



### MA30 General Description:

The MA30 is equipped with a 30 watt power amplifier with 4 $\Omega$ , 8 $\Omega$ , 25V, and 70V speaker outputs available at screw terminals. The unit is powered by 120VAC 60Hz. The main AC input is protected by a circuit breaker on the rear panel. An unswitched convenience AC outlet is provided on the rear panel that is protected by a separate circuit breaker. The mixer/amplifier includes 3 input channels. The first channel (marked MIC/TEL on the front panel) is switchable for microphone or telephone inputs and also includes a switch to select the AUX 2 dual combining RCA-phono connectors. This channel also includes a TEL/MIC switch. In the TEL (telephone) position, this switch pads the input to allow the channel to be fed by a 600 $\Omega$  balanced line level telephone page port output signal. The first channel includes a MUTE ON/OFF switch. When the mute switch is turned ON, a dynamic microphone or telephone input will mute the AUX 1, Aux 3, or Program inputs. The second channel (marked PROGRAM on the front panel) is switchable for program input screw terminals or AUX 3 dual combining RCA-phono connectors. The third channel (marked AUX 1 on the front panel) is for the AUX 1 dual combining RCA-phono connectors. The front panel also includes BASS and TREBLE controls, a power-on LED, and an output level LED indicator.

### Getting Started:

Please study carefully the "IMPORTANT SAFETY INSTRUCTIONS" that are given on page 2 before applying power to your MA30 mixer/amplifier. Those experienced with the use of a mixer/amplifier will find that the input jacks, output jacks, and controls follow industry standard conventions and will be very intuitive. Standard 4 $\Omega$ , 8 $\Omega$ , 25V, and 70V speaker outputs are provided. Those that are not familiar with the speaker wiring required for these industry standard outputs will find a very helpful section covering this topic on pages 6, 7, and 8 of this "Installation Sheet and Owner's Manual".

### Optional Accessories (sold separately):

Avlelec offers the optional MA30-WK wall kit (used to wall mount the MA30 Mixer/Amplifier), the MA30-RK rack kit (used to mount the MA30 Mixer/Amplifier in a 19" rack), the MA30-HRK half-rack kit (used to mount the MA30 Mixer/Amplifier in a half rack), along with a full line of 19" equipment cabinets, half-rack cabinets, wall mount shelves, rack mount AC power panels, AC power strips, and cooling fans that can be used to install the Avlelec Amplifier products. See [www.AVLELEC.com](http://www.AVLELEC.com) for product details.



## IMPORTANT SAFETY INSTRUCTIONS



- Read these instructions.     Keep these instructions.     Heed all warnings.
- Follow all instructions.     Do not use this apparatus near water.
- Clean only with a dry cloth.
- Do not block any ventilation openings. Install in accordance with manufacturer's instructions.
- Do not install near any heat sources such as radiators, registers, stoves, or other apparatus (including amplifiers) that produce heat.
- Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding-type plug has two blades and a third grounding prong. The wide blade or third prong is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
- Protect the power cord and plug from being walked on or pinched particularly at plugs, convenience receptacles, and the point where it exits from the apparatus.
- Only use attachments and accessories specified by the manufacturer.
- Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.
- Unplug this apparatus during lightning storms or when unused for long periods of time.
- Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.
- The plug on the power cord is the AC mains disconnect device and must remain readily operable. To completely disconnect this apparatus from the AC mains, disconnect the power supply cord plug from the AC receptacle.
- This apparatus shall be connected to a mains socket outlet with a protective earthing connection.
- When permanently connected, an all-pole mains switch with a contact separation of at least 3 mm in each pole shall be incorporated in the electrical installation of the building.
- If rack mounting, provide adequate ventilation. Equipment may be located above or below this apparatus, but some equipment (like large power amplifiers) may cause an unacceptable amount of hum or may generate too much heat and degrade the performance of this apparatus.
- This apparatus may be installed in an industry standard equipment rack. Use screws through all mounting holes to provide the best support.

**WARNING:** To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture. Apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, such as vases, shall be placed on the apparatus.

**NOTE:** This equipment may generate, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected

Consult the dealer or an experienced radio/TV technician for help.

