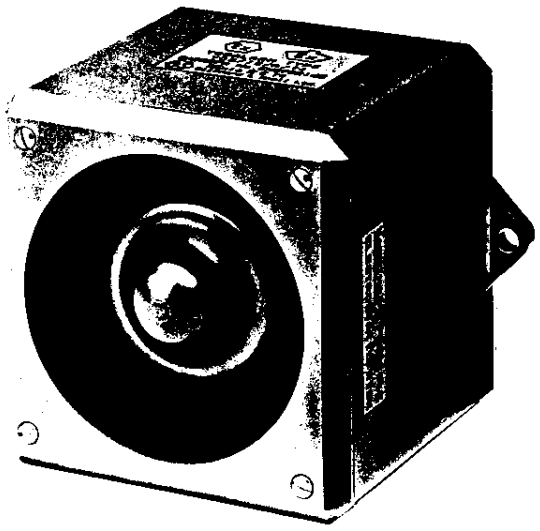
BEKA associates



YODALARM
YO5/ISA/T4

Intrinsically safe audible alarm

Instruction manual

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1 Description

The Yodalarm 2-wire solid state electronic audible alarm produces a loud warning signal within a hazardous area. To avoid confusion between alarm signals the Yodalarm can be set on-site to generate any one of 11 unique first stage alarm signals. Eight of the first stage settings can produce distinct second stage alarm signals. The Yodalarm can be set to generate simple continuous tones, single or dual tones with slow or fast switching rates, slow or fast whoop, swept frequency or a siren. A maximum continuous output of 105dB(A) at 1 metre is available, but this can be reduced by approximately 15dB(A) using the internal volume control.

2 Operation of the Yodalarm Circuit

The Yodalarm uses a microprocessor to generate the desired sound. Single or dual stage alarms can be activated using either two or three wire circuits. Fig 1 shows a simplified block diagram of the sounder. It has two sets of terminals in parallel, each set numbered 1 to 4. One set allows connections from the safety barriers, the second set has been provided for the end-of-line resistors (when required).

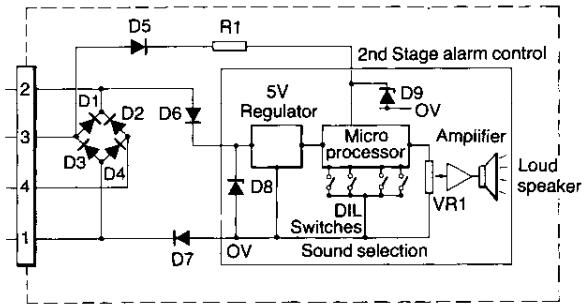


Fig 1 Simplified Yodalarm block diagram

2.1 Single Stage Alarm

The Yodalarm can be operated as a single stage alarm. The certified sounder must always be powered from an intrinsically safe source (zener or isolating barrier). The maximum output will be obtained when the supply is connected between the sounder terminals 1 (negative) and 2 (positive), see Fig 1. The current flows from the sounder terminal 2 to the 5V regulator via D6. The current returns to the sounder terminal 1 via D7. The 5V regulator is protected by D8, a 15V zener diode (this zener is protected by the resistance of the certified barrier powering the sounder). A microprocessor is used to generate the desired sound. The sound is selected using four dual-in-line (DIL) switches. The DIL switches are mounted on the sounder printed circuit board (pcb). The sound is amplified to drive the loudspeaker. The volume is adjusted using VR1, which is mounted on the sounder pcb.

2.2 Dual Stage Alarm

The Yodalarm can also be operated as a dual stage alarm. The dual alarm can be activated using either two or three wires powered from an intrinsically safe source (zener or isolating barrier).

The two wire solution requires supply polarity reversal. Sounder terminals 3 and 4, see Fig 1, are now used. The Yodalarm is energised via D1 to D4, a full wave bridge, ensuring that the positive is always connected to the 5V regulator via D6. The return current flows to the full wave bridge via D7. When terminal 4 is positive with respect to terminal 3; the Yodalarm will produce the first stage alarm signal (as described above). When the supply polarity is reversed, so that terminal 3 is positive with respect to terminal 4, an additional current flows into the microprocessor via D5. The additional current flowing into the microprocessor activates the second stage alarm. A 5V zener diode, D9, and resistor R1, protect the microprocessor. The sounder is powered via the full wave bridge as described above.

