

## Designing T-Gen2 Emergency Warning Systems

*The T-Gen2 is a sophisticated, but easily configured and adapted Emergency Warning Control and Indicator Equipment (EWCIE) tone generator/ amplifier system complying with AS 4428.16. This bulletin explains some of the factors that determine a building's emergency evacuation requirements and how the T-Gen2 can be arranged in different configurations to suit these. This bulletin is written for AS 1670.1:2015, AS 1670.4:2015; AS 4428.16:2015 and the NCC that calls up these standards. Future versions of these standards may have different requirements.*

### Emergency Warning Systems

An emergency warning system (EWS) is used to warn the occupants of a building to the occurrence of an emergency situation and provide instructions/directions on how they should proceed.

Usually the EWS is triggered by the fire alarm detection system (includes a sprinkler system) and is arranged to provide an orderly evacuation of the occupants through the use of warning tones, messages and flashing (strobe) lights.

In addition the EWS could be used for other emergency situations like gas leaks, lock-down, active shooter, tornado, etc.

Larger or multi-storey buildings will usually be divided into multiple evacuation zones, with the warning signals separately generated to each zone, so that the evacuation can be phased – i.e., done zone by zone, or that different signals could be sent to each zone.

The EWS will usually use loudspeakers installed throughout each zone to provide the tones, messages and optional live voice announcements; with flashing strobes or beacons installed in high ambient noise areas or places where hard-of-hearing people might be present.

The Australian Standards for fire alarm systems (AS 1670.1:2015) and Emergency Warning Systems (AS 1670.4:2015) both require that the EWS provide separate outputs to each floor or area no larger than 2000m<sup>2</sup> of the building, so that a fault in one floor/area does not affect any other.

The EWS will usually achieve this by using separate outputs for each floor/area or use splitter modules that split one output into multiple outputs – with each output short circuit protected from the others.

In some buildings these outputs may need to be separate evacuation zones so that different tones or messages can be generated to each zone at the same time.

The number of different warning tones and messages (signals) that need to be generated in a building will vary considerably.

Small buildings will have just a single evacuation tone, that could include one or more pre-recorded speech messages (e.g., different languages) advising the occupants to leave the building via the nearest fire exit.

Multi-storey or large buildings may break the system up into multiple zones so that the evacuation can be phased through the floors/areas. For example, stepping the evacuation up through the floors of the building from the floor in alarm, then evacuating the floors below that in alarm.

Some buildings may also have an Alert signal that is used to notify trained floor wardens to the occurrence of the emergency so that they can prepare for and manage the evacuation.

A few buildings may need additional warning signals for situations like gas leaks, lock-down, etc.

All these factors - the design and layout of the building (number of floors, floor area, etc.), the evacuation scheme (all-out, phased evacuation, possibly including alert) and the number of emergency signals required will be used to determine the arrangement and necessary configuration of the emergency warning system.

AS 1670.1 and AS 1670.4 require an EWCIE complying with AS 4428.16.

### **AS 4428.16 Emergency Warning Control and Indicating Equipment (EWCIE)**

Australian Standard AS 4428.16:2015 defines the requirements for EWCIE. It specifies 3 grades of equipment.

- Grade 3 A single zone (all-out) system where the same warning signal is generated throughout the building. This can be used for single or multi-floor buildings, with one or more warning signals (there will be a priority so that only one signal is generated if multiple situations exist). A single floor building of not more than  $<2000\text{m}^2$  can have just one output from the EWS wired to all speakers. A multi-storey building or an area greater than  $2000\text{m}^2$  will need separate outputs per floor or area  $>2000\text{m}^2$ . The equipment can be mounted in, powered and controlled by the fire alarm panel and does not need any user interface. However, a user interface could be included to provide manual controls, paging facilities, or an emergency speech function.