**CAUTION:** Changes or modifications not expressly approved by Avlelec will void the manufacturers warranty..

### WARNING



To reduce the risk of electrical shock, do not open the unit. No user serviceable parts inside. Refer servicing to qualified service personnel.

The symbols shown below are internationally accepted symbols that warn of potential hazards with electrical products.

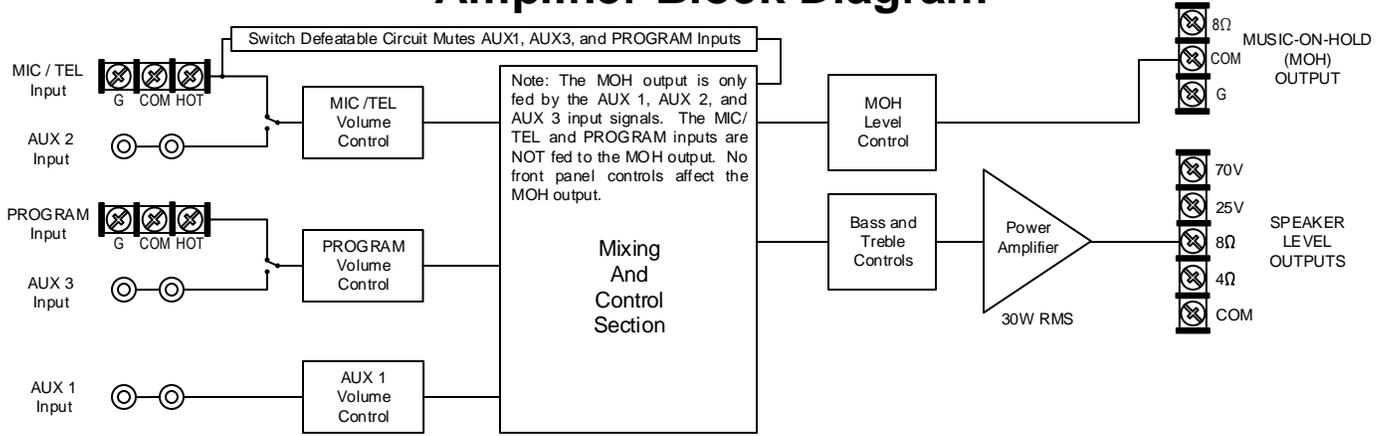


This symbol indicates that a dangerous voltage constituting a risk of electric shock is present within this unit.



This symbol indicates that there are important operating and maintenance instructions in the literature accompanying this unit.

# Amplifier Block Diagram



## Technical Specifications

AC Supply Voltage: 120VAC 60Hz ± 10%,

Power Consumption: 90W @ Rated Power

Convenience AC Outlet: 500W maximum unswitched outlet

Dimensions: 8.35" wide x 3.46" high x 10.83" deep (212mm wide x 88mm high x 275mm deep)

Weight: MA30: 8.82LBS. (4KGS)

Shipping Weight: MA30: 10.0LBS. (4.54KGS)

Color: Black

Accessories: MA30-WK (wall mounting kit), MA30-RK (rack kit), and MA30-HRK (half-rack kit) are sold separately.

Speaker Level Outputs: Screw terminal strips,  
Main Output: 4Ω, 8Ω, 25V, 70V, 30W RMS  
Music-On-Hold: (MOH), 1W @ 8Ω

Mic Input: Screw terminals, 1mV @ 600Ω balanced (Phantom power is not available.)

Telephone Input: Screw terminals (switchable, same terminals as mic input)  
100mV @ 10kΩ balanced

Program Input: Screw terminals 100mV @ 10kΩ balanced

Aux Inputs 1-3: Dual parallel unbalanced RCA-phono jacks, Stereo converted to mono, 150mV @ 10kΩ

Frequency Response: 50Hz-20KHz ± 3dB (Test signal inserted at aux input)

Total Harmonic Distortion: Less than 1% at 1kHz at rated power.