If supply reversal is not possible, a dual stage alarm can be implemented using a single polarity power supply and a three wire connection. The power is applied with positive connected to terminal 2 and the return via terminal 1 (the same as the single stage alarm described above). The second stage alarm is activated via a third wire which provides a positive voltage via terminal 3. The additional current (approx 5mA) enters the microprocessor via diode D5, which results in the second stage alarm being generated (see section 6 "Application Examples" for details).

3 Intrinsic Safety of the Yodalarm

The Yodalarm has been designed and certified intrinsically safe. The flow of stored energy flowing from within the Yodalarm circuit is prevented using internally mounted safety diodes, safety resistors and potting of the pcb.

The BASEEFA apparatus certificate allows the Yodalarm to be connected to an intrinsically safe supply (zener or isolating barrier) whose parameters do not exceed the following:–

$U_{max:out}$ = 30V
$I_{max:out}$ = 133mA
$W_{max:out}$ = 1.3W

This certification permits the sounder to be powered from the majority of certified zener and isolating type barriers. The certificate specifies many of the industry standard safety barriers. The actual barrier types and combination of barriers are determined by the application.

4 Installation

4.1 Mounting

The Yodalarm sounder may be mounted in any plane, but avoid positioning the sounder upwards where water may collect in the sounder horn. The enclosure can be directly mounted on any flat surface using the two M8 fixing holes. The cable entry is via a single untapped hole which will accept an M20 gland or conduit fitting.

WARNING

The Yodalarm type YO5/ISA/T4 has been designed for use in hazardous areas. It must at all times be powered via a certified intrinsically safe zener or isolating barrier (see section 6 Application Examples). Direct connection to a power supply invalidates the safety of the Yodalarm and it will also cause permanent damage to the Yodalarm. See section 5 Testing.

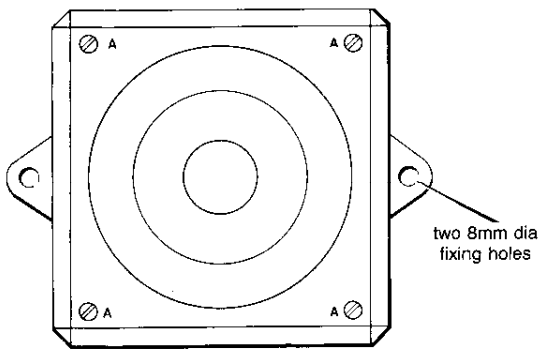


Fig 2 Location of cover screws

4.2 Installation Procedure

(i) Remove the sounder cover by unscrewing the four 'A' screws, see Fig 2. The terminals and electronics are mounted on the rear surface of this cover. The cover remains attached to the housing by a plastic retaining strap.
(ii) The sound selection DIL switch can now be set to produce the desired sound (see Table 1).
(iii) Connect field wiring to the appropriate terminals (see section 6 Applications Examples).
(iv) Switch on the loop and adjust sound level using the pcb mounted volume control, see Fig 3
(v) Replace lid and fit the four 'A' screws.

Table 1 Design table

FIRST STAGE SIGNAL (sound level/current)*	SECOND STAGE SIGNAL (sound level/current)*	DIL SWITCH in open position
Continuous tone 800Hz *(101dB(A)/21mA)*	**Alternate two tone** 800/1000Hz 0.5sec *(101dB(A)/23mA)*	1 - - -
Continuous tone 2400Hz *(105dB(A)/32mA)*	**Alternate two tone** 2400/2900Hz at 0.5sec *(101dB(A)/34mA)*	1 2 3 -
Interrupted tone 800Hz at 0.5sec *(98dB(A)/17mA)*	**Alternate two tone** 800/1000Hz at 0.5sec *(101dB(A)/23mA)*	1 2 - -
Interrupted tone 2400Hz at 0.5sec *(102dB(A)/23mA)*	**Alternate two tone** 2400/2900Hz at 0.5sec *(105dB(A)/34mA)*	1 - - 4
Alternate two tone 800/1000Hz at 0.5sec *(101dB(A)/23mA)*	**Same as first stage signal**	- - - -
Alternate two tone 800/1000Hz at 0.5sec *(101dB(A)/23mA)*	**Alternate fast two tone** 800/1000Hz at 0.25sec *(101dB(A)/23mA)*	1 - 3 -
Alternate two tone 2400/2900Hz at 0.5sec *(105dB(A)/34mA)*	**Same as first stage signal**	- 2 3 -
Alternate fast two tone 800/1000Hz at 0.25sec *(101dB(A)/23mA)*	**Same as first stage signal**	- - 3 -
Slow whoop 500-1200Hz at 3sec *(101dB(A)/23mA)*	**Continuous tone** 800Hz *(101dB(A)/21mA)*	1 2 - 4
Fast whoop 500-1200Hz at 0.1sec *(101dB(A)/19mA)*	**Siren** at 3 sec *(100dB(A)/22mA)*	1 2 3 4
Swept frequency 1200-500Hz at 1sec *(100dB(A)/36mA)*	**Continuous tone** 800Hz *(101dB(A)/21mA)*	1 - 3 4
Siren at 3sec *(100dB(A)/22mA)*	**Same as first stage signal**	- 2 3 4

