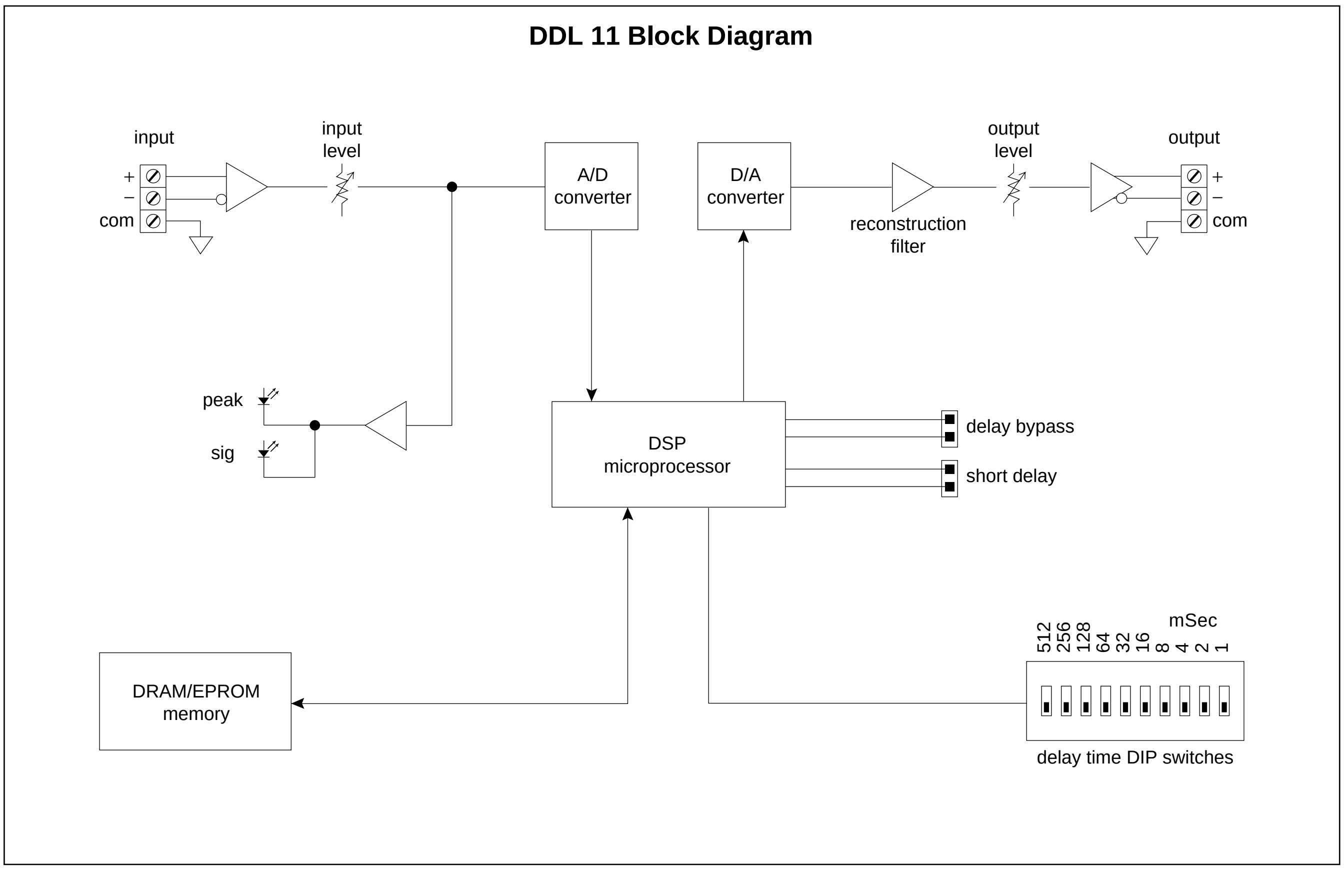
TWO-WAY SPEAKER SYSTEM



SPECIFICATIONS

Frequency Response (20Hz~20kHz @ +4dBu)**:**	±1.5dB
Total Harmonic Distortion (1kHz @ +4dBu)**:**	< 0.015%
Dynamic Range (20Hz~20kHz)**:**	> 90dBu
Input Impedance (balanced)**:**	20k ohms
Maximum Input Level (@ unity gain)**:**	+24dBu
Output Impedance:	200 ohms
Maximum Output Level (2kΩ minimum load)**:**	+18dBu
Maximum Delay Time:	1.023 seconds
Delay Resolution (minimum increments)**:**	1mSec or 20.8µSec
Sampling Rate:	48kHz
Analog-to-Digital Converter:	64x oversampled 16 bit Sigma-Delta
Digital-to-Analog Converter:	16 bit PCM linear
64x Oversampling Decimation Delay:	764 µSec
Power Requirements:	110/240VAC 50/60Hz
Power Consumption:	10 Watts max.
Dimensions:	
height (1 rack space)	1.75 inches (44mm)
width	19 inches (483mm)
depth	7 inches (178mm)
Weight:	5.8 lbs. (2.63kg)

BLOCK DIAGRAM



WARRANTY

BIAMP SYSTEMS IS PLEASED TO EXTEND THE FOLLOWING 5-YEAR LIMITED WARRANTY TO THE ORIGINAL PURCHASER OF THE PROFESSIONAL SOUND EQUIPMENT DESCRIBED IN THIS MANUAL.

BIAMP Systems expressly warrants this product to be free from defects in material and workmanship for a period of 5 YEARS from the date of purchase as a new product from an authorized BIAMP Systems dealer under the following conditions.

1. The Purchaser is responsible for completing and mailing to BIAMP Systems, within 10 days of purchase, the attached warranty application.

2. In the event the warranted BIAMP Systems product requires service during the warranty period, BIAMP Systems will repair or replace, at its option, defective materials, provided you have identified yourself as the original purchaser of the product to any authorized BIAMP Systems Service Center. Transportation and insurance charges to and from an authorized Service Center or the BIAMP Systems factory for warranted products or components thereof to obtain repairs shall be the responsibility of the purchaser.