A Grade 3 system may have an alert signal for non-evacuation emergencies, but cannot have an alert signal preceding the Evacuation signal. Also, being a single zone (all-out) system it cannot be used where a phased or managed evacuation is required. Grade 3 systems are, subject to NCC limitations, suitable for:

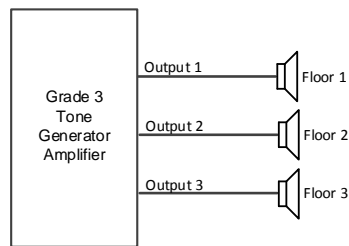
- Apartment blocks
- hotels
- backpackers / hostels
- school / university residential accommodation
- car parks

- small aged care , health care nursing homes
- small detention centre
- small shopping centres
- small office buildings
- Warehouses
- Factories

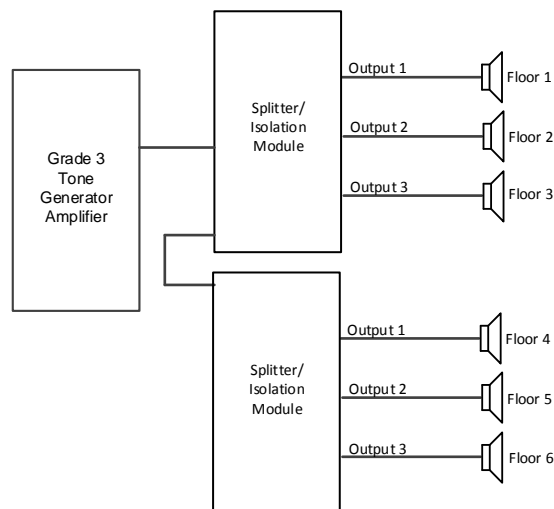
Figure 1 shows some Grade 3 arrangements.

In Arrangement A a single tone generator/amplifier with multiple outputs, or multiple tone generators/amplifiers, are used to provide individual outputs per floor/area. All operate in unison. Each amplifier must be rated for the output it serves.

In Arrangement B the output of a single tone generator/amplifier is connected to each floor/area through a splitter/isolation module that disconnects an output if a short-circuit fault is present. The amplifier must be rated for the sum of all outputs it serves.



A – Grade 3 – Multiple Outputs for Multiple Floors or Areas > 2000m<sup>2</sup>



B – Grade 3 – Splitter/Isolation Modules for Multiple Floors or Areas > 2000m<sup>2</sup>

Figure 1  
Grade 3 Arrangements

**Grade 2** A multi-zone EWS where the activation and silencing of the warning signals is controlled by the fire alarm system. This will usually have a phased evacuation and may involve the alert signal as well. The emergency Speech function may also be present. It must be powered separately to the fire alarm panel, but can be controlled by the fire panel.

A Grade 2 system could be used where a fully complying Grade 1 system is not required under the NCC, but multiple evacuation signals or phased evacuation are required.

It must have a user interface indicating at least zone alarm and emergency signal conditions, plus provide an all-evacuate control and an emergency microphone.

A Grade 2 system would not have any warden phones (an emergency intercom system (EIS)) and would generally be used in buildings greater than 1 storey but under <25m. The local council may allow it for higher buildings if wardens cannot be assigned to manually control the evacuation.

Grade 2 systems would be suitable for:

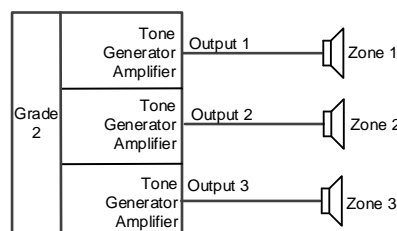
- Apartment buildings
- Hotels
- Backpackers / hostels
- Office buildings
- Carparks
- Warehouses

Figure 2 shows some Grade 2 arrangements.