*24V dc supply via zener barrier

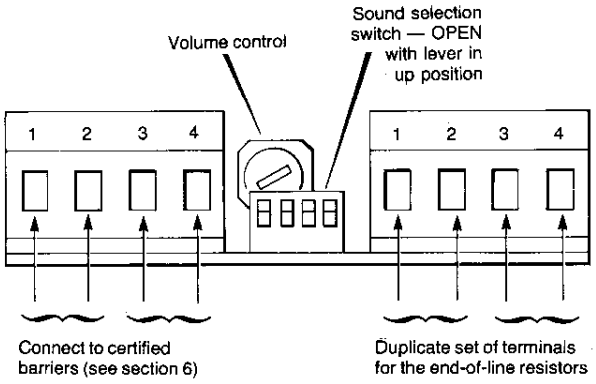


Fig 3 Location of terminals and volume control

5 Testing

Should the Yodalarm not operate in the loop check the following:

(i) Measure voltages on the safe area side of the certified zener or isolating barriers.
(ii) Check the wiring.
(iii) If the sounder still does not work then disconnect the sounder and take it to a safe area workshop for further testing.

(iv) **The following tests are carried out in a safe area workshop.**
Connect sounder to a 24V dc power supply via a 340Ω resistor as shown in Fig 4. **Direct connection of the Yodalarm to the 24V supply will cause permanent damage to the sounder**. If the sounder operates correctly disconnect the wires from terminals 1 and 2. Now connect the wires to terminals 3 and 4 (positive) **(again via the 340Ω resistor)**, and then reverse the polarity ie reconnect the wires so that the positive goes to terminal 3 and the negative to terminal 4.
(v) If the Yodalarm operates with the test in (iv), re-check the model numbers of the safety barriers and the wiring.
(vi) If the Yodalarm still does not operate contact your nearest BEKA distributor.

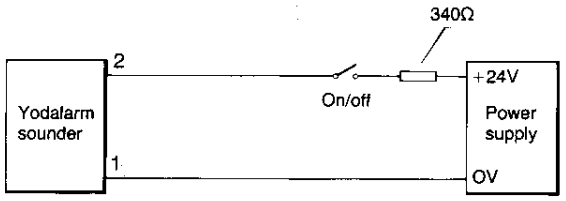


Fig 4 Testing the Yodalarm in a safe area workshop

6 Application Examples

This section is split into single stage and dual stage alarms each shown with zener and isolating barriers. Examples have been included to show end-of-line monitoring. Appendix 1 shows typical zener and isolating barriers. Appendix 2 shows the corresponding maximum permissible cable parameters.

6.1 Single Stage Alarm using Zener Barriers

The number of barrier channels required is determined by the sounder control switch. The barrier polarity being determined by the power supply polarity. The examples show positive power supplies with positive polarity barriers. Negative power supplies would require negative polarity barriers. Fig 5 is the simplest solution which is used when the switch is in series with the positive from the supply. This uses a single channel, 28V 300Ω positive, zener barrier. The current returns to the power supply via a connection to the barrier earth bar. Fig 6 has the switch in series with the return to the power supply. This requires the addition of a 28V positive, diode return zener barrier.

