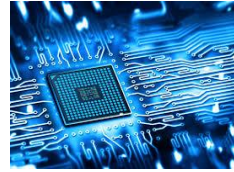# ALARM SYNCRONISATION

TDS-016 Issue 02 Ziztel Technical Bulletin

Thank you for your interest in Ziztel - we are a UK based manufacturer of PAGA and Intercom products. Our systems are mainly designed for use in Marine, Hazardous Oil, Gas and Petrochemical industries.

This technical document describes the synchronisation architecture implemented on a Ziztel PAGA / MBS (Main Broadcast system) A + B or networked system to ensure alarm tone broadcast intelligibility.

ZX100 A + B ALARM SYNCRONISATION

The Ziztel PAGA system retains alarm tone files within a highly secure FPGA (field programmable array) device.

Alarm tones are not dependent on software execution and hence are immune to latent software bugs / possible corruption, are immediately available and do not require any kind of boot up / reboots.

The alarm tone sets are arranged as "tiles" within the device with each tile specified to comply with international standards/regulations and to unique client specific requirements.

A1	A2	A3	A4	A5	A6	A7	A8
B1	B2	B3	B4	B5	B6	B7	B8
C1	C2	C3	C4	C5	C6	C7	C8
D1	D2	D3	D4	D5	D6	D7	D8
E1	E2	E3	E4	E5	E6	E7	E8
F1	F2	F3	F4	F5	F6	F7	F8
G1	G2	G3	G4	G5	G6	G7	G8
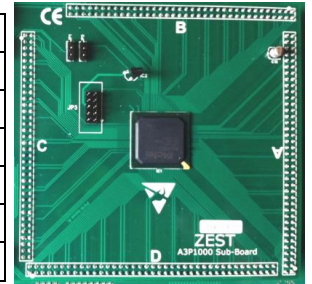
For example, tile **A1** - retains IMO SOLAS alarm tone signals, **A2** - PEFER, **A3** - NORSOK. (For detailed listing of the alarm tone menu see TDS 017). (The tiles extend to **Z8**)

The alarm tones are held and generated in each ZEST PAGA system ZX100 processor management subsystem and for security reasons operate autonomously.

For safety critical applications the PAGA / MBS (main broadcast system) can be duplicated A + B and in this architecture loud speakers from each sub system are interleaved to maintain coverage in event of catastrophic failure of either the A or B subsystem. To eliminate common mode failure risk each A / B sub system rack is equipped with dedicated alarm tone resources which are broadcast independently of the other subsystem. To ensure alarm tone intelligibility is maintained a means of A / B synchronisation is required between the two sub systems.