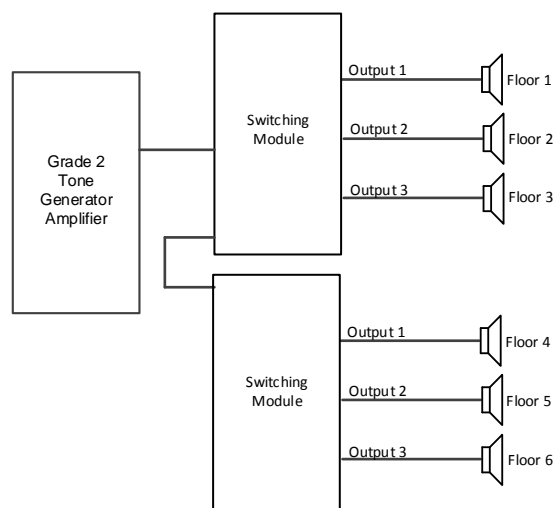
In Arrangement A the system has a tone generator/amplifier per zone, so that each zone can be controlled separately. Each amplifier needs to be rated for the zone it serves. This arrangement may allow different signals to be generated in each zone.

In Arrangement B a single tone generator/amplifier connects to the input of one (or more) switching modules that can connect each of its outputs onto the input under system control.

This allows just one tone to be directed to specific zones (or all zones in the case of emergency speech for example). The amplifier needs to be rated for the sum of all outputs it serves.



A – Grade 2 Individual Tone Generator/Amplifier Per Zone Output



B – Switching Module Controls Each Zone Output

Figure 2  
Grade 2 Arrangements

**Grade 1** A multi-zone EWS where only the activation of the warning signals is controlled by the fire alarm system. The EWS will continue operating even if the alarms are cleared (reset) on the fire alarm system and it will be necessary to reset the warning signals on the EWS. Therefore it is almost always a completely separate system to the fire panel.

A Grade 1 system must have individual zone controls and indication so that different warning signals can be generated in each zone, plus there must be All-Zone controls for the Alert, Evacuate and Speech functions so that these can be generated to all zones at the touch of a button.

It will usually have a phased evacuation and must support the Alert signal as well.

A Grade 1 system would be installed, in accordance with NCC E4.9, in:

- Buildings greater than 25m in height
- Buildings larger than 2000m<sup>2</sup> and or more than 2 stories that are used for:
  - Hospitals, nursing homes, aged care, disability services
  - Schools, universities with accommodation, assembly areas / entertainment complexes, public halls
- Buildings with a smoke management system and or sprinklers and require staged or managed evacuation.

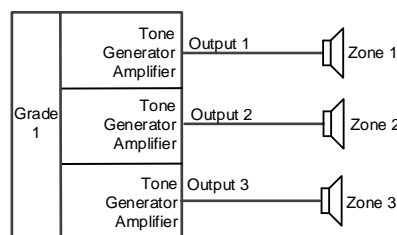
The types of buildings that would use a Grade 1 system include

- High rise / office buildings
- Large apartments
- Large hotels
- Entertainment complexes
- Large shopping centres
- Airports
- Universities

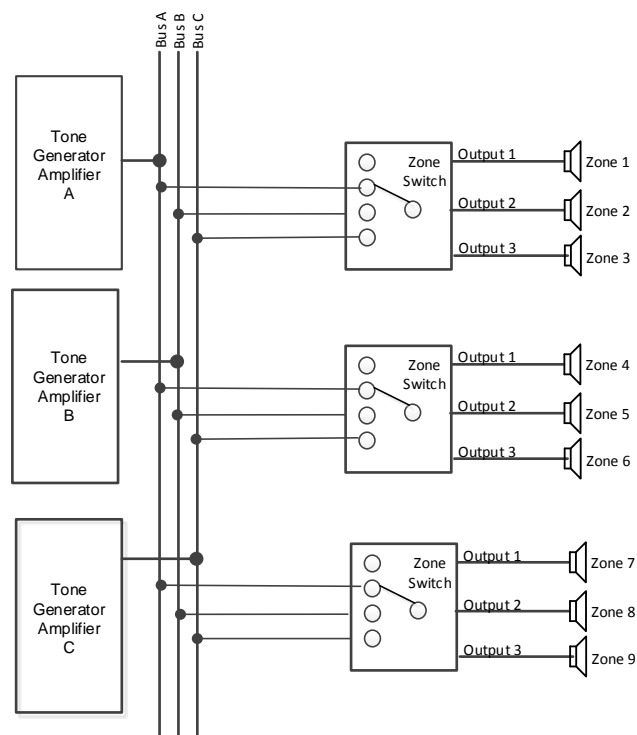
Figure 3 shows Grade 1 arrangements.

