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U1S S2188 S2207

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GB 2295073 A **WO 88/05979 A1** **US 4054910 A**

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INT CL^6 **H04B , H04H , H04N**
Online: WPI, JAPIO, INSPEC

(54) Transmission of video and audio information

(57) An apparatus for security surveillance uses a wide-band operational amplifier (A1) to convert a voltage from an image sensor 29 e.g. a video camera into a differential line driver current with a superimposed common mode audio voltage signal, applied to line pair W2, W3 of a multiple way transmission cable, and relayed thereby to a remote base station including a tv/video monitor 65 at which the video and audio signals are separated by a differential receiver amplifier A2 and a voltage tapping across a load resistor Rb. The differential video current drive overcomes the capacitance to ground signal attenuation and enables the operational range to be extended. Further improvement may be obtained through use of twisted pair screened cables. Power supply voltages may be sent via two lines W1, W4 and ancillary signals relating to a bell push, door latch, IR beam may be transmitted through an additional line pair.

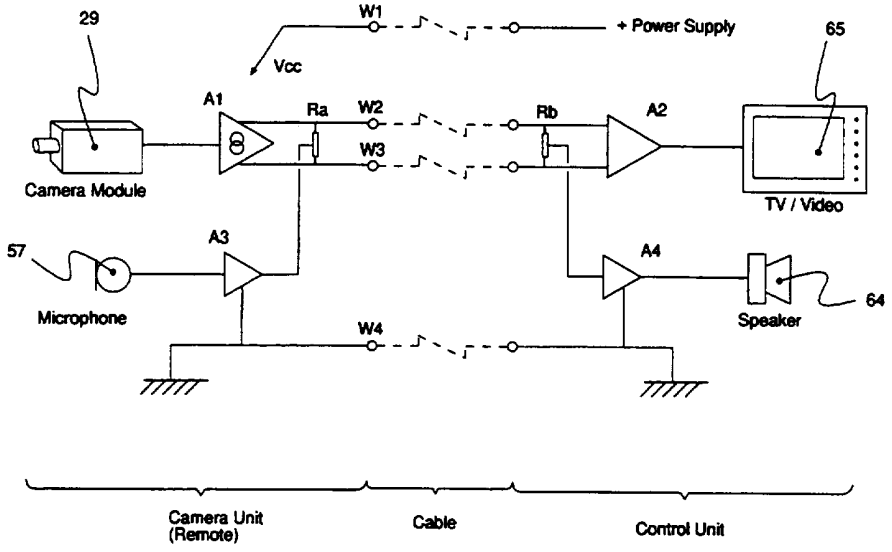


Figure 1

GB 2 319 712 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

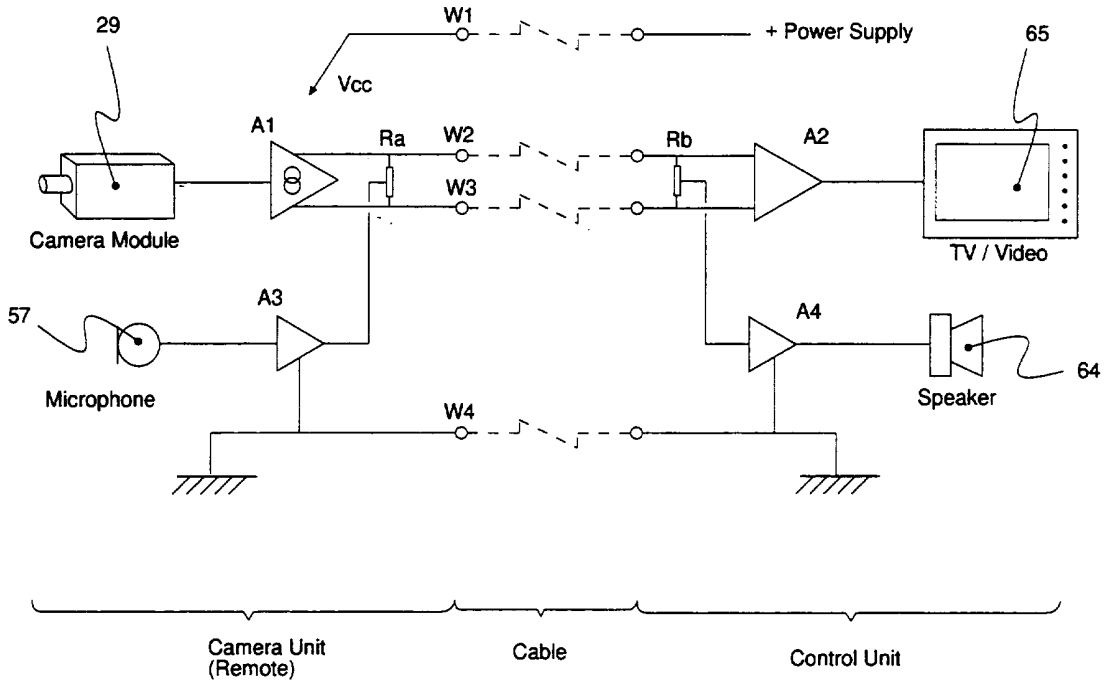

29
W1
+ Power Supply
65
Vcc
A1
Ra
W2
Rb
A2
W3
Camera Module
TV / Video
A3
A4
57
64
Microphone
Speaker
W4
Camera Unit
(Remote)
Cable
Control Unit