Signal to Noise Ratio: 80dB (Test signal inserted at Aux input)

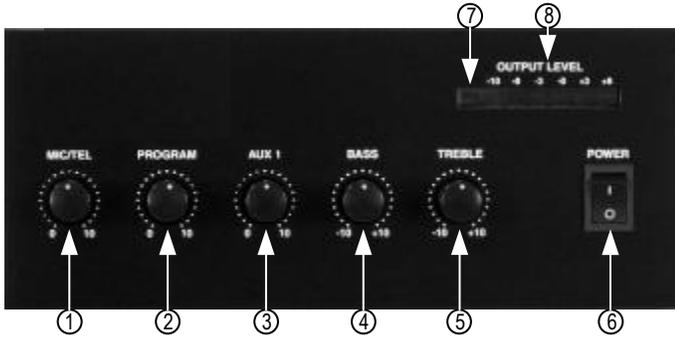
Tone Controls: Bass ± 10dB @ 100Hz, Treble ± 10dB @ 10kHz,

## Amplifier Muting-Priority Scheme

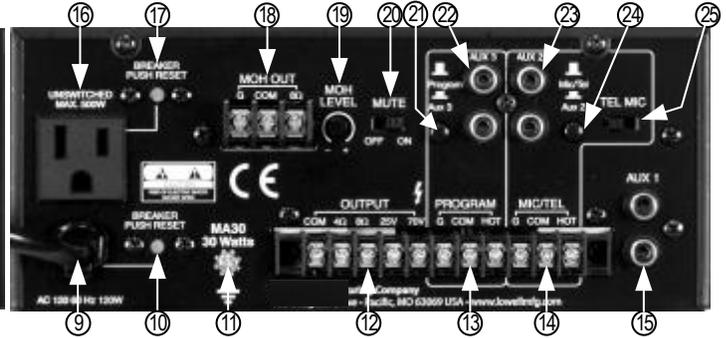
The amplifier includes unique voice-activated (VOX) ducking/muting circuitry. The mute circuit is only active when the "MUTE" switch on the rear panel has been turned "ON". When a page is made into the microphone or telephone input (Channel MIC/TEL), the PROGRAM, Aux 1, and Aux 3 music inputs will duck in volume (not be completely muted). If the incoming page is strong enough in level, the music volume will be completely muted. When the page has been completed, the volume of the music will return to its normal level. Note that AUX 2 is not involved in the muting circuit, because when the Mic/Tel-Aux 2 switch is in the Aux 2 position, the Aux 2 input is active but the MIC/TEL input is defeated so muting by the MIC/TEL input is not an issue.

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## MA30 Front Panel



## MA30 Rear Panel



- |                              |                                      |  |
|------------------------------|--------------------------------------|--|
| ① MIC/TEL Volume Control     | ⑨ AC Line Cord                       | ⑱ Music-On-Hold (MOH) Output (Screw Term)                                      |
| ② PROGRAM Volume Control     | ⑩ Circuit Breaker for Amplifier      | ⑲ Music-On-Hold (MOH) Level Control  |
| ③ AUX 1 Volume Control       | ⑪ Earth Ground Connection Screw      | ⑳ Mute Switch (Switch "ON", MIC/TEL Input Mutes AUX 1, AUX 3 & PROGRAM Inputs) |
| ④ Bass Control               | ⑫ Speaker Output (Screw Terminals)   | ㉑ Program or Aux 3 Selector Switch   |
| ⑤ Treble Control             | ⑬ Program Input (Screw Terminals)    | ㉒ Aux 3 Input (RCA Jacks)  |
| ⑥ Power Switch               | ⑭ MIC/TEL Input (Screw Terminals)    | ㉓ Aux 2 Input (RCA Jacks)  |
| ⑦ Power Indicator LED        | ⑮ Aux 1 Input (RCA Jacks)            | ㉔ MIC/TEL or Aux 2 Selector Switch   |
| ⑧ Output Level Indicator LED | ⑯ Convenience AC Outlet              | ㉕ MIC/TEL Input Pad Switch   |
|                              | ⑰ Circuit Breaker/Convenience Outlet |  |

## Amplifier Installation and Connection

### GENERAL WIRING AND INSTALLATION GUIDELINES

**DO NOT** run microphone cables near AC power wires, data cables, telephone cables, or speaker wiring to avoid picking up extraneous signals in the sound system.