In Arrangement A, each zone output has its own tone generator/amplifier, so can generate any signal independently of another. Each amplifier needs to be rated for the output it serves.

In Arrangement B, there are 3 common tone generators/amplifiers connected to the inputs of a four way switch for each zone output. Each tone generator would be assigned to generate the Alert, Evacuate or Speech signal. The switch would connect each zone output to one of the tone generators/amplifiers allowing the required function to be output (or switched to none for silence). Each amplifier must be rated for the sum of all outputs.



A – Grade 1 – Individual Tone Generator/Amplifier per Zone Output



B – Grade 1 – 3 Tone Generator/Amplifiers & Zone Switching

Figure 3  
Grade 1 Arrangements

## **T-Gen2 Emergency Warning System**

The T-Gen2 EWS is made up of a number of modules that can be arranged in various ways. The rest of this bulletin describes some of these modules and how they can be used to form Grade 3, Grade 2 and Grade 1 systems. For more details on each of the components or complete systems refer to Product Bulletin PBG0203A.

### **T-Gen2 Tone Generator / Amplifier**

The T-Gen2 tone generator/amplifier provides a 100V audio output suitable for wiring to multiple 100V loud speakers located in an evacuation zone of the building. There are two models available – T-Gen 60 which provides a 60W rms output and T-Gen 120 which provides 120W rms.

Both models include:

- A 2A supervised strobe output suitable for driving a number of evacuation strobes, either the Simplex 4096-9103/4 synchronised white flashing strobes, or self-oscillating red strobes or beacons. These can be used in high ambient noise areas or places where hard-of-hearing people may be present.
- A supervised PA microphone audio/PTT input compatible with a hand-held microphone for making live speech announcements to the occupants of the building.
- 6 Supervised digital inputs for triggering alarm conditions in the various zones of the building, or activating the playing of specific recorded messages or tones, audio inputs or fault conditions.
- 2 line-level audio inputs for functions like background music, paging announcements, etc.
- Master / Slave operation whereby one T-Gen2 is configured as a master, and up to 9 other T-Gen2s can be connected as slave units with the slaves producing an audio output generated by the master T-Gen2.

Additional modules that can be connected to the T-Gen2 to make an EWS include:

### **100V Splitter Module**

The 100V Splitter Module (FP1117) takes the T-Gen2 100V output and splits it into 4 separately supervised and short-circuit isolated 100V outputs. Each output is normally connected to the input, so the loud speakers receive the audio output from the T-Gen2. But on a short circuit fault being applied to an output that output is automatically disconnected so that the other outputs continue to receive the audio. The output is reconnected when the fault is removed.

The T-Gen2 100V signal can be daisy-chain connected to multiple 100V Splitter Modules to provide additional outputs.

### **100V Switching Module**

The 100V Switching Module (FP1118) is similar to the 100V Splitter Module, but with this module there are two 100V audio inputs – A and B, and each 100V output can be switched by the controlling T-Gen2 onto input A, input B or neither. This allows the T-Gen2 to control which outputs receive which signal – or none at all. By pairing up two 100V Switching Modules and parallel wiring the 4 x 100V outputs it is

possible to construct a 4-way switch to each output so that any one (or none) of the three 100V inputs can be selected to drive the output.

This allows each output to generate one of three audio signals (e.g., Alert, Evacuate or Speech), or silence, as required for a Grade 1 EWS.