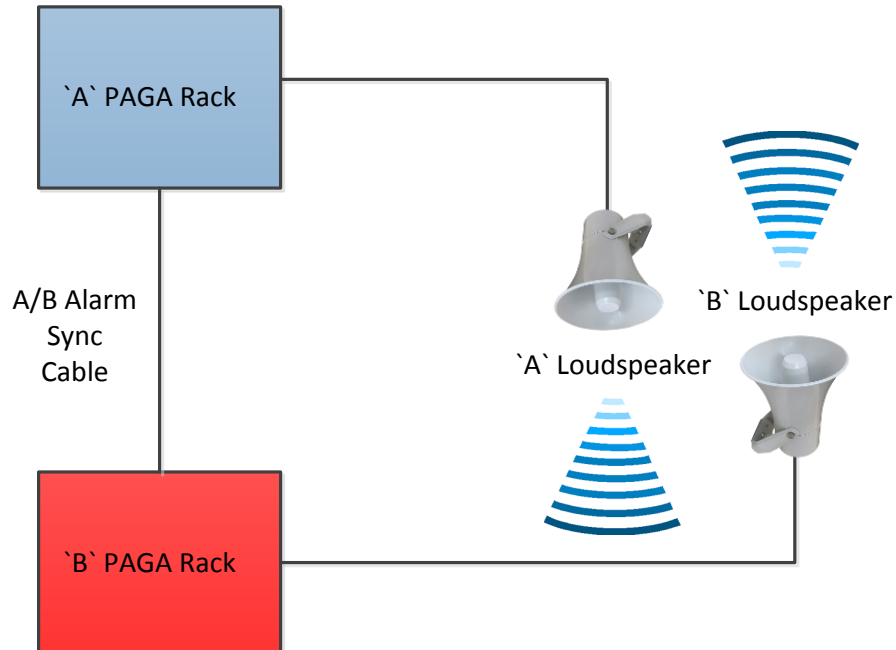# A + B duplicated PAGA / MBS solution

`A` PAGA Rack

`B` Loudspeaker

`A` Loudspeaker

`B` PAGA Rack
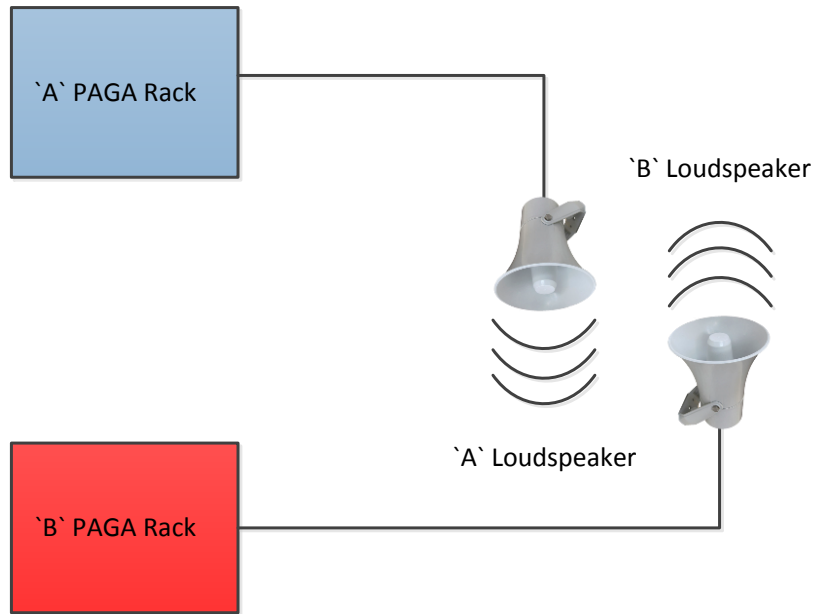
The alarm tone broadcast are held in synchronism by an optically coupled cable which interconnects the A / B sub system central racks. The synchronisation cable is a non-critical standard single twisted pair.

`A` PAGA Rack

A/B Alarm Sync Cable

`B` Loudspeaker

`A` Loudspeaker

`B` PAGA Rack

The interconnecting field cable is terminated to interface devices located in each central rack MDF as follows:
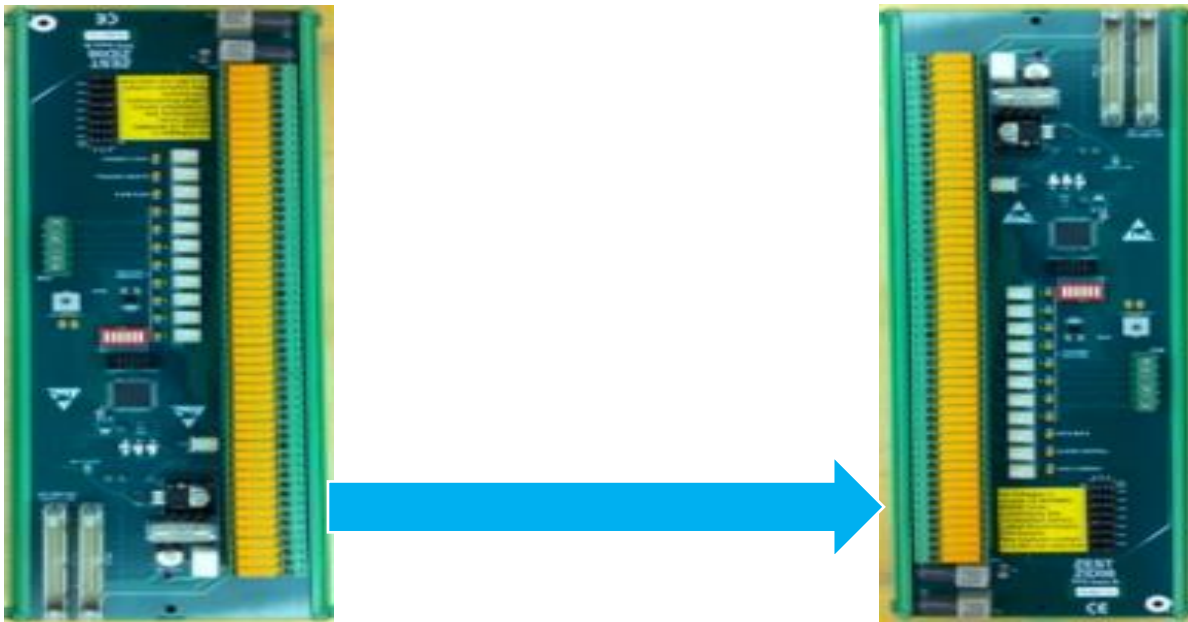
ZID08-34A TERMINATION DEVICE