Figure 1

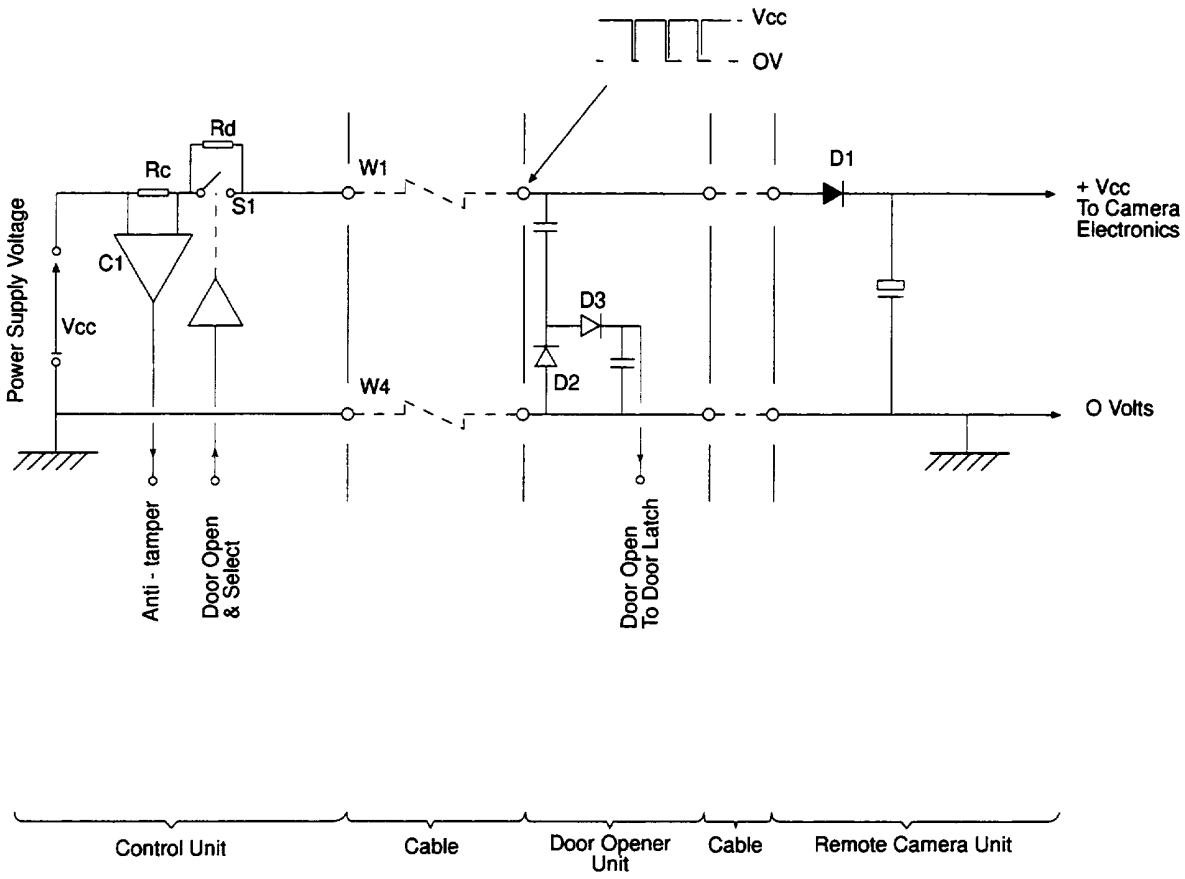

Vcc
OV
Rd
Rc
S1
W1
D1
+ Vcc
To Camera
Electronics
Power Supply Voltage
C1
Vcc
D3
D2
W4
O Volts
Anti - tamper
Door Open
& Select
Door Open
To Door Latch
Control Unit
Cable
Door Opener
Unit
Cable
Remote Camera Unit

Figure 2

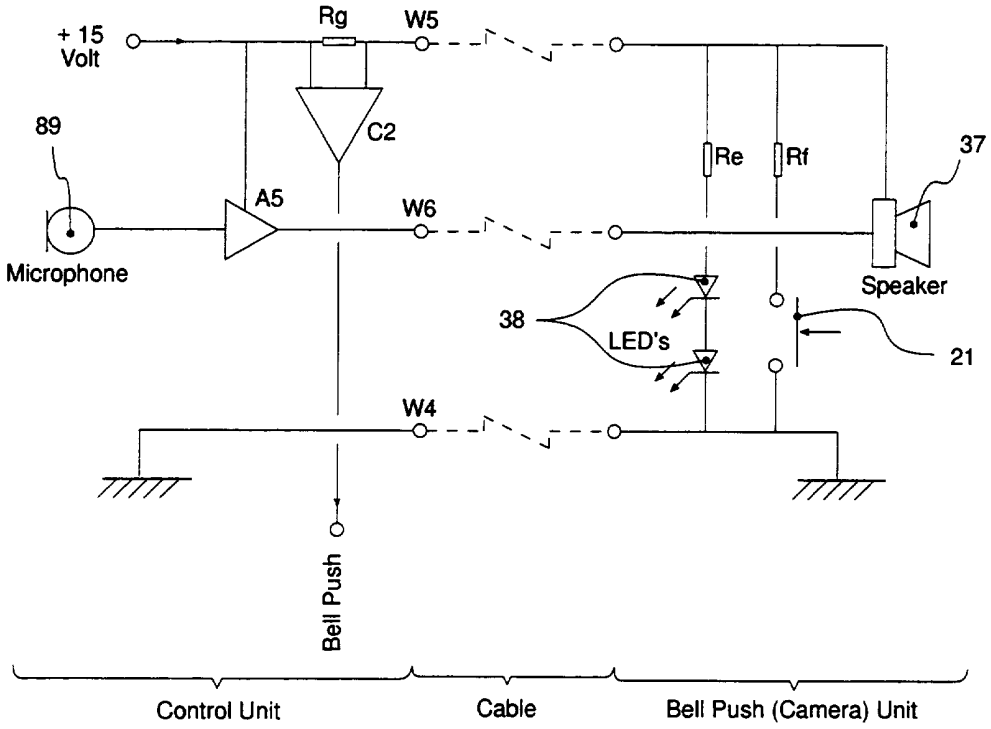

+ 15
Volt
Rg
W5
89
C2
Re
Rf
37
A5
W6
Microphone
Speaker
38
LED's
21
W4
Bell Push
Control Unit
Cable
Bell Push (Camera) Unit

Figure 3

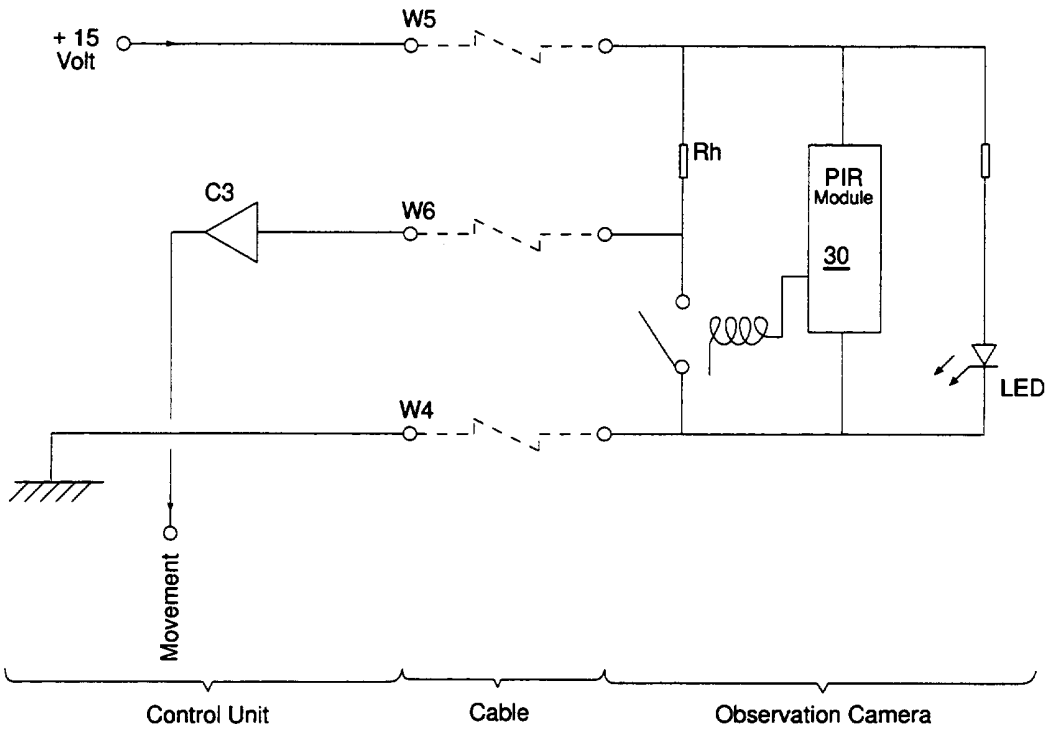

+ 15
Volt
W5
Rh
PIR
Module
30
C3
W6
W4
LED
Movement
Control Unit
Cable
Observation Camera