Multiple T-Gen units are used to generate the different 100V signals that connect to the 100V Switching Module Inputs, with these controlled by the master T-Gen2 to direct the required audio signal to each 100V output.

### **Slave T-Gen2**

It is possible to connect up to 9 T-Gen2 configured for slave operation to a master T-Gen2. The master will generate up to 3 audio signals and distribute these to all the slave T-Gen2 and instruct each slave as to which audio signal it should select and amplify to its 100V output. This allows the master T-Gen2 to control the generation of multiple signals and have these delivered to the various 100V speaker outputs to create a multi-zone multi-function EWS.

### **User Interface Options**

The T-Gen2 can be configured with an optional Grade 3 user interface to provide controls and indication for operation of Alert, Evacuate and Speech emergency signals for a single evacuation zone - in either Automatic or Manual mode. A supervised microphone is also incorporated for making emergency speech or non-emergency paging announcements. 2 programmable user buttons can be utilised for additional functions like test or lockdown message activation. A Grade 2 (or 1) User Interface incorporating individual alert, evacuate and speech controls for up to 20 zones is also available.

### **T-Gen2 EWS**

By combining these modules a T-Gen2 EWS can be constructed to meet each of the different AS 4428.16 grade arrangements shown previously.

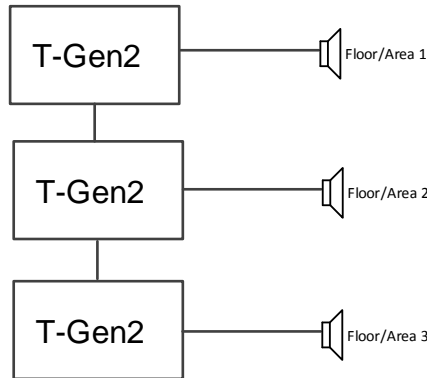
### **Grade 3**

Figure 4A shows the 100V output of the first T-Gen2 driving two loudspeaker feeds. All speakers generate the same sound and if one speaker cable is shorted all speakers stop working. So this arrangement is suitable for a single floor building or area less than 2000m<sup>2</sup>. If the total speaker load exceeds the rating of the T-Gen2, a slave T-Gen2 can be added to provide additional power output, which must be wired as a separate speaker circuit(s). This has an additional benefit, in that the 100V outputs of the two T-Gen2 are short-circuit isolated, so a building of 2 floors or up to 4000m<sup>2</sup> can now be supported. Additional slave T-Gen2 could be added (up to 9 in total), each providing a short-circuit isolated output.

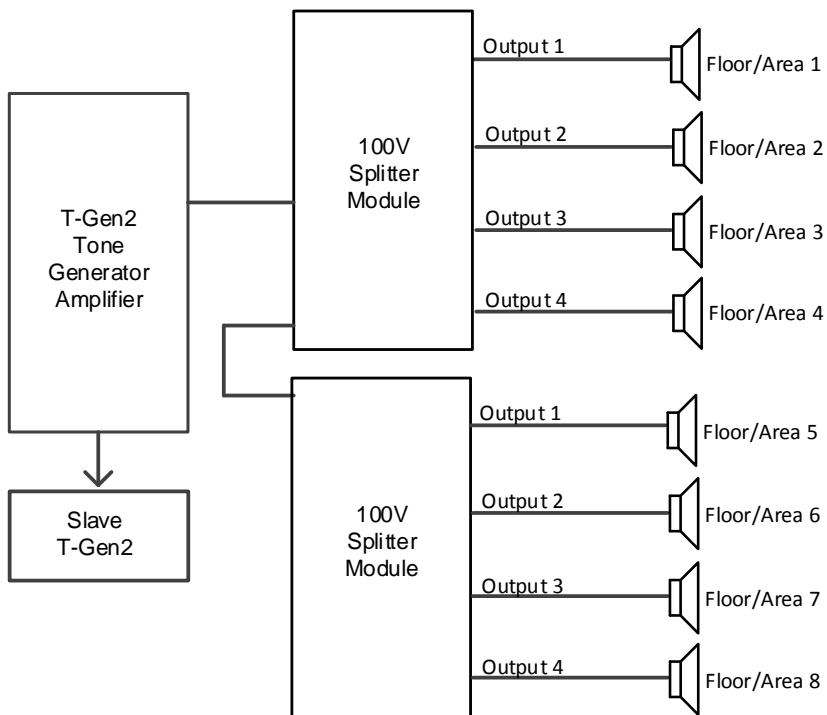
Figure 4B shows another arrangement suitable for multi-floor or large buildings. The 100V Splitter Module is used to split the T-Gen2 output into 4 separate outputs, with each output driving a floor or area <2000m<sup>2</sup>. Additional 100V Splitter Modules can be daisy-chained onto the same T-Gen2 output, to provide more outputs up until the total speaker load equals the output power rating of the T-Gen2. Slave T-Gen2s can also be added, perhaps with their own 100V Splitter Modules, to provide multiple outputs all generating the same audio signal.