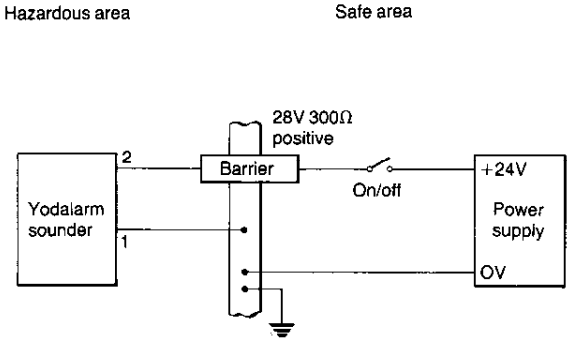


Fig 5 Single stage alarm, single channel barrier

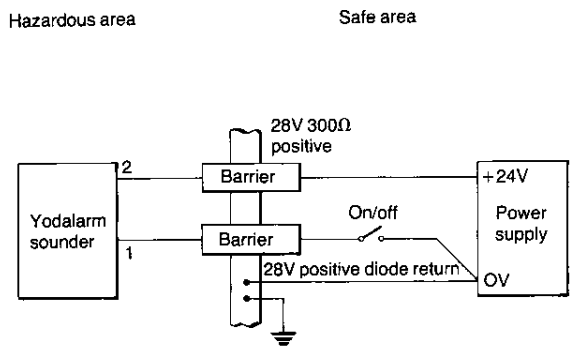


Fig 6 Single stage alarm, two channel barrier

6.2 Single Stage Alarm with end-of-line monitoring using Zener Barriers

Fig 7 shows the safe area located control/end-of-line monitoring circuit connected to the hazardous area located Yodalarm via a 28V 300Ω ac zener barrier. The end-of-line resistor can be connected across the additional terminal block mounted on the Yodalarm pcb. This terminal block is in parallel with the terminal block which is connected to the safety barriers. The positive polarity 24V from the control electronics will activate the sounder. Reverse polarity monitoring (minus 24V) is used to detect the end-of-line resistor. The BASEEFA certificate specifies that the end-of-line *resistor must be a wire wound or film type with a resistance of not less than 750 ohms and a power rating not less than 2 watts; or not less than 4700 ohms and a power rating not less than 0.4 watts.*

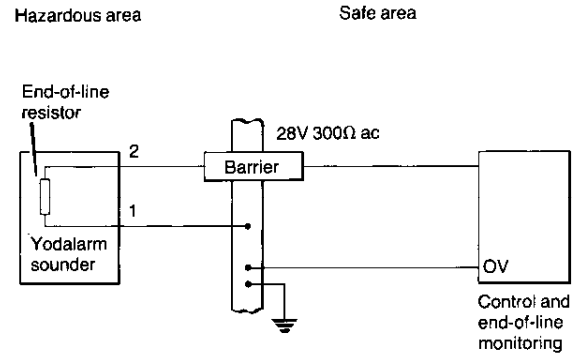


Fig 7 Single Stage Alarm with end-of-line monitoring

6.3 Single Stage Alarm using an Isolating Barrier

Fig 8 shows a certified isolating barrier driving a Yodalarm. The isolating barrier needs to provide a minimum of 9V at 36mA (maximum of 15V). This type of isolating barrier is normally designed to operate solenoid values. Appendix 1 shows which solenoid drivers have systems certification.

6.4 Dual Stage Alarm using Zener Barriers

The dual stage alarm can be actived with either two wires and a dual polarity power supply; or three wires and a single polarity supply.

6.4A Dual Polarity Supply – 2 Wires

Fig 9 shows a dual polarity supply connected via a 28V 300Ω ac zener barrier. The second stage alarm is activated by reversal of the power supply polarity.