**DO NOT** run high impedance unbalanced wiring more than 20' to avoid picking up noise and affecting the frequency response of the sound system.

**DO NOT** run speaker output cables near data cables, telephone cables, or other low voltage wiring that could pick up the signal from the higher level speaker cables.

**DO** use shielded cable for all microphone and line level cables (except the balanced 600 ohm input line from a telephone system may be twisted pair cable).

**DO** make sure that all speakers are wired in phase with each other.

**DO** make sure there are no short circuits on the loudspeaker lines before connecting them to the amplifier output.

### INSPECTION

This unit was carefully checked and packed before leaving the factory. However, it is always a good idea to inspect the shipping container and unit for indications of improper handling. If the unit has been damaged, make an immediate claim to the dealer or distributor from whom it was purchased. If the unit was shipped to you, notify the transportation company without delay, saving all packing materials, in order to process the claim.

### INITIAL PERFORMANCE CHECK

Before installing the amplifier, continue the inspection by running a quick performance check. Connect an 8Ω test speaker to the 8Ω direct output terminals and a tuner, tape deck, or CD player to one of the aux inputs and set the controls for operation. **CAUTION: TO PROTECT THE SPEAKER FROM DAMAGE, DO NOT TURN THE UNIT ON UNTIL ALL CONNECTIONS HAVE BEEN MADE. IN ADDITION, MAKE SURE THE UNIT IS GROUNDED BEFORE TESTING.** In this way you can check the basic operation of the amplifier before actually installing the unit and making all of the final terminations required for the permanent installation. If shipping damage has resulted in the amplifier being inoperable out of the box, call Avlelec to arrange for a replacement.

## PASSIVE CONVECTION COOLING AND VENTILATION

This unit is cooled via passive convection and therefore designed for continuous operation. Excessive heat due to poor ventilation can shorten the lifespan of electronic equipment and could void the manufacturer's warranty. Do not block the amplifier's vent slots located on the top and bottom of the chassis.

## MOUNTING THE AMPLIFIER

This MA30 may be placed on a wooden or metal wall-mount shelf. Do not remove the plastic feet from the bottom of the amplifier chassis. When the amplifier is placed on a countertop or is shelf-mounted, the plastic feet maintain the proper spacing under the amplifier for passive convection cooling. Do not place anything on top of the amplifier where the vents on the top of the chassis would be blocked. If the amplifier will be rack mounted, we recommend that you provide a minimum of 1.75" of open space above and below the unit to assure proper ventilation. Provide ventilation fans in the equipment cabinet if that is required to maintain an amplifier operating temperature of no higher than 92° F. To mount the amplifier in an Avlelec equipment cabinet, use standard 10-32 Phillips-head machine screws (like the model RS or RSP rack screws) with integral plastic washers to protect the finish of the front panel of the amplifier. Avlelec rack brackets MA30-RK (rack mounting kit) and MA30-HRK (half-rack mounting kit) for the amplifier are sold separately. The MA30-WK (wall mounting kit) for the amplifier is also sold separately. The wall mounting kit brackets may be used to mount the amplifier to a telephone wiring board or a any flat wall surface.

## POWER WIRING

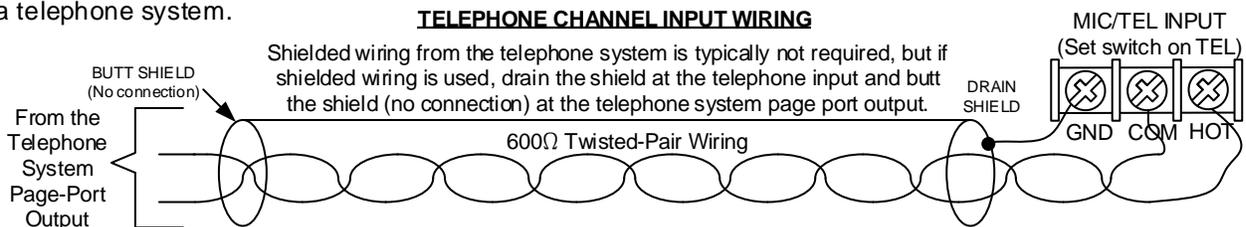
The MA30 includes a power cord with a standard 15A 120VAC 3-prong grounded plug. A push-to-reset circuit breaker for the amplifier is provided on the rear panel. An unswitched 500W maximum convenience outlet with a separate circuit breaker is also provided on the rear panel. **Warning: THIS UNIT MUST BE EARTH GROUNDED.**