In Figure 4B the 100V Splitter Modules could be replaced with 100V Switching Modules and the Master T-Gen2 could then control the audio outputs to provide different areas – for example for paging or controlling which speakers get background music.



A – Individual T-Gen2 Per Floor/Area > 2000m<sup>2</sup>



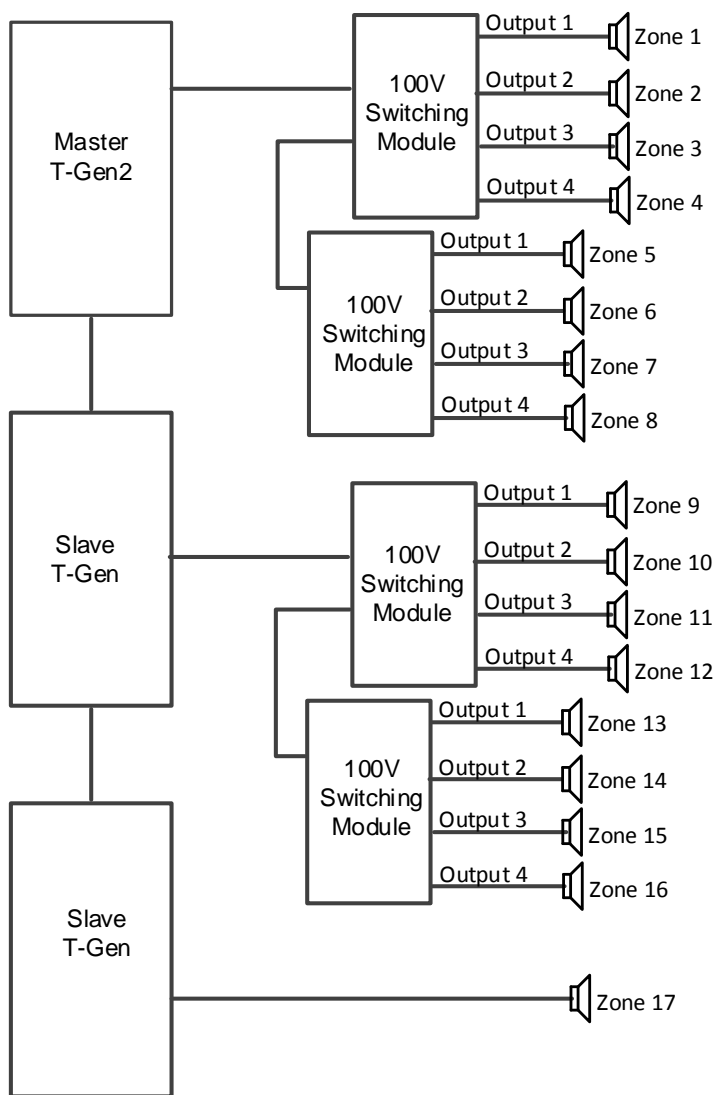
B – 100V Splitter Module Outputs per Floor/Area > 2000m<sup>2</sup>