Figure 4

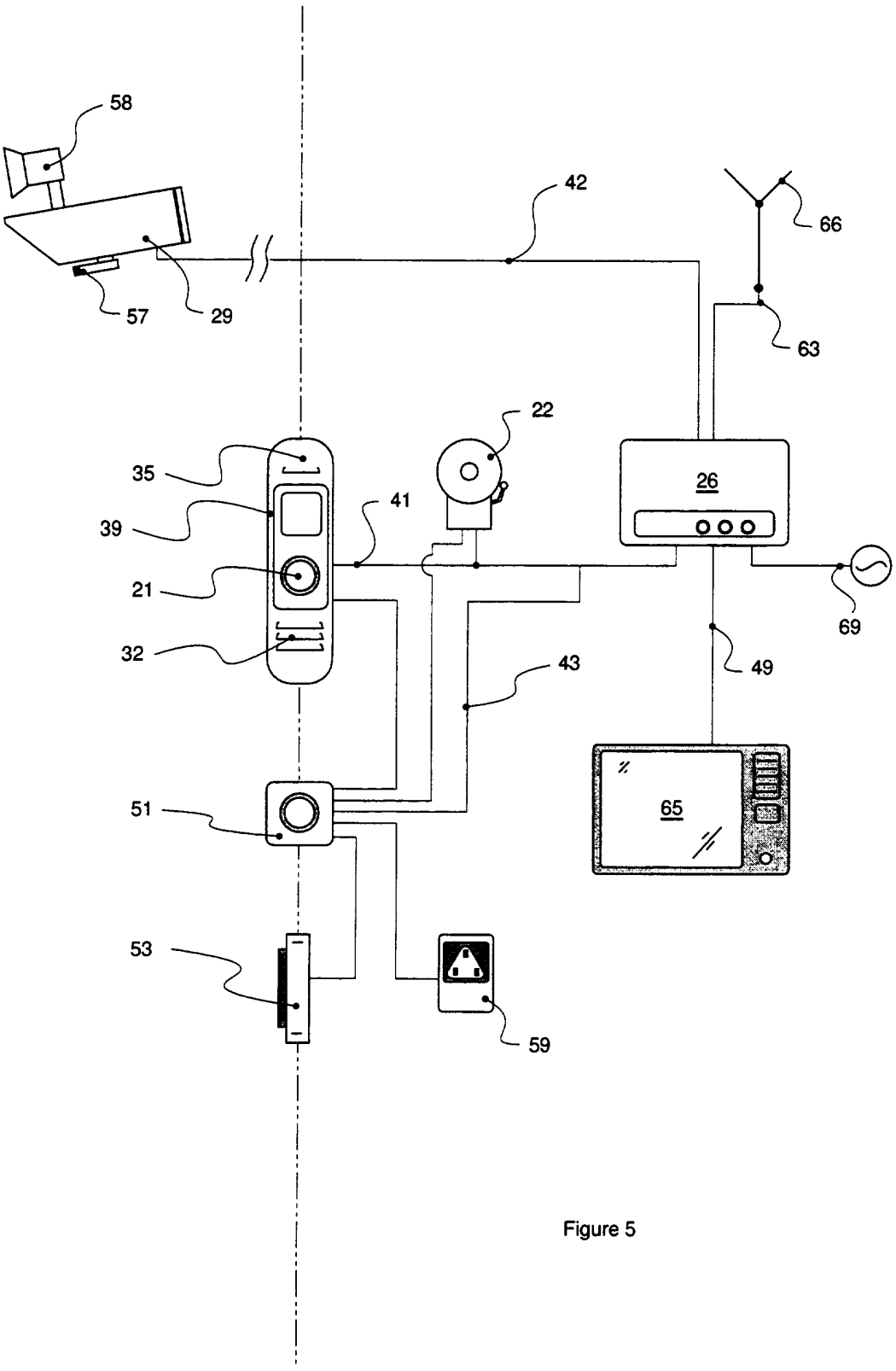


Figure 5

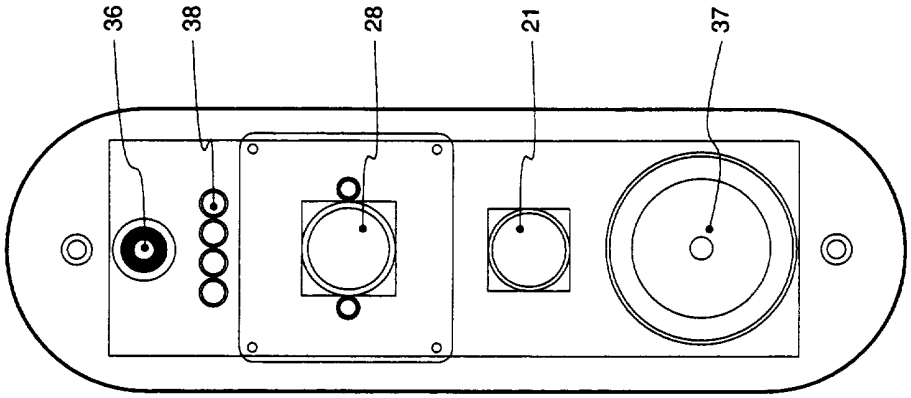


Figure 6D

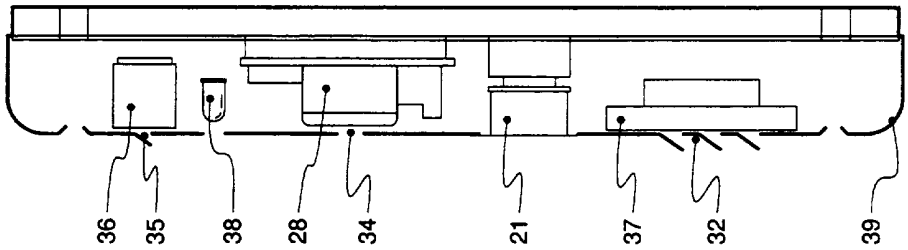


Figure 6C

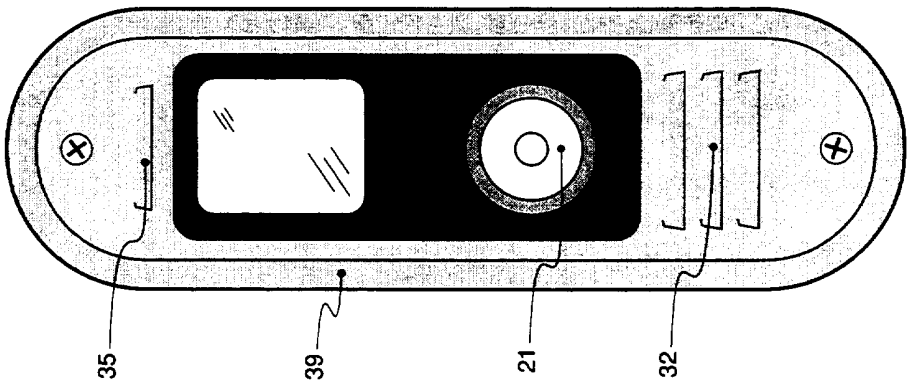


Figure 6B

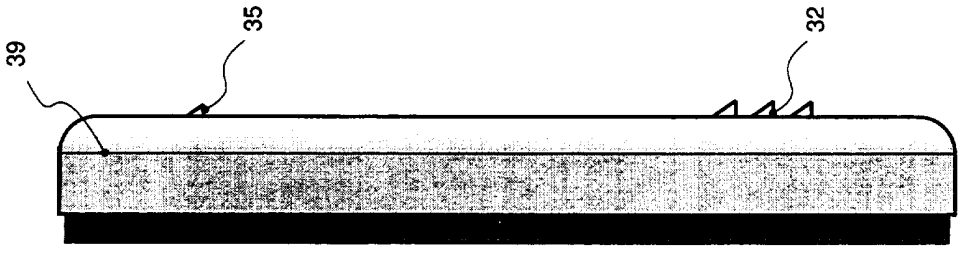


Figure 6A

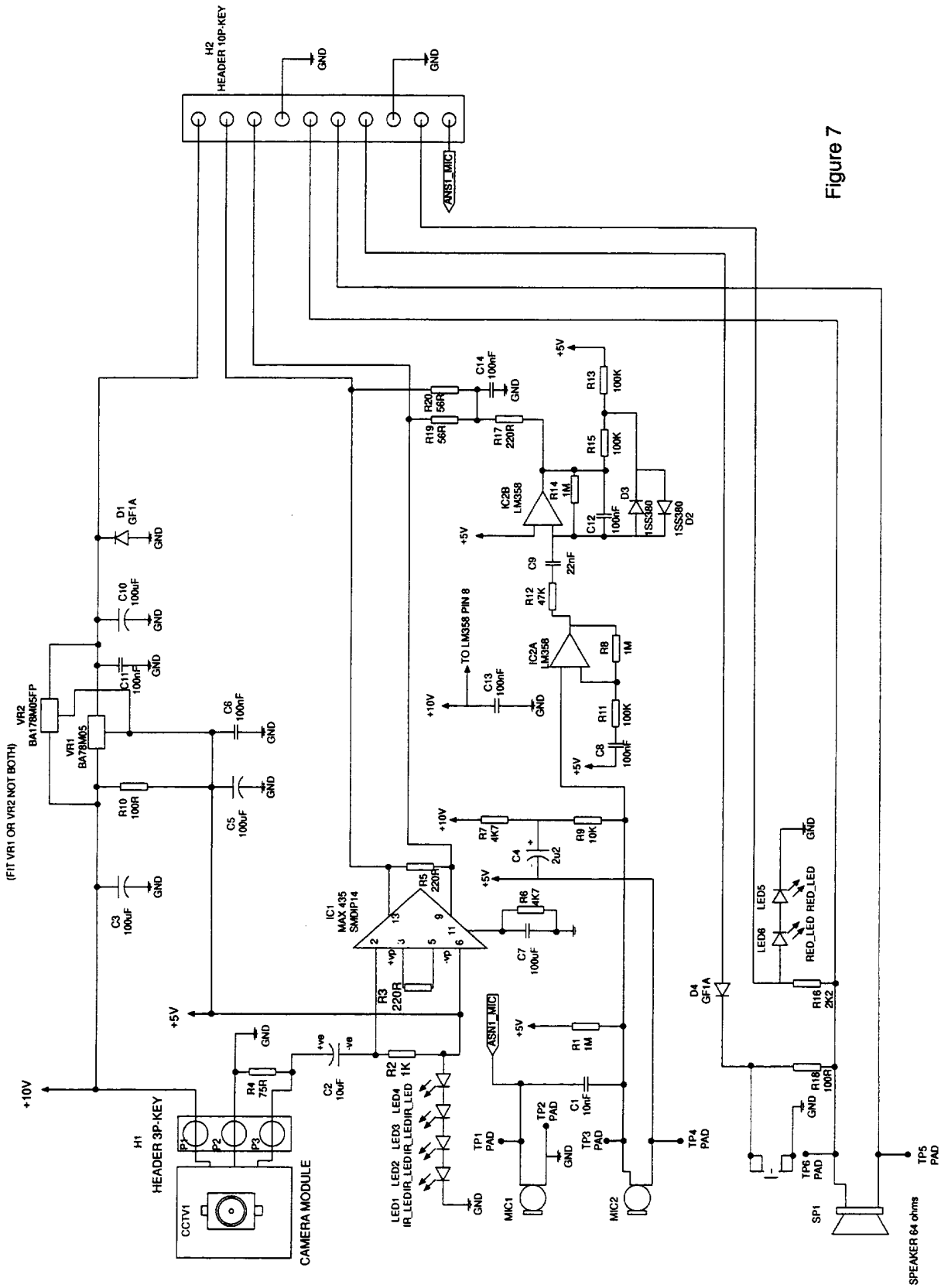

H2
HEADER 10P-KEY
GND
GND
ASNT_MIC
C14
100nF
R20
56R
R19
56R
R17
220R
R13
100K
R15
100K
IC2B
LM358
R14
1M
C12
100nF
D3
1SS380
D2
1SS380
+5V
C9
22nF
R12
47K
TO LM358 PIN 8
IC2A
LM358
R8
1M
C13
100nF
+10V
GND
R11
100K
C8
100nF
D1
GF1A
C10
100uF
C11
100nF
VR2
BA178M05FP
VR1
BA79M05
(FIT VR1 OR VR2 NOT BOTH)
C6
100nF
R10
100R
C5
100uF
C3
100uF
R7
4K7
R9
10K
C4
2u2
R5
220R
IC1
MAX 435
SMDIP14
R6
4K7
C7
100uF
R3
220R
R4
75R
C2
10uF
R2
1K
R1
1M
C1
10nF
H1
HEADER 3P-KEY
P1
P2
P3
CCTV1
CAMERA MODULE
LED1
IR_LED
LED2
IR_LED
LED3
IR_LED
LED4
IR_LED
TP1
PAD
TP2
PAD
TP3
PAD
TP4
PAD
MIC1
MIC2
D4
GF1A
LED6
LED5
RED_LED
RED_LED
R16
2K2
R18
100R
TP6
PAD
TP5
PAD
SP1
SPEAKER 64 ohms