## MIC LEVEL INPUT CONNECTIONS

The amplifier includes a low-impedance balanced microphone input at the MIC/TEL channel with the TEL/MIC switch in the MIC position. Phantom power is **NOT** available. If Phantom power is required for your application, you may use an outboard phantom power supply (sold by others), or consider an upgrade to the Lowell MA60 Mixer/Amplifier which does have phantom power available on the microphone channel inputs.

## TELEPHONE INPUT CHANNEL

The amplifier includes a telephone input at the MIC/TEL channel with the TEL/MIC switch in the TEL position. This input accepts a low impedance balanced 600Ω line level input that would typically be available as a page port output from a telephone system.



## LINE LEVEL "AUX" INPUT CONNECTIONS

The amplifier includes high-impedance unbalanced auxiliary inputs which may be used for connecting signal sources such as an AMFM tuner, CD player, or cassette deck. A push switch is provided on the MIC/TEL channel that selects either the MIC/TEL screw terminal input or the Aux 2 input. A push switch is provided on the PROGRAM channel that selects either the PROGRAM screw terminal input or the Aux 3 input. Two (2) RCA-phono connectors are provided for each aux input so stereo input cables can be connected. The stereo input signal is converted internally to a mono signal. Mono inputs need only use one or the other of the RCA-phono connectors.

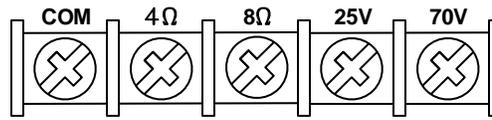
## MUSIC-ON-HOLD (MOH) OUTPUT

The music-on hold output (MOH) is an 8 ohm speaker level output that may be used to feed external devices including the music-on-hold input of a telephone system. It is important to understand the signals that will be present at the MOH output. The microphone, telephone, and program inputs are never present at the MOH output. The AUX 1, AUX 2, and AUX 3 inputs are the only signals that are fed to the MOH output. The front panel controls (including the treble and bass controls) have no effect on the MOH output. The aux inputs are routed to the MOH output directly. The only control that affects the MOH output is the MOH level control on the rear panel of the chassis.

## Speaker System Connections

The amplifier includes a speaker output screw terminal strip. Connect the speaker line common to "COM" and the hot side to the 70V, 25V, 8Ω, or 4Ω terminals.

Never connect an 8Ω or 4Ω speaker system (that has no 70V or 25V matching transformers) to the 70V or 25V outputs.

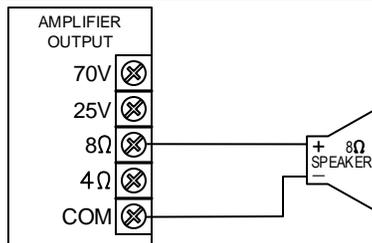


## 8 Ohm Series/Parallel Speaker System Wiring

Avlelec amplifiers include 8Ω and 4Ω outputs that can drive basic 8Ω speakers without the use of any line matching transformers. The impedance of the speaker load must always be equal to or greater than the impedance of the amplifier output. For example, it is safe for the amplifier if the 8Ω output is used to drive an 8Ω load or a 16Ω load, and it is safe for the 4Ω output to drive a 4Ω load or a 6Ω load, but it is not safe for the 8Ω output to drive a 6Ω load and it is not safe for the 4Ω output to drive a 2Ω load. Overloading the amplifier output can cause distortion and can damage the amplifier and void the manufacturer's warranty. It is also important to pay attention to the power rating of the speakers used. If an 8Ω speaker is fed from the 8Ω output of an amplifier and the amplifier is turned all the way up, the speaker will receive the maximum power output of the amplifier. A speaker must be chosen with sufficient power handling capacity for the amplifier used. For example, if an 8Ω speaker can handle 150 watts and it will be fed from the 8Ω output of the amplifier, an amplifier with a power output of 150 watts or less should be chosen so that if the amplifier is turned all the way up, the speaker will be able to handle the amplifier's full power output. All of the Series/Parallel configurations shown below will result in load impedances that will be safe for the amplifier when connected as shown. Depending on the size of the amplifier used, verify that the maximum amplifier power when divided between the speakers, will not exceed the power rating of the speaker chosen.