Sync cable terminal assignment ZID08-34A:

A rack transmit –   TSA 39 (conductor S1) and 40 (conductor S2)

B rack receive –   TSA37 (conductor S1) and 38 (conductor S2)

ZID08 TERMINATION DEVICE

Sync cable terminal assignment ZID08 termination device:

A rack transmit –   TSA 51 (conductor S1) and 52 (conductor S2)

B rack receive –   TSA 53 (conductor S1) and 54 (conductor S2)

Note: - On ZIDo8 termination device option the single pair interconnecting copper cable can be replaced with a multi-mode mode fibre optic cable connection.

The synchronisation cable pair screen is terminated on the 'instrument /telecoms' earth bar.

The cable pair has a minimum cross sectional area of 0.5 mm^2 CSA (cross sectional area) / conductor.

Maximum cable pair conductor CSA is 2.5 mm^2.

The maximum cable length is 2000 Meters.

The pair is polarized and it is critical that S1 conductor is not crossed with S2 conductor otherwise synchronisation will not work.

The cable carries a sync pulse which ensures that the selected A / B alarm sub system `tile` clock in each ZX100 is held in step. The period between sync pulses alters according to the selected alarm tone cadence.

In quiescent a *heartbeat tick* is generated by the `A` ZX100 alarm tone structure (Tile Z1) this is generated at 4 second intervals and has an amplitude of nominal 48VDC.

The duration of the sync pulse is 50mS. The correct transmission of the sync pulse is indicated at the `A` ZX100 by an LED pulsed illumination.

The ZX100 LED display window **"Alarm/PAGA"** is fitted with a red LED called SYNC. This LED pulses `on to indicate dispatch of an alarm sync pulse from the `A` rack. The `B` rack ZX100 SYNC red LED pulses in sympathy with the reception of a valid SYNC pulse from the `A` rack. In the event that the sync

pulse fails to be resolved correctly at the `B` rack then:- (a) the `B` rack SYNC red LED is lit constantly (b) a major system fault is latched by the `B` rack ZX100 supervisory and green HEALTHY LED is extinguished. Images below show the LED indications at the B rack in event of failure to receive a sync pulse from the A system. Note that the HEALTHY LED in the right hand image on the B ZX100 is extinguished.

Possible cause of `B` rack failing to resolve the `A` rack sync pulse is as follows: -

`A` rack de-energized

'A' rack has a fault condition, possibly the ZX100 or the connectivity between the ZX100 and the interface termination device which is preventing despatch of the sync pulse from the A rack.

Sync cable polarity incorrectly terminated (i.e. S1 to S1 / S2 to S2)