Figure 7

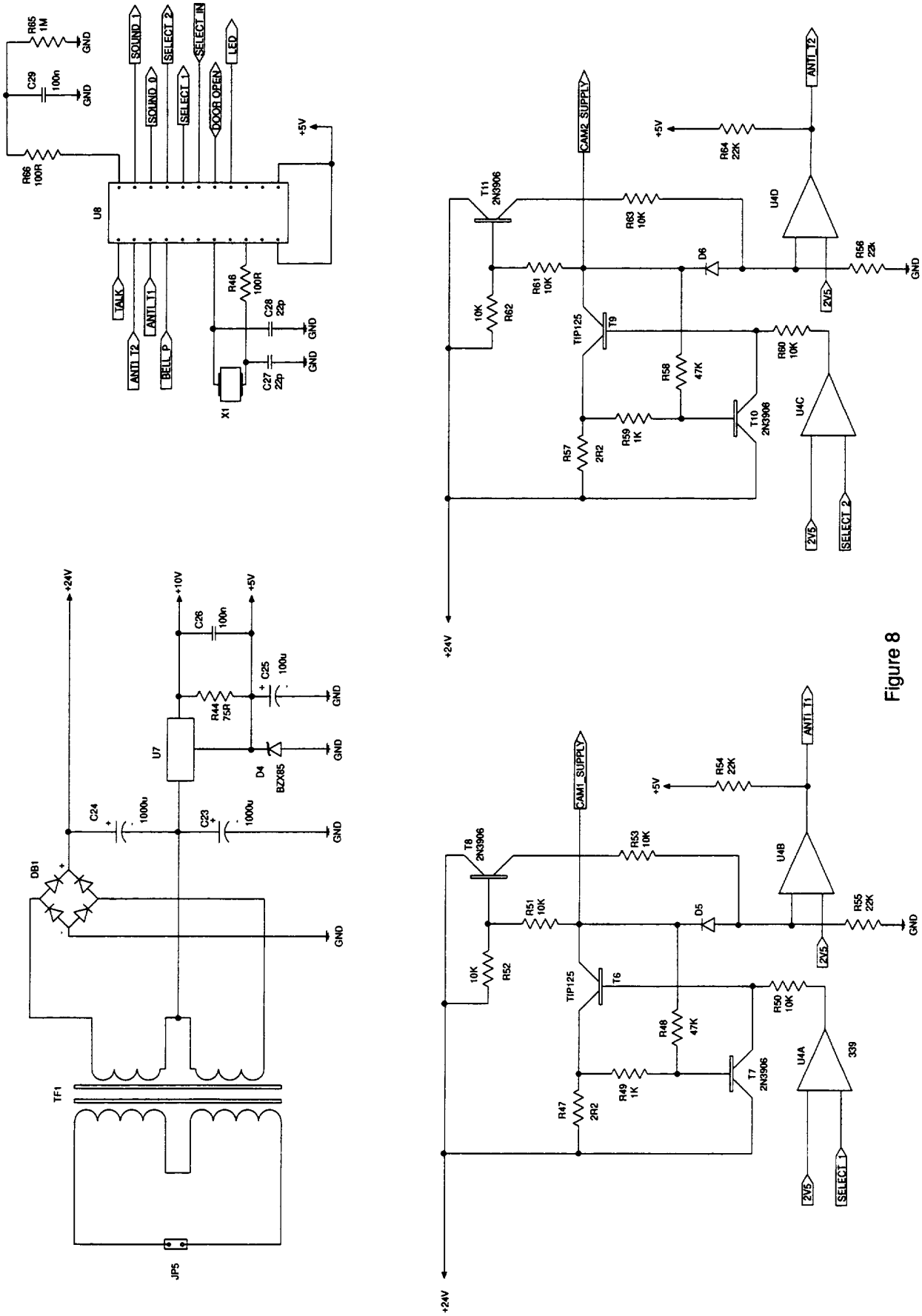

R65 1M
GND
C29 100n
GND
R66 100R
SOUND_1
SOUND_0
SELECT_2
SELECT_1
SELECT_IN
DOOR OPEN
LED
+5V
U8
TALK
ANTI_T2
ANTI_T1
BELL_P
R46 100R
C28 22p
GND
C27 22p
GND
X1
+24V
+10V
+5V
C26 100n
C25 100u
R44 75R
U7
D4 BZX85
C24 1000u
C23 1000u
DB1
TF1
JP5
CAM2_SUPPLY
ANTI_T2
T11 2N3906
R63 10K
R64 22K
U4D
D6
R56 22k
R61 10K
10K R62
TIP125 T9
R60 10K
R58 47K
U4C
R59 1K
T10 2N3906
R57 2R2
2V5
SELECT_2
CAM1_SUPPLY
ANTI_T1
T8 2N3906
R53 10K
R54 22K
U4B
D5
R55 22K
R51 10K
10K R52
TIP125 T6
R50 10K
R48 47K
U4A 339
T7 2N3906
R49 1K
R47 2R2
SELECT_1