3. This warranty will be VOIDED if the serial number has been removed or defaced; or if the product has been subjected to accidental damage, abuse, rental usage, alterations, or attempted repair by any person not authorized by BIAMP Systems to make repairs; or if the product has been installed contrary to BIAMP Systems's recommendations.

4. Electro-mechanical fans, electrolytic capacitors, and the normal wear and tear of appearance items such as paint, knobs, handles, and covers are not covered under this warranty.

5. BIAMP SYSTEMS SHALL NOT IN ANY EVENT BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, LOSS OF USE, PROPERTY DAMAGE, INJURY TO GOODWILL, OR OTHER ECONOMIC LOSS OF ANY SORT. EXCEPT AS EXPRESSLY PROVIDED HEREIN, BIAMP SYSTEMS DISCLAIMS ALL OTHER LIABILITY TO PURCHASER OR ANY OTHER PERSONS ARISING OUT OF USE OR PERFORMANCE OF THE PRODUCT, INCLUDING LIABILITY FOR NEGLIGENCE OR STRICT LIABILITY IN TORT.

6. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED. BIAMP SYSTEMS EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES SET FORTH HEREIN SHALL BE THE PURCHASER'S SOLE AND EXCLUSIVE REMEDIES WITH RESPECT TO ANY DEFECTIVE PRODUCT. THE AGENTS, EMPLOYEES, DISTRIBUTORS, AND DEALERS OF BIAMP SYSTEMS ARE NOT AUTHORIZED TO MODIFY THIS WARRANTY OR TO MAKE ADDITIONAL WARRANTIES BINDING ON BIAMP SYSTEMS. ACCORDINGLY, ADDITIONAL STATEMENTS SUCH AS DEALER ADVERTISEMENTS OR REPRESENTATIONS DO NOT CONSTITUTE WARRANTIES BY BIAMP SYSTEMS.

7. No action for breach of this warranty may be commenced more than one year after the expiration of this warranty.

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