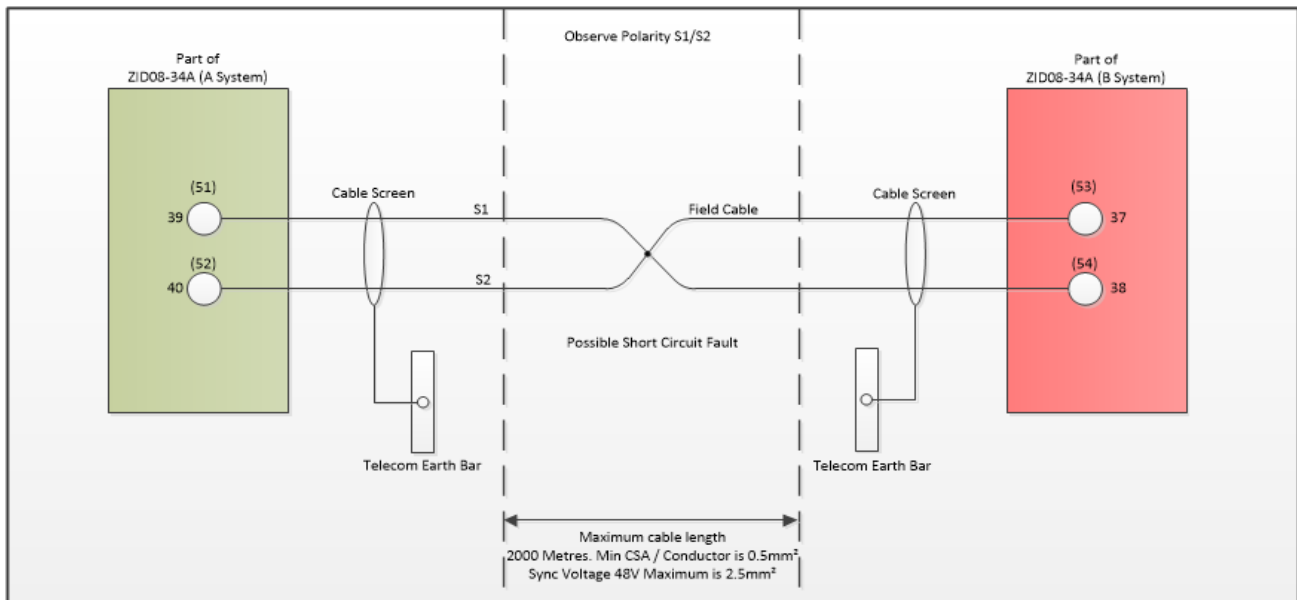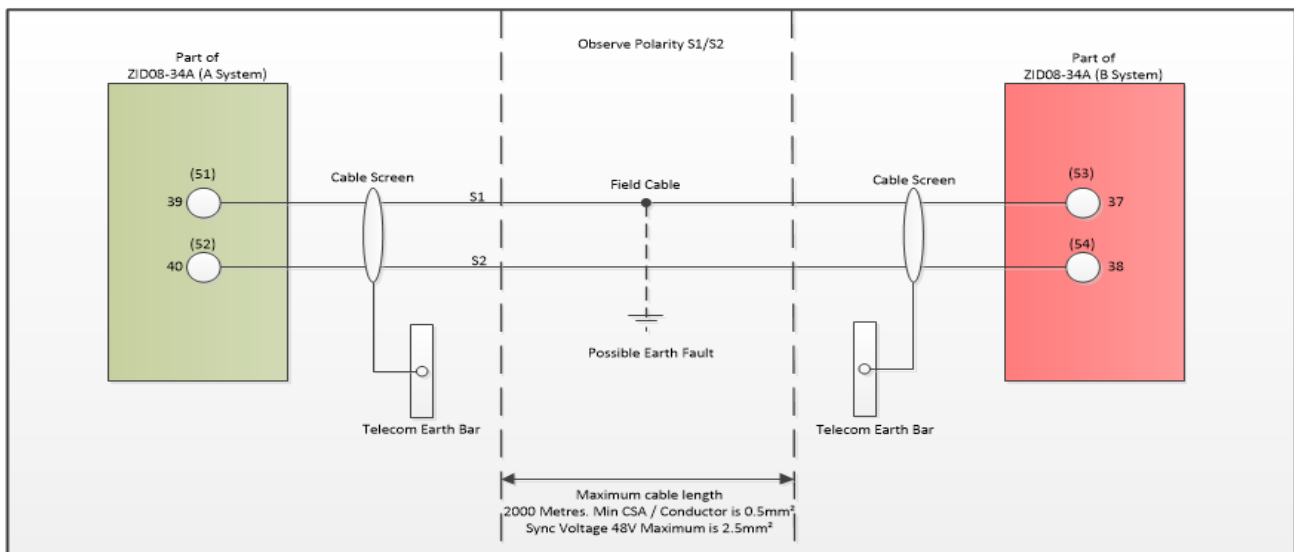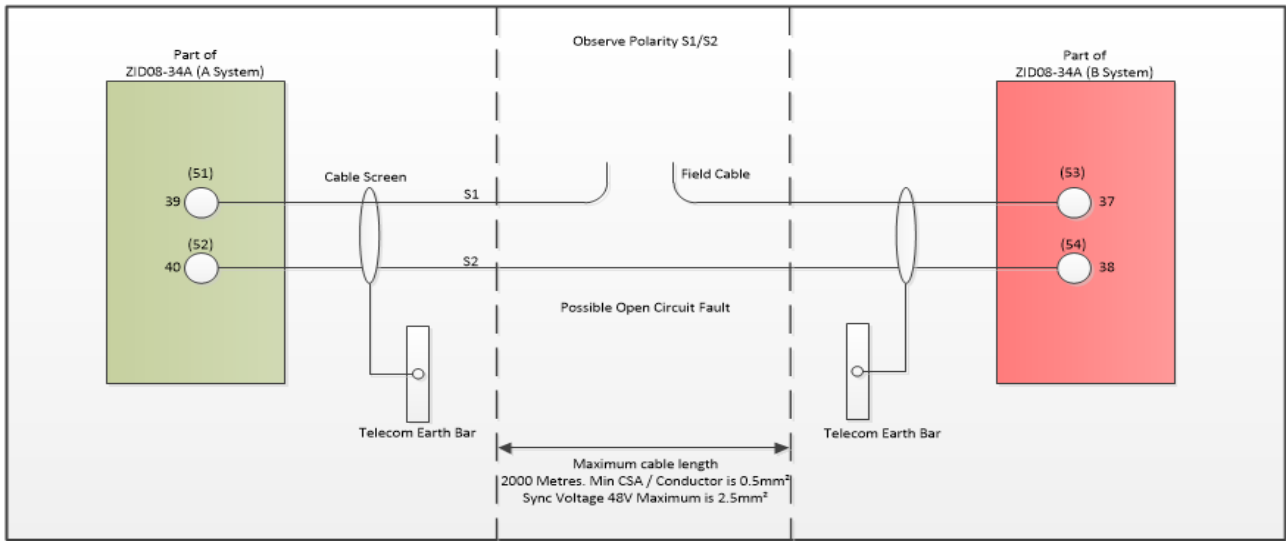Sync cable open / short circuit pair, Sync cable earth fault