Figure 8

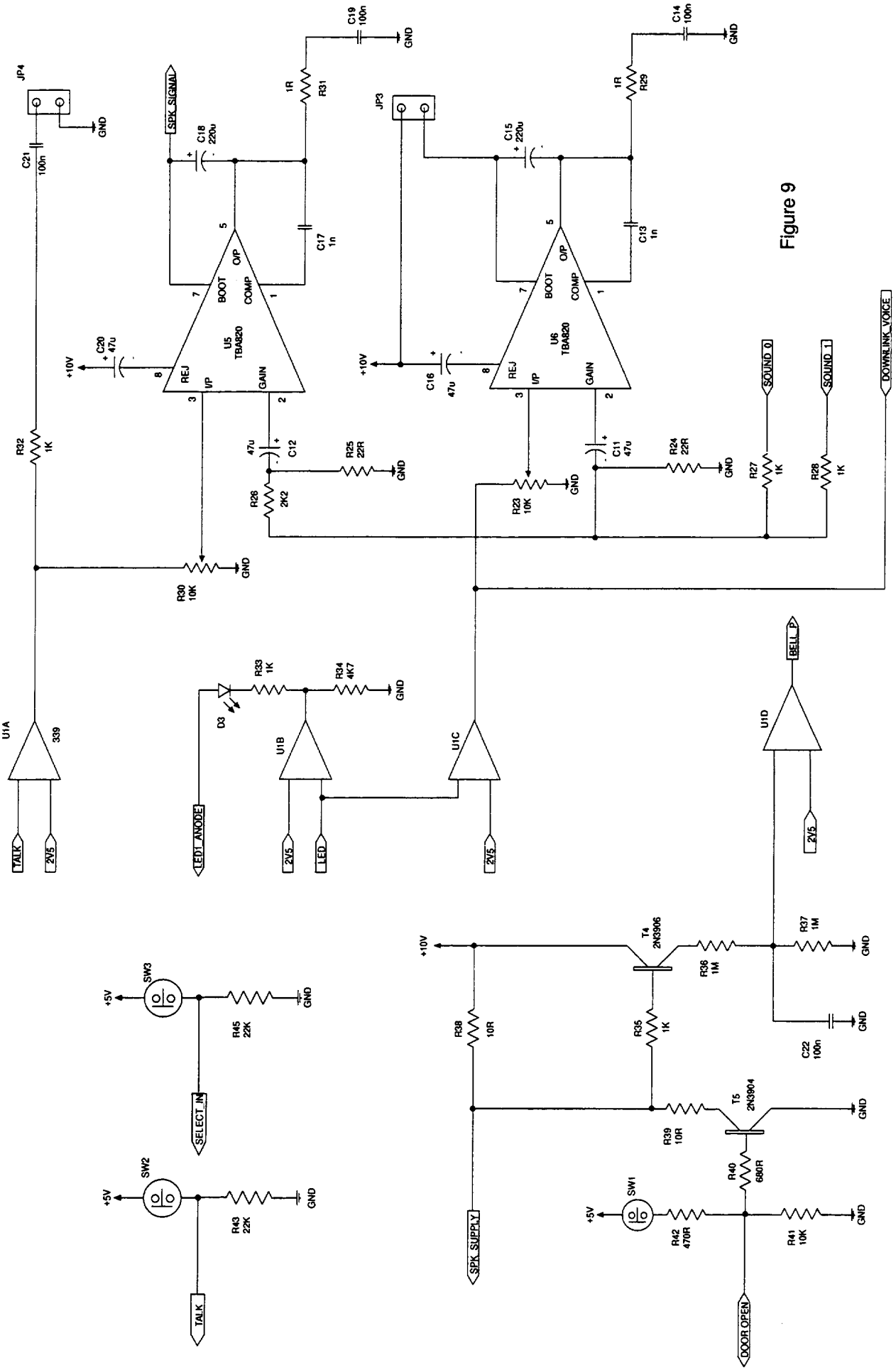

JP4
JP3
SPK_SIGNAL
C21 100n
C18 220u
C15 220u
C19 100n
C14 100n
1R R31
1R R29
C17 1n
C13 1n
U5 TBA820
U6 TBA820
BOOT
O/P
COMP
REJ
I/P
GAIN
C20 47u
C16 47u
+10V
GND
R32 1K
R30 10K
R26 2K2
R23 10K
C12 47u
C11 47u
R25 22R
R24 22R
R27 1K
R28 1K
SOUND_0
SOUND_1
DOWNLINK_VOICE
U1A 339
U1B
U1C
U1D
D3
R33 1K
R34 4K7
TALK
2V5
LED1_ANODE
LED
BELL_P
T4 2N3906
T5 2N3904
R37 1M
R36 1M
R38 10R
R35 1K
R39 10R
R40 680R
R41 10K
R42 470R
C22 100n
SW1
SW2
SW3
+5V
R45 22K
R43 22K
SELECT_IN
SPK_SUPPLY
DOOR OPEN

Figure 9

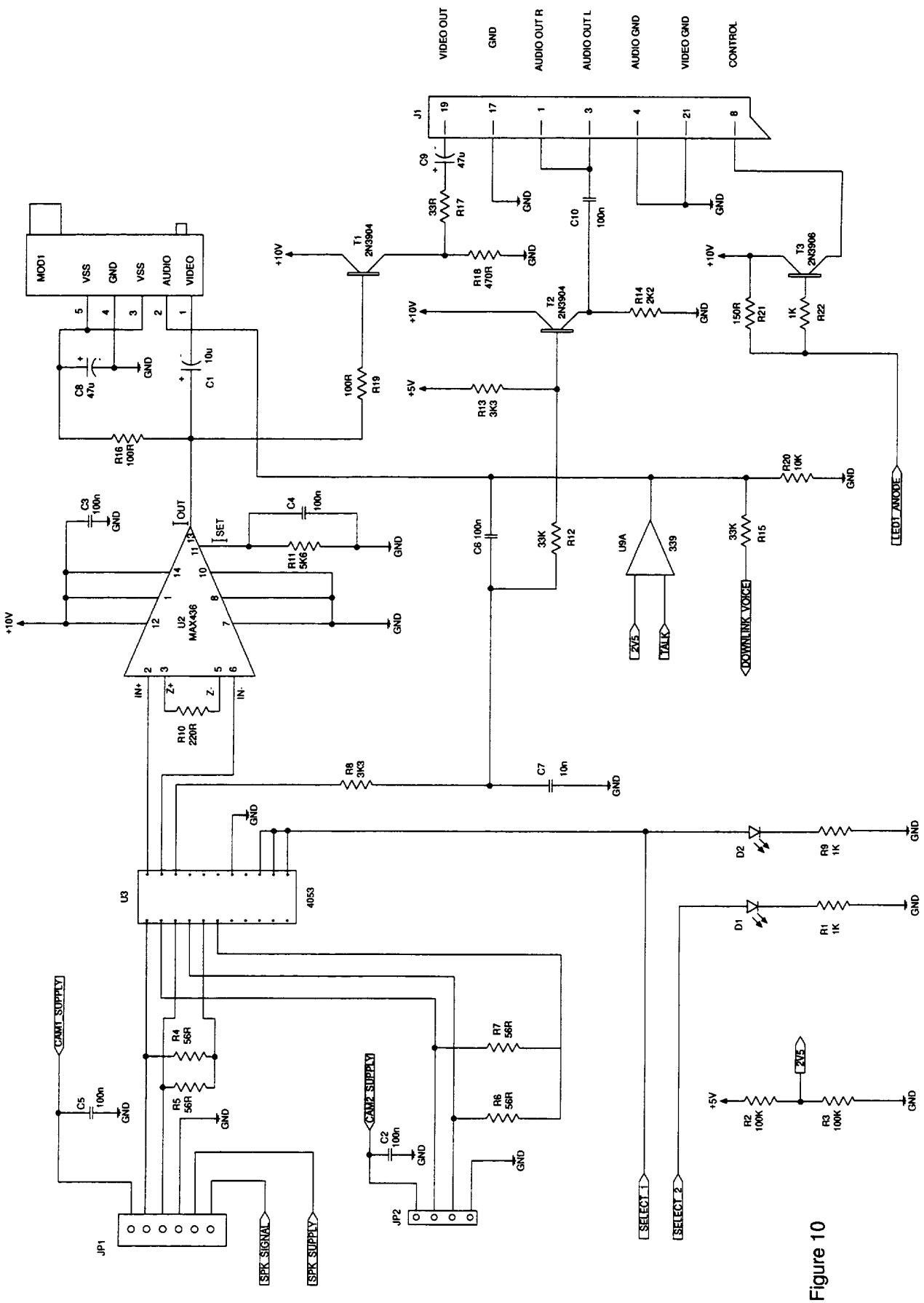
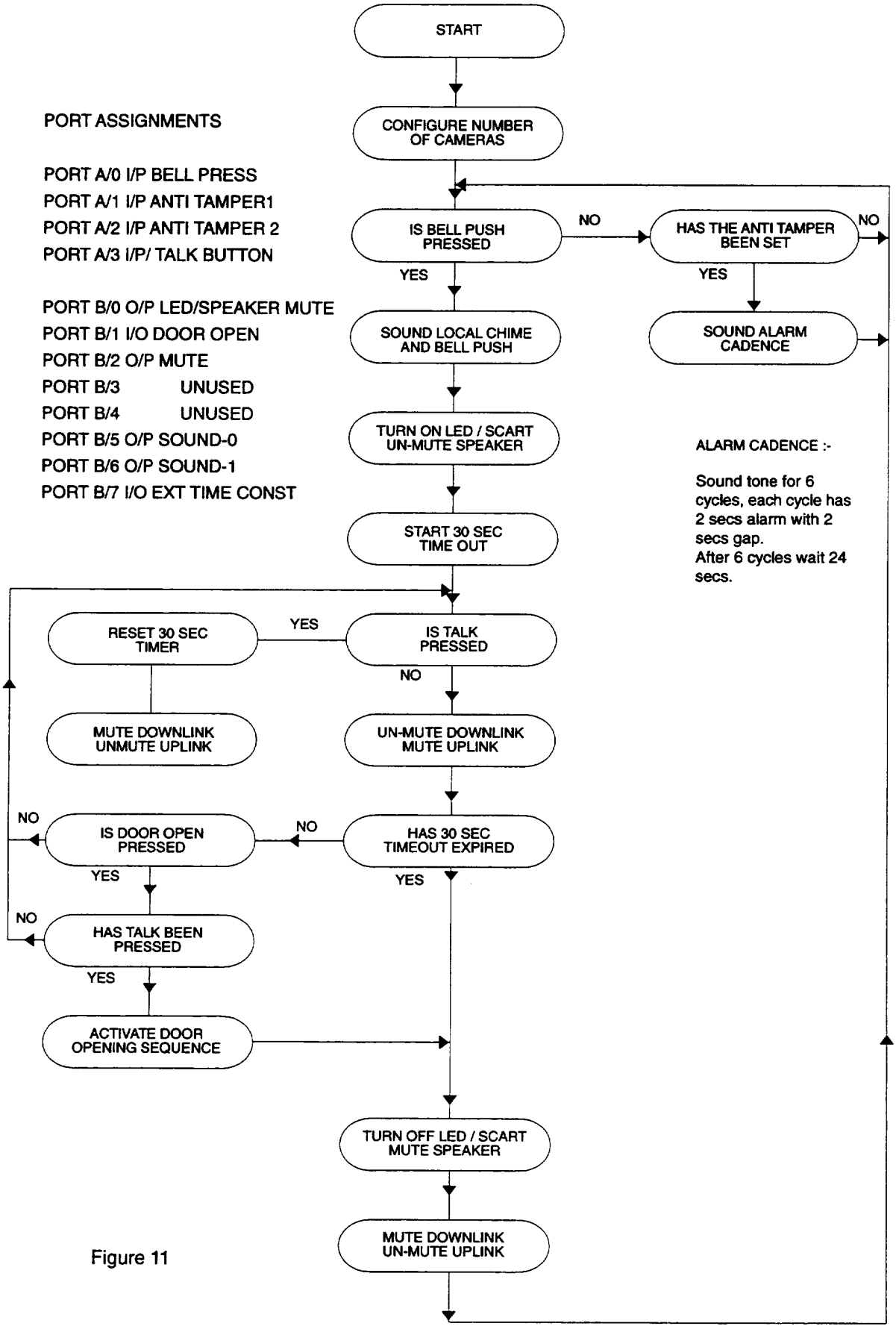