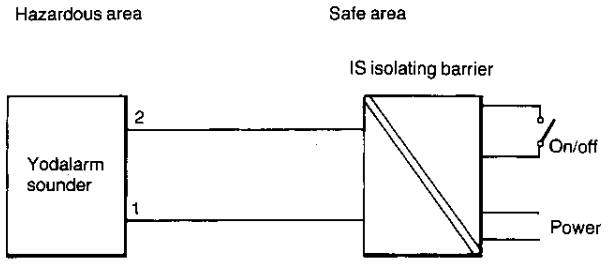


Fig 8 Single Stage Alarm using an isolating barrier

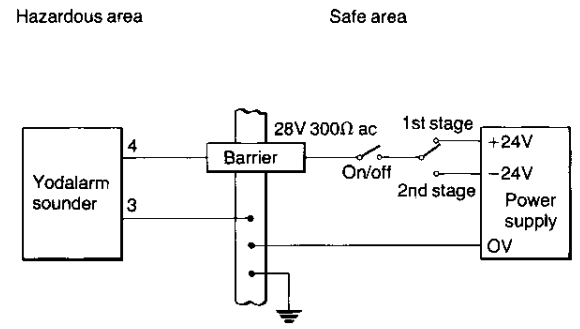


Fig 9 Dual Stage Alarm, dual polarity supply – 2 wires

6.4B Dual Voltage Supply, Single Polarity – 3 Wires

Fig 10 shows a dual voltage, single polarity supply. The 24V positive being connected to the Yodalarm via a 28V 300Ω positive zener barrier. The second stage alarm is selected by applying an additional positive 10V (at 5mA) to the Yodalarm via a 12V 1KΩ positive zener barrier.

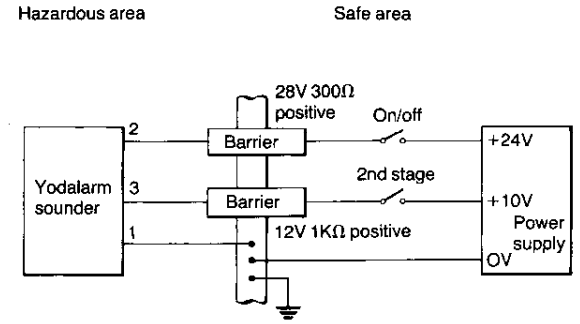


Fig10 Dual Stage Alarm, single polarity, dual voltage supply

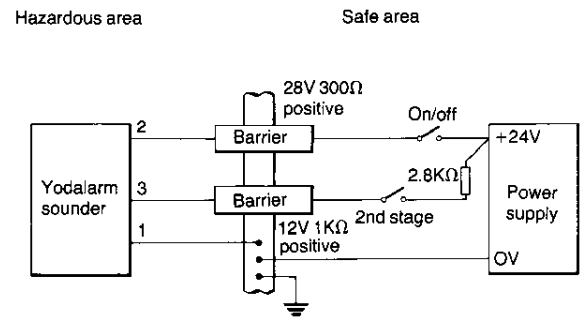


Fig11 Dual Stage Alarm, single polarity, single voltage supply

6.4C Single Voltage, Single Polarity – 3 Wires

Fig 11 uses a single polarity, single voltage supply. It is similar to the solution in Fig 10, except the 10V (at 5mA) is provided from the 24V positive supply via a 2.8KΩ resistor.

6.4D Single Voltage, Single Polarity – 2 Wires

Fig 12 uses a single polarity supply and two wires. The polarity reversal is achieved using a certified intrinsically safe Polarity Switch Module. The Yodalarm and Polarity Switch Module are protected using a 28V 300Ω positive safety barrier and a 28V positive diode return safety barrier.

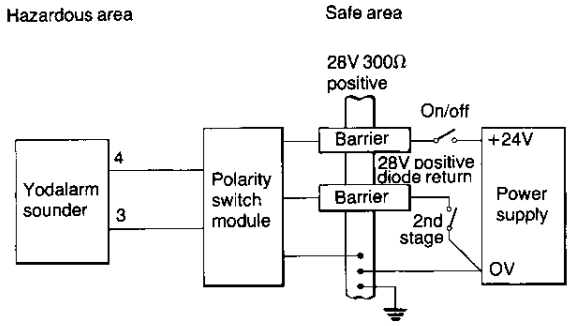


Fig 12 Dual Stage Alarm with a Polarity Switch Module

6.5 Dual Stage Alarm with end-of-line monitoring using Zener Barriers

Fig 13 shows the safe area located control/end-of-line monitoring circuit connected to the hazardous area located Yodalarm via a 28V 300Ω ac and a 12V 1KΩ positive zener barrier. The end-of-line resistor can be connected across the additional terminal block located inside the Yodalarm. This terminal block is in parallel with the terminal block which is connected to the safety barriers. The positive 24V from the control electronics will activate the sounder's first stage alarm. The second stage alarm is controlled by applying an additional 10V positive (at 5mA) to the Yodalarm via a 12V 1KΩ positive zener barrier. Reverse polarity monitoring (less than 1V) is used to detect the end-of-line resistor. The BASEEFA certificate specifies that the end-of-line *resistor must be a wire wound or film type with a resistance of not less than 750 ohms and a power rating not less than 2 watts; or not less than 4700 ohms and a power rating not less than 0.4 watts.*