In the event of SYNC red LED being permanently illuminated on the `B` rack then the B alarm tone structure inside the B ZX100 is not receiving synchronization pulses from the A system and the A / B alarm tone broadcasts *may* drift out of synchronisation.

The time to resolve a sync failure at the B rack is as follows:-

Cable open circuit   8 seconds

Cable earth fault or short circuit   4 seconds

Diagram 1 (Top)

Part of ZID08-34A (A System)

Observe Polarity S1/S2

Part of ZID08-34A (B System)

(51) 39 — Cable Screen — S1 — Field Cable — (53) 37

(52) 40 — S2 — (54) 38

Possible Open Circuit Fault

Telecom Earth Bar

Telecom Earth Bar

Maximum cable length
2000 Metres. Min CSA / Conductor is 0.5mm²
Sync Voltage 48V Maximum is 2.5mm²

Diagram 2 (Middle)

Part of ZID08-34A (A System)

Observe Polarity S1/S2

Part of ZID08-34A (B System)

(51) 39 — Cable Screen — S1 — Field Cable — Cable Screen — (53) 37

(52) 40 — S2 — (54) 38

Possible Earth Fault

Telecom Earth Bar

Telecom Earth Bar

Maximum cable length
2000 Metres. Min CSA / Conductor is 0.5mm²
Sync Voltage 48V Maximum is 2.5mm²

Diagram 3 (Bottom)

Part of ZID08-34A (A System)

Observe Polarity S1/S2

Part of ZID08-34A (B System)

(51) 39 — Cable Screen — S1 — Field Cable — Cable Screen — (53) 37

(52) 40 — S2 — (54) 38

Possible Short Circuit Fault

Telecom Earth Bar

Telecom Earth Bar

Maximum cable length
2000 Metres. Min CSA / Conductor is 0.5mm²
Sync Voltage 48V Maximum is 2.5mm²