Figure 4  
T-Gen2 in Grade 3 Arrangements

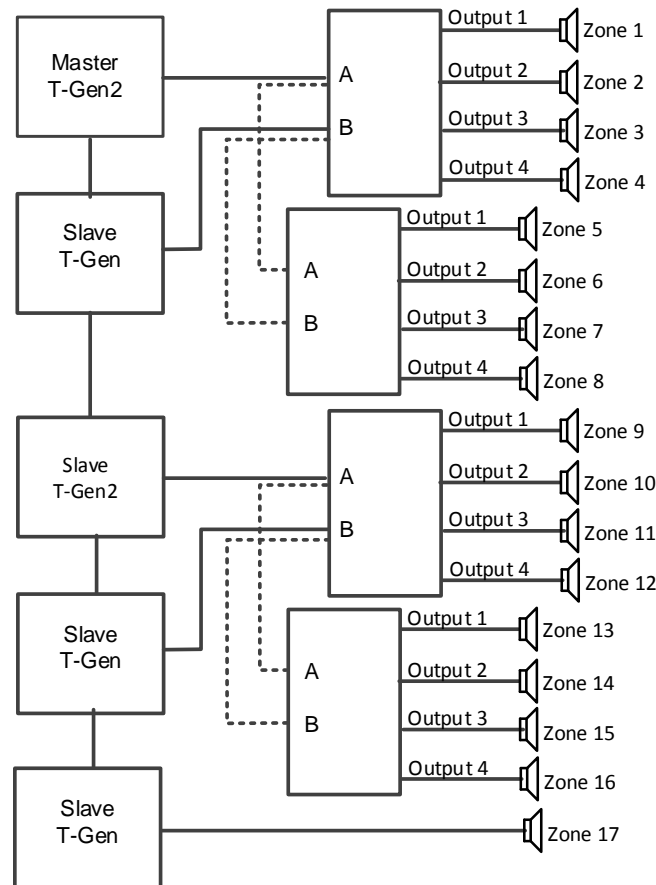
**Grade 2**

The arrangement in Figure 5A shows an expanded minimalist Grade 2 system that suits a site where individual evacuation per zone is required, but only All PA is needed. The output of one T-Gen2 is wired to one or more 100V Switching Modules to provide zone control. If Evac was operating and Speech was selected for all zones then the T-Gen2 generates Speech and this goes to all zones. If Speech was selected for only some zones, then the evacuate signal would stop in all zones while Speech is generated in some. The T-Gen2 needs to be rated for the sum of all connected outputs. Additional T-Gen2 and Switching Modules could be added, and the 100V output of a T-Gen2 could serve one zone directly (as shown in Figure 5A).

Arrangement B uses a Slave T-Gen2 to generate a second audio signal, which is wired to the B inputs of the 100V Switching Modules. This allows two separate signals (e.g., Alert and Evacuate, or Evacuate and Speech) to be directed to specific zones at the same time. Each T-Gen2 needs to be rated for all connected outputs. However, additional T-Gen2 pairs could be added for more power output or zones or a T-Gen2 dedicated to a specific zone.



A – Evac & All Speech Per Zone



B – Alert & Evac/PA Per Zone

Figure 5  
T-Gen2 in Grade 2 Arrangements

**Grade 1**

In Figure 6 Arrangement A a T-Gen2 serves each zone. This allows each zone to operate independently (generating Alert, Evacuate, Speech or Silence), with the T-Gen2 rated for its connected output.