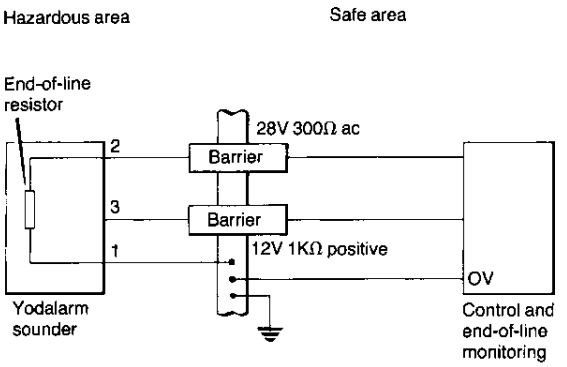


Fig 13 Dual Stage Alarm with end-of-line monitoring

6.6 Dual Stage Alarm using Isolating Barriers

Fig 14 shows a certified isolating barrier driving a Yodalarm. The isolating barrier needs to provide a minimum of 9V at 36mA (maximum of 15V). This type of isolating barrier is normally designed to operate solenoid valves. Appendix 1 shows which solenoid drivers have systems certification. The polarity reversal is achieved using the intrinsically safe relay.

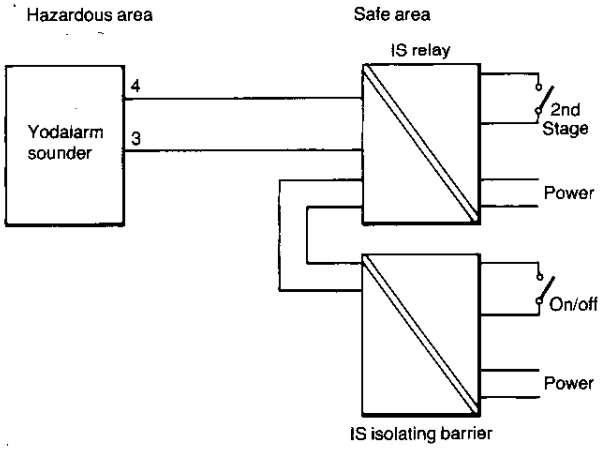


Fig 14 Dual Stage Alarm using isolating barriers

Appendix 1: Typical Zener & Isolating Barriers

	Pepperl + Fuchs	STL	R Stahl	MTL
Fig 2	Z129/Ex	E951+	8901/31-280/093/60	MTL728+, or MTL708+
Fig 3	Z187/Ex	E965+	8901/31-280/093/60 8901/33-280/000/60	MTL787+, or MTL707+, or MTL 787S+
Fig 4	–	E954	8901/33-280/093/60	MTL728ac
Fig 5	ZG27/Ex*	–	–	MTL2241*, or MTL302I
Fig 6	–	E954	8901/32-280/093/60	MTL728ac
Fig 7	–	–	8901/31-280/093/60 8901/31-120/012/60	MTL728+, or MTL 708+ MTL764+
Fig 8	–	–	8901/31-280/093/60 8901/31-120/012/60	MTL728+, or MTL708+ MTL764+
Fig 9	–	E965+ PS90	–	–
Fig 10	–	–	8901/32-280/093/60 8901/31-120/012/60	MTL728ac MTL764+
Fig 11	–	–	–	MTL2241* (Power), or MTL 3021 (Power), MTL2215 (Relay)