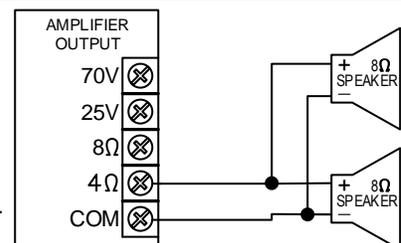
### One 8Ω Speaker

Result:  
One speaker receives the total amplifier power.



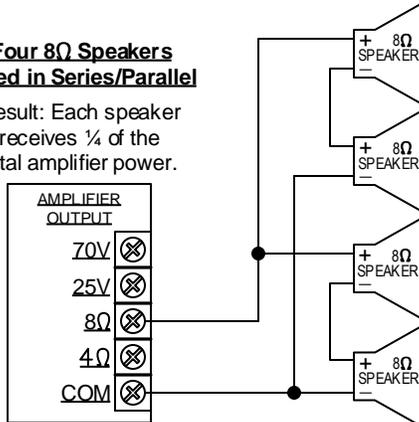
### Two 8Ω Speakers wired in Parallel

Result:  
Each speaker receives ½ of the total amplifier power.



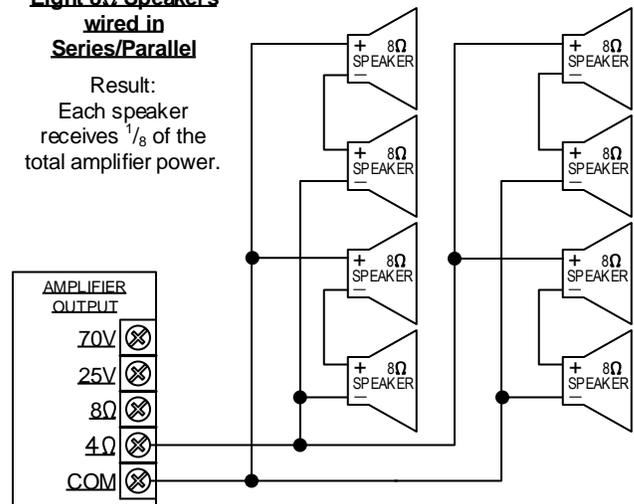
### Four 8Ω Speakers wired in Series/Parallel

Result: Each speaker receives ¼ of the total amplifier power.



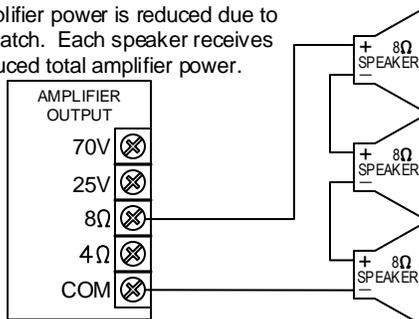
### Eight 8Ω Speakers wired in Series/Parallel

Result:  
Each speaker receives 1/8 of the total amplifier power.



### Three 8Ω Speakers wired in Series

Result: Total amplifier power is reduced due to impedance mismatch. Each speaker receives 1/3 of the reduced total amplifier power.