NOTE

1) *Regardless of synchronization status each rack will continue to deliver alarm tone broadcast.*
2) The ZX100 Alarm tone structure is crystal controlled and assuming the A / B racks are initiated simultaneously then the alarm tone broadcast will be delivered in synchronism for many hours regardless of the sync pulse status before noticeable drift in alarm tone is perceived.
3) Each rack must be assigned "receive" or "transmit". This is prescribed by a tamper proof hex switch located on the ZX100 motherboard.
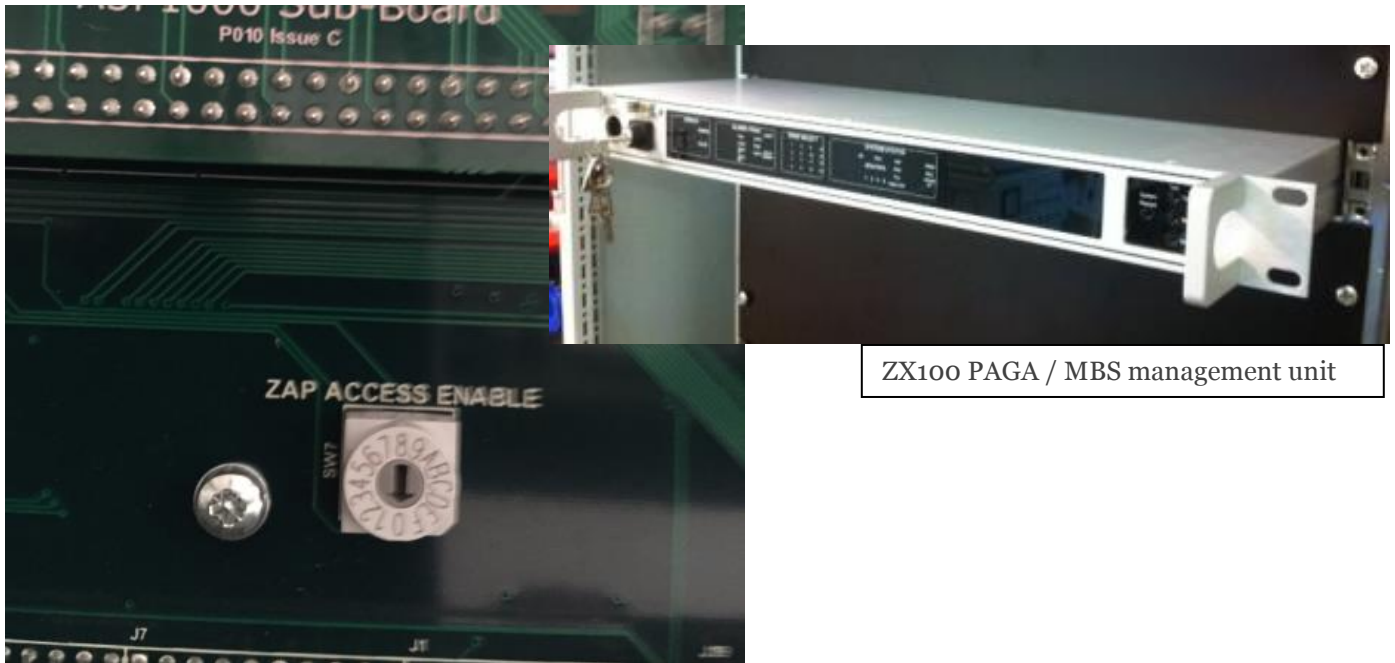
ZX100 PAGA / MBS management unit

The hex switch is accessed by removal of the management unit top cover and is identified by **SW7 ZAP ACCESS ENABLE** and is located centre front just behind the LED display window on the ZX100.