*These solenoid drivers have systems certification with the Yodalarm

Appendix 2: Maximum Permissible Cable Parameters

	Capacitance μF	Inductance mH	L/R ratio μH/Ω	
Fig 2	0.13	4.2	55	28V 300Ω dc
Fig 3	0.13	4.2	55	28V 300Ω dc & 28V Diode dc
Fig 4	0.13	4.2	55	28V 300Ω ac
Fig 5	0.11	4.8	54	ZG27/Ex
	0.13	4.2	55	MTL2241 or MTL3021
Fig 6	0.13	4.2	55	28V 300Ω ac
Fig 7	0.13	3.5	42	28V 300Ω dc & 12V 1KΩ dc
Fig 8	0.13	3.5	42	28V 300Ω dc & 12V 1KΩ dc
Fig 9	0.13	4.2	55	28V 300Ω dc & 28V Diode dc
Fig 10	0.06	3.5	42	28V 300Ω ac & 12V 1KΩ dc
Fig 11	0.13	4.2	55	MTL2241 & MTL 2215 or MTL 3021 & MTL2215

Note: Values given are for Group IIC. The values for Group IIB and Group IIA are three and eight times these values respectively

Appendix 3: Specification

Power Supply

Voltages	
Supply (nominal)	24V, 18V and 12V dc via suitable barriers
Max across sounder	15V dc (Yodalarm has an internal 16V zener diode)
Min across sounder	9V dc
Current	36mA max (see design table)

Output

Continuously rated	
Sound level at 1 metre	105 dB(A) (see design table)
Volume control	15 dB(A) level reduction
2 stage alarm	by polarity reversal

Intrinsic Safety

BASEEFA	
standard	BS5501:Part 7:1977:EN50 020
code	EEx ia IIC T4
certificate numbers:	
apparatus	BAS Ex87B2163
system	BAS Ex 872300
IS supply	
Umax:in	30V dc
Imax:in	133mA
Wmax:in	1.3W
location	Zone 0, 1 or 2
installation	The Yodalarm type YO5/ISA may be connected to any certified intrinsically safe zener barrier whose parameters do not exceed the IS supply values shown above. See certificate and AG: Yodalarm for full details

Environmental

operating temperature	−25 to +40°C
storage temperature	−40 to +70°C
humidity	to 95% RH at 40°C
case	IP55 housing, moulded ABS

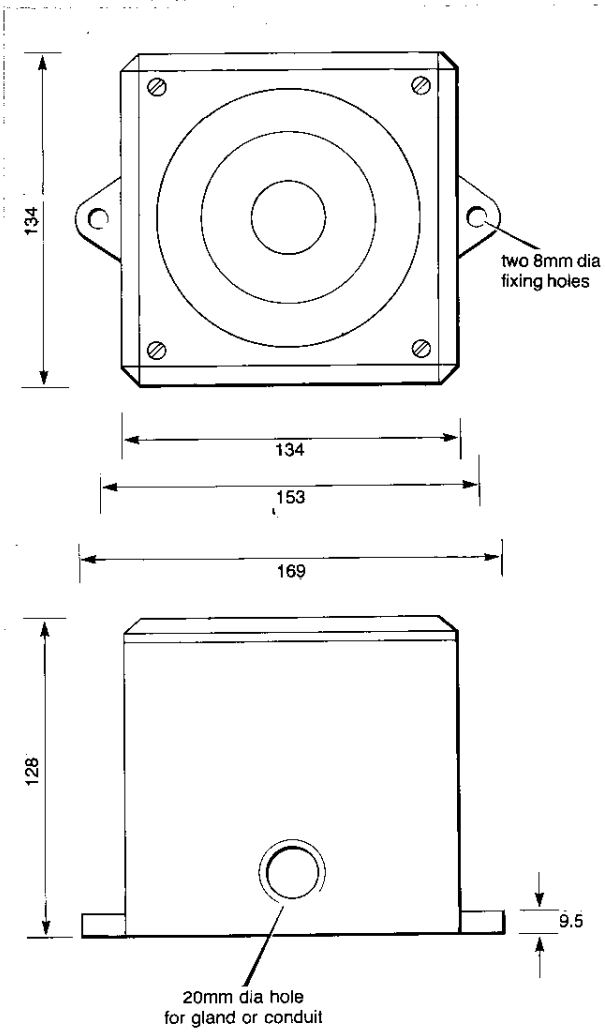
Mechanical

terminals	screw clamp for two 1.5mm² conductors. Separate input and output terminal blocks
weight	0.7g

Accessories

tag plate	embossed metal tag plate screwed to side of sounder

DIMENSIONS (mm)



HOW TO ORDER: please specify

model number	Yodalarm type YO5/ISA/T4

Accessory item:

embossed metal tagging plate	specify legend required

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