### 70V / 25V Speaker System Wiring

70 volt and 25 volt “Constant Voltage Distribution Systems” have been a source of confusion for people for a long time. Our Series/Parallel speaker wiring discussion on page 6, illustrates why industry engineers developed the “Constant Voltage” concept. Series/Parallel configurations are manageable for small localized systems using up to 8 speakers and when no expansion is anticipated. Even with only 8 speakers, wiring a Series/Parallel configuration can be confusing. Nobody would ever want to attempt Series/Parallel wiring for 8000 speakers spread over an entire office complex. The 70V and 25V speaker systems (and the 100V system which is used in Europe) rely on inexpensive line matching transformers to simplify the “impedance matching” and “amplifier loading” issues. The line matching transformers allow all of the speakers in a 70V or 25V speaker system to be wired in parallel regardless if there are 8 speakers or 8000 speakers in the system, as long as **the total of all transformer taps used does not exceed the power rating of the amplifier**. Parallel connections make field wiring easy and it makes it possible to add speakers anywhere along the speaker string without any concern about Series/Parallel load impedance. The term “Constant Voltage” can be misleading. “Constant Voltage” means whether you have a 10W 70V amplifier, 100W 70V amplifier, or a 1000W 70V amplifier, the output will be at 70.7V when the amplifier is turned all the way up. When a 70V amplifier is turned down, it will be running at less than 70V. The key thing to remember is that the transformer power tap values are calculated for when the amplifier is running at a full 70V. A 70V speaker transformer tapped at 5 watts, will only draw a full 5 watts, when the amplifier is at its full 70V output.

### 70V / 25V Constant Voltage Speaker System Advantages:

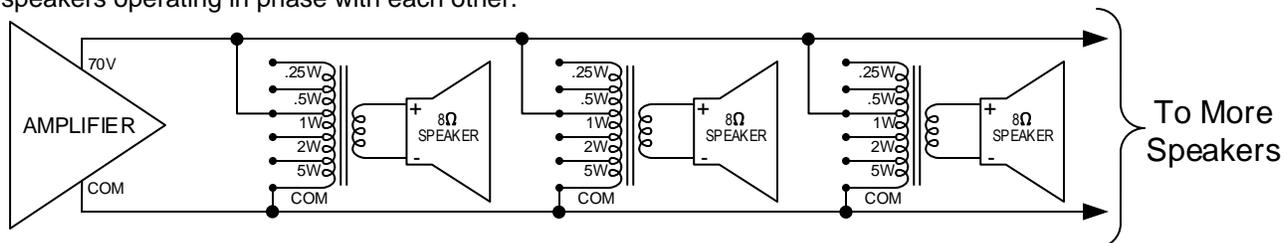
A 70V or 25V speaker system is easy to design and easy to wire in the field because all speakers can be wired in parallel. The higher transmission voltages used greatly reduce the power lost in the speaker lines so smaller less expensive speaker wiring can be used. The volume of a single speaker on the line can be adjusted louder or softer by adjusting the power tap used on that speaker’s matching transformer. That adjustment does not affect the volume of the other speakers in the system. The volume adjustment of a single speaker on the line or the volume adjustment of groups of speakers in a zone can be made accessible to the user by way of inexpensive wall-mount autoformer-based volume controls. The settings on wall-mount volume controls can be easily bypassed during pages or during emergency announcements. (See Avlelec “priority attenuator” volume controls that include a “-PA” in the model number). It is easy to add speakers to the system in the future without having to change any of the existing wiring. If adding additional speakers in the future will require a more powerful amplifier at the head-end, an amplifier with a higher output power capability can replace the existing unit without changing any of the existing speaker wiring or any of the existing speaker transformer tap settings. For example: An Avlelec MA60 could be replaced with an Avlelec MA125 so that more speakers could be added to the system, with no other changes required to the existing speaker wiring or transformer taps.

### Individual Speaker Transformer Tap Settings:

A 70V or 25V speaker that is chosen by the system designer, has a matching transformer with a maximum power rating. For example, the Avlelec R1810-72 (shown to the right) has an Avlelec TLM-572 5-watt 70V/25V dual voltage transformer. That means that this speaker can be used on both 70V systems and 25V systems. The 8Ω secondary of the transformer is connected directly to the 8Ω input terminals on the 810 speaker. The primary has transformer taps for either 70V or 25V at 0.25W, 0.5W, 1W, 2W, and 5W. When a designer is mapping out the coverage of these ceiling speakers, he/she will determine how many speakers are required and in what locations, and what power tap will be used for the speakers to be loud enough for this application. Let’s say for example that the designer has determined that 100 speakers will be required tapped at 1W each at 70 volts. That means that our total speaker load is 100 watts. The speakers will be wired in the field in parallel as shown below making sure the connections are made with the proper polarity to keep all of the speakers operating in phase with each other.