Switch settings must be set thus:-

Rack `A`   Hex switch `1` transmit sync pulses

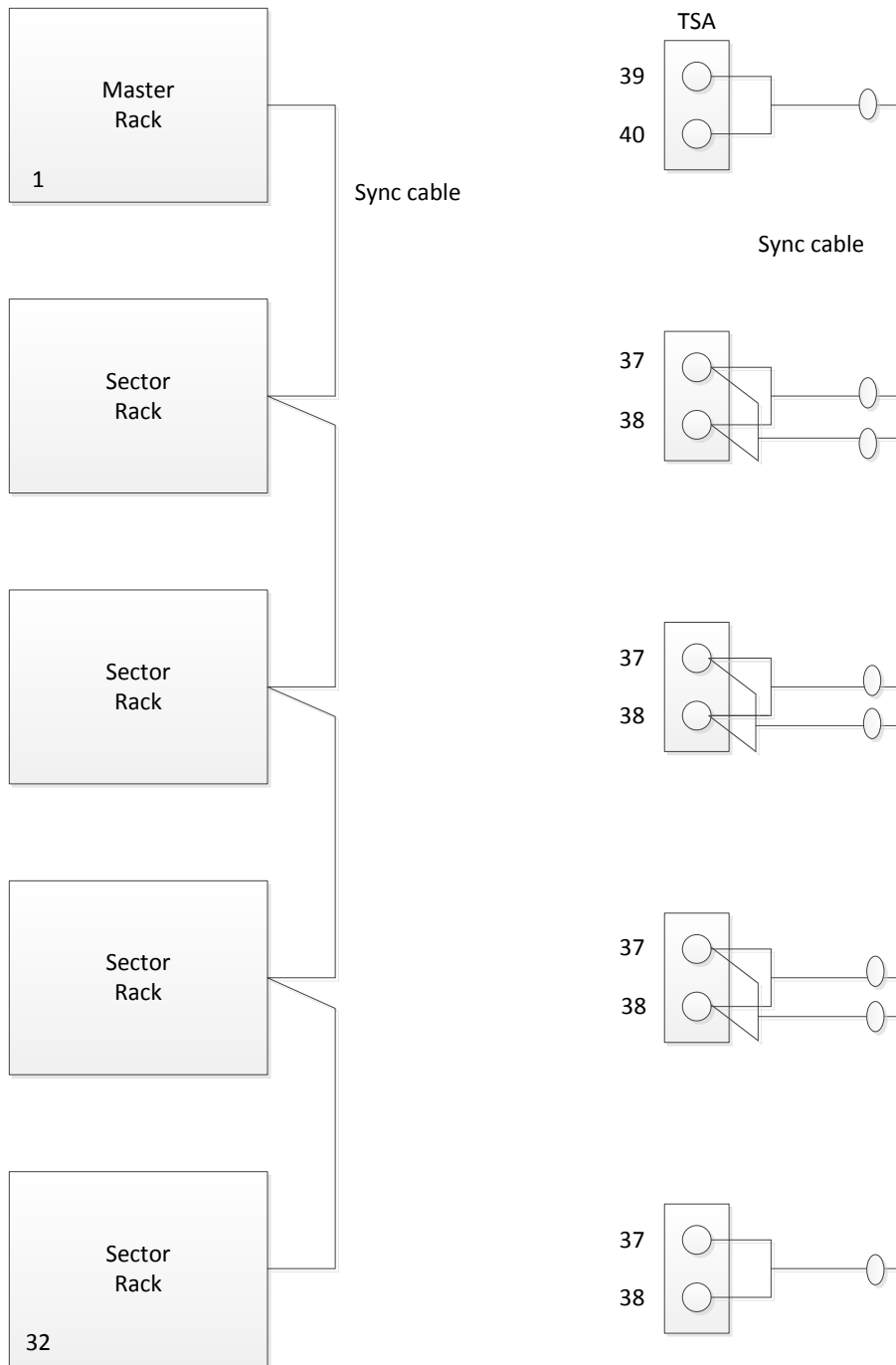Rack `B`   Hex switch `0` receive sync pulses

In the image shown above this ZX100 is set to receive and is by convention identified as the B rack.

For large sites it is not uncommon to assign several 'sector' PAGA racks to provide efficient broadcast distribution, where there is overlap of loudspeaker coverage from different sector racks then alarm synchronisation eliminates possible broadcast of out of phase signals. It is possible to synchronize up to 32 x PAGA sector racks by "daisy chaining" (loop in / out) of the sync cable: - (Note that the term *master* is used to define the source of the sync pulses; in all other respects this rack is identical to the *sector* racks)

TSA

Master
Rack

1

Sync cable

39
40

Sync cable

Sector
Rack

37
38

Sector
Rack

37
38

Sector
Rack

37
38

Sector
Rack

32

37
38

Connection shown for ZID08-34A

Multiple sector alarm synchronisation shows a multi drop field cable architecture, connectivity is identical for ZID08 termination device using TSA 51/52 transmit and TSA53/54 receive.