VIDEO OUT
GND
AUDIO OUT R
AUDIO OUT L
AUDIO GND
VIDEO GND
CONTROL
J1
MOD1
VSS
GND
VSS
AUDIO
VIDEO
T1 2N3904
T2 2N3904
T3 2N3906
U2 MAX436
U3 4053
U9A 339
+10V
+5V
GND
LED1 ANODE
2V5
TALK
DOWNLINK VOICE
SELECT 1
SELECT 2
CAM1 SUPPLY
CAM2 SUPPLY
SPK SIGNAL
SPK SUPPLY
JP1
JP2

Figure 10

PORT ASSIGNMENTS

PORT A/0 I/P BELL PRESS
PORT A/1 I/P ANTI TAMPER1
PORT A/2 I/P ANTI TAMPER 2
PORT A/3 I/P/ TALK BUTTON

PORT B/0 O/P LED/SPEAKER MUTE
PORT B/1 I/O DOOR OPEN
PORT B/2 O/P MUTE
PORT B/3 UNUSED
PORT B/4 UNUSED
PORT B/5 O/P SOUND-0
PORT B/6 O/P SOUND-1
PORT B/7 I/O EXT TIME CONST



ALARM CADENCE :-

Sound tone for 6 cycles, each cycle has 2 secs alarm with 2 secs gap.
After 6 cycles wait 24 secs.

Figure 11

Audio Visual Cable Relay for Security Surveillance

This invention relates to remote image relay, and is particularly, but not exclusively, concerned with remote image relay over a 'hard wire' (as opposed to 'wireless' or radio) transmission line, or cable.

A video signal - essentially a varying voltage representing the brightness or intensity of multiple individual picture elements or 'pixels' scanned in succession - is characterised by high frequency and high bandwidth or spread of frequencies.

A transmission line suffers from losses attendant inherent inductance and capacitance.

Effectively, the line is perceived as a low pass filter, with higher frequencies proportionately more attenuated - through electromagnetic radiation loss - which in turn can generate interference.

Such signal radiation may breach EMC regulations.

The consequent picture degradation is typically expressed as loss of image resolution detail or picture blurring.

Broadly, two alternative routes for closed circuit television (CCTV) relay links have been adopted.

In professional surveillance or TV studio systems, where cost is not a priority, in favour of preserving image quality, co-axial cable (co-ax) has traditionally represented the easiest or preferred route for low loss high frequency (HF) video picture signal.

Separate cables are generally used for the complementary audio signal and power supply.

Another consideration is speed of signals down the cabling, for example when relaying image signals from multiple cameras on a single scene.

Even with co-ax there are range limitations, and so large section co-ax or repeater amplifiers may also be required to minimise radiation losses and interference to and from a picture signal.

Such co-ax employs an inner conductor core, screened by a braided outer sheath, with intervening insulation.

Generally, with standard gauge co-ax, lengths of some 75/100m are feasible before marked signal degradation.

Beyond co-ax, fibre optic cable technology is available, but the cable costs are prohibitive, and the circuitry complex at the cable ends.

The characteristic impedance of typical coax is some 75 ohms and attendant input and

output circuitry needs matching to that for efficient transfer of signal energy.

As a low cost alterative to co-ax, multi-stranded or multi-core 'alarm' cable has been employed.

This is readily available in various numbers of conductor ways.

Conventional CCTV systems are known which use so-called 'base band' transmission over such low grade cable and accept the attendant high frequency (HF) signal degradation - with a consequent effective range of around 10m before unacceptable quality loss.