Avlelec R1810-72



**70V and 25V Amplifier Load Calculations and Amplifier Selection:**

**Never use a speaker load (the sum of all speaker transformer taps) that exceeds the amplifier power rating. Overloading the amplifier can cause distortion and could damage the amplifier and void the warranty.**

In fact, it is good design practice to limit the speaker load only 70% of the amplifier's power rating. That designed-in headroom allows for future expansion (adding a few speakers) and also the reduced load will increase the lifetime of the amplifier by allowing it to run cooler. Continuing with the example from page 7, the designer knows that the expected speaker load is 100 watts. What would be an appropriately sized amplifier for that system? If the designer considers a 125W amplifier,  $125 \times .7 = 87.5$  watts. It would be good design practice to limit the speaker load to no more than 87.5 watts, so since the speaker load in the example is 100W, the 125W watt amplifier would be a good choice. Sometimes the amplifier has already been purchased and the number of speakers required is known, but the question becomes what transformer tap setting to use. Desired speaker SPL calculations to determine the speaker transformer tap required are beyond the scope of this paper, but there are some practical considerations when choosing the power tap. If a 125 watt amplifier has already been purchased, using the 70% loading rule of thumb,  $125 \times .7 = 87.5$  watts. It would be good design practice to limit the speaker load to no more than 87.5W.

Some system designers feel it is best to tap the speaker transformers as high as possible. Consider an example where a sound system that has a 125W 70V amplifier, only has 10 speakers. If the transformers are tapped at 0.25W each, the total speaker load will be  $0.25W \times 10$  speakers = 2.5W. If the amplifier is turned all the way up so its output is 70 volts, those speakers will still only draw a maximum of 0.25W each and it would not be possible to get the speakers any louder. That would result in tons of headroom but you wouldn't have much volume out of the speakers. Some designers would suggest that the speakers in this example should be tapped at 5W each so the speaker load would be  $5W \times 10$  speakers = 50W. Again, plenty of headroom for the amplifier but more than 12dB more sound pressure level out of the speakers. Other designers would prefer that the speakers be tapped at 1W each (if they are sure that the 1W tap would provide sufficient SPL) because the 1W tap provides 2 higher powered taps that are available if this particular speaker needs to be louder, and 2 lower-powered taps if this speaker is too loud. The designer needs to determine the appropriate tap setting after considering the requirements of the system design. The question might be asked, what happens when the designer has a 125 watt amplifier, and needs 25 speakers tapped at 5 watts each? That results in a speaker load of 125 watts with no headroom. Sometimes a designer is confident that adding speakers in the future will not be necessary, and competitive pressure in a bid situation will not make it possible to use a larger amplifier to provide the desired headroom. Although headroom is always desirable, be assured that the Avlelec amplifiers will survive and operate safely when fully loaded.

**Wiring Size and Length:**

Cable distance should be kept as short as possible to minimize power loss. The chart below can be used as a general guide showing various wire sizes and the maximum distance related to cable loading that speakers can be placed from the unit for an approximate 0.5dB loss (-12.5% power).

**2 WIRE COPPER CABLE LENGTHS FOR SPEAKER LINES AT -0.5dB LOSS IN SPL (12.5% POWER LOSS IN WATTS)**

AWG SIZE	LOW IMPEDANCE SPEAKER LINE			70.7V SPEAKER LINE (FOR 25V LINE DIVIDE ALL 70.7V LENGTHS BY 8) NOMINAL POWER IN LOAD								
	4 OHMS	8 OHMS	16 OHMS	7.5W	15W	30W	60W	100W	125W	250W	400W	500W
10	120	240	480	-	-	5,000	2,500	1,500	1,100	550	365	275
12	75	150	300	-	6,200	3,100	1,550	940	750	375	230	185
14	50	95	190	7,600	3,800	1,900	950	600	450	225	140	110
16	30	60	120	4,800	2,400	1,200	600	370	290	145	90	-
18	20	40	75	3,000	1,500	750	375	230	180	90	-	-
20	15	25	50	1,920	960	480	240	150	110	-	-	-
22	10	15	30	1,200	600	300	150	95	-	-	-	-
	WIRE LENGTHS IN FEET			WIRE LENGTHS IN FEET								