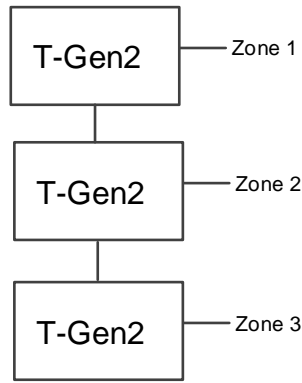
This suits sites with large power requirements per zone (30-60W with T-Gen 60, 60-120W with T-Gen2), with up to 10 zones being supported.

Figure 6 Arrangement B suits sites with lower power requirements per zone (e.g., 0-30W per zone). Three T-Gen2 (60 or 120W depending on the total power connected) provide 3 audio busses (A, B, C) that connect to the inputs of two (or more) 100V Switching Modules with their 100V outputs wired in parallel.

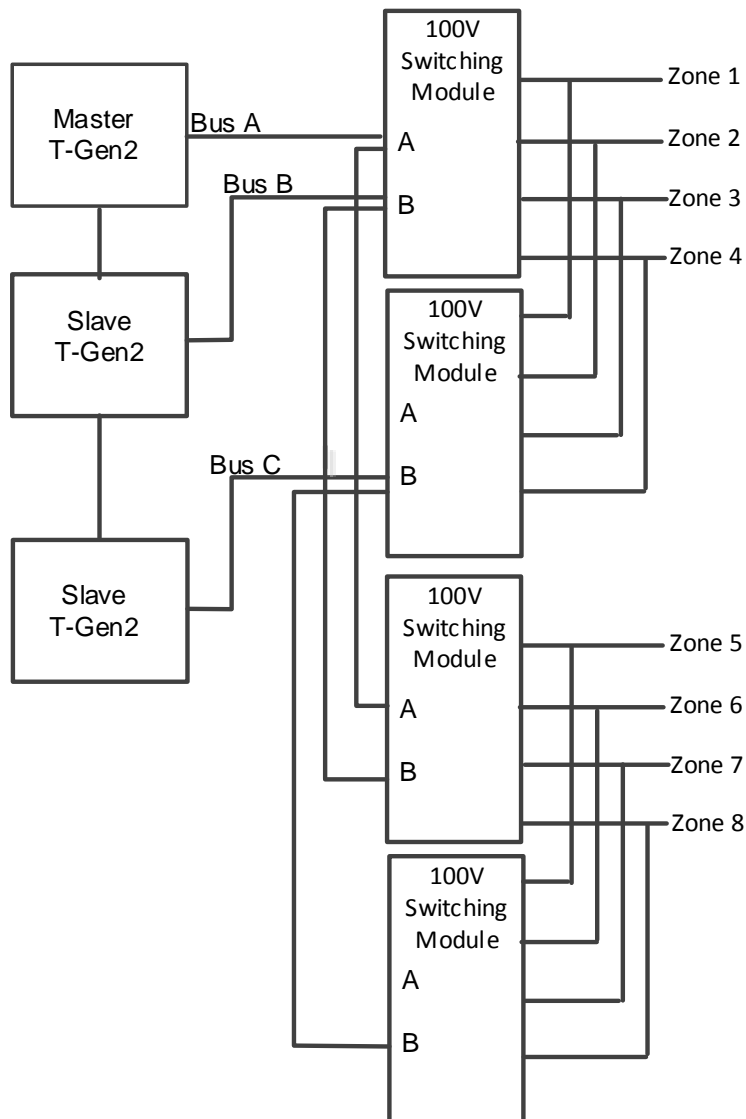
Each output can be connected to one of the T-Gen2 (allowing a choice of Alert, Evacuate, or Speech, for example, or Silence).

Each T-Gen2 must be rated for the sum of all connected outputs.

Additional sets of 3 x T-Gen2 and 2 (or more) 100V switching modules could be added for additional zones/higher power outputs. Alternatively a T-Gen2 could be dedicated to a specific zone (not shown).



A – Individual T-Gen2 Per Zone



B – 3 x T-Gen2 Generate Alert/Evac/PA for Multiple Zones

Figure 6  
Grade 1 Arrangements