Typically, 4-way cable is used for picture, sound and power, with attendant risk of interference.

One particular - and higher grade - variant of multi-core cable is so-called 'twisted pair' cable, as commonly used for telephone systems, and in which wires are grouped in pairs and twisted together to cancel out radiation losses.

Thus, whilst it is known to send base-band video on low cost 4-way alarm cable, the cable run for even higher cable grades is limited to about 15 metres, with some degradation of picture - and to less than 5 metres for colour pictures.

In such known systems, claims of 50 metres range have typically been at the expense of considerable picture blurring, with no colour relayed from a colour camera.

Moreover, as the signal is essentially an 'unbalanced' single-ended voltage signal, it will also be susceptible to interference pick-up from long cable runs and so unlikely to pass the mandatory EMC directive requirements to acquire an emission compliant 'CE' qualification.

Some embodiments of the present invention offer a two wire system capability, with four wire and six wire variants to allow simplification of the circuitry at each cable end, consistent with preserving image quality and long range.

In a four wire approach,
according to one aspect of the invention,
two wires are used for video,
plus a common 'ground' wire;
two wires, including a common ground,
are used for power supply;
audio is superimposed upon
(each of) dual 'opposed' video signals
- *so that these dual video signals suffer losses*
which effectively cancel each other out -
current drive is used for the dual video signals;
this current is converted to voltage
across a load resistor
at the output or receiver end of the line;

a differential amplifier at the receiver end
extracts the audio signal from the video,
by cancelling out the two video signals.

The power supply is used by, inter alia, a camera, microphone and ancillary devices, such as door opening latches, camera lights, and bell push illumination.

Effectively, the differential video (current) drive according to the invention cancels out the otherwise debilitating effect of the capacitance to ground in a conventional transmission line, and thus eliminates the low pass filter characteristic and attendant signal attenuation.

This 'balance' of signals is such that radiation and interference pick-up from the transmission cable are minimal - and so in turn EMC approval is not problematic.

Only two low cost wires are required for this differential mode current video signal.

According to another aspect of the invention, the video signal is implemented using very high speed data transmission integrated circuits.

Their capability is such that an analogue video signal can be accommodated.

Indeed, the particular devices employed can operate up to fifty times faster than needed for this particular use.

Moreover, only two additional wires are required to supply DC power and ground return for the camera(s).

Overall, cable lengths of some 100 metres can be used with low cost 4-way alarm cable.

This range can be increased to up to a Kilometre with suitable twisted pair screened cables.

This approach is compatible with colour TV systems worldwide and tests have shown negligible picture image degradation over some 100 metres of low quality unscreened alarm cable.

Moreover, application of a differential drive to a twisted cable pair, further reduces effective signal loss and attendant interference from radiation.

Whilst certain differential drive and twisted pair cable provision is known in telephone circuitry, its implementation, according to a further aspect of the invention, in conjunction with 'transconductance' - that is the change of voltage to current (drive) - has not hitherto been used in telephony.

According to another aspect of the invention, an audio signal can be transmitted down the same cable as a video signal, in a form which can be separated from the video signal.

More specifically, the audio signal is a single-ended voltage mode - that is it could be sent down a single wire - but in fact identical audio voltage signals are sent down both video wires, to produce a combination signal.

The audio signal is of relatively low level and in order to relay it from a remote microphone (say, at a door bell push switch) to a control unit, a so-called common mode voltage signal is placed on a video cable pair.

This technique is known as a 'phantom' signal, as it cannot be detected at the receiving end of the cable by the video differential amplifier used to pick off the video signal.

Following the multi-wire approach, an anti-tamper alarm is implemented by using the supply and return cable pair as a current loop - with too high or too low a current being sensed at the control unit and used to trigger an alarm.

Ancillary functions, such as an audio link to a (surveillance) camera, sensing a bell push, or interception of a PIR beam, operation of a door latch, illumination of the bell push, can be implemented through an additional cable pair - bringing the total to six - and the existing ground.

This provides all the various features necessary for a door access system over low cost 6-way alarm cable.

Relayed picture image quality is ultimately dependent upon the camera definition, and the present invention has been developed initially in relation to cameras or camera chips with a 300 line per inch resolution, equating at scanning frequency to a bandwidth of some 4 MHz.

The quality standard for the multicore approach of the invention broadly equates to the losses attendant some 3/5m of coax, with a maximum frequency response of some 8MHz.

By way of reference, at only 1MHz there would be marked image blurring.

Some embodiments of the present invention have preserved a (picture signal) bandwidth of better than some 5MHz at 250m range or overall cable length.

Moreover, were - albeit more expensive - twisted pair cables to be used, ranges of some 1 Km would be feasible.

According to yet another aspect
of the present invention,
a video signal is split
into two complementary signals
of opposite polarity,
by application to an inverting amplifier,
to produce
a 'negative-going' signal in relation to ground,

whilst preserving a 'positive-going' signal,
the split being achieved in practice,
with so-called transconductance amplifiers;
signal transmission being over four cables,
used respectively as
a positive line,
a zero voltage line,
and a video pair.

In the transmission line cable, the signal represents opposed transitions, each of which suffer independent (but again opposed) degradation through losses attendant the cable low pass filter load characteristic.

However - provided the cables are kept close together - these (net radiation) losses effectively cancel one another out, by virtue of the differential drive and cancellation of the effect of capacitance to ground.

Whilst certain aspects of this differential drive technique are in some respects known per se in telephony, it has not hitherto been applied to video signal transmission, as realised in the present invention.

Nor in itself is the differential drive technique sufficient to resolve the entire transmission problem, and so additional measures are employed, as explained later.

Thus, in order to take account of the inherent cable impedance, the present invention converts a voltage (initially) related to the picture signal (intensity level) to a dual differential, or opposed, current drive.

The transmission line characteristic impedance relates to its L(inductance)/C(capacitance) ratio.

This adversely affects the signal voltage, as compared with, say, a current drive - in which a current generator applies, say, a 10mA current signal to the same line resistance.

A proprietary amplifier chip is employed, which is actually intended for high speed data, but which, under the present invention, handles an analogue video signal.

The transconductance characteristic of the amplifier effectively means responding to a changing voltage by achieving a current drive.

The invention employs a differential current mode signal, known per se,

The audio signal is superimposed on each video signal, to achieve a so-called 'common mode' - and can be separated out at the receiving end.

This is also known on certain telephone systems, in order to allow 3 conversations on only two lines - a so called 'phantom signal' technique.

This phantom signal cannot be detected at the receiving end by the differential video amplifier - and thus there is no interference between the sound and video signals.

Rather, the sound is 'picked' off by a tapping from each video line across a common load.

Especially for domestic systems, cost is a dominant factor in the commercial viability.

Thus, hitherto, adoption of domestic video closed circuit TV surveillance has been constrained by installation capital costs.

With the emergence of low cost miniature cameras, a remote video link has become economically feasible, offering greater functionality and intuitive user appeal.

Multi-camera systems can also be offered.

Low cost cameras merit a complementary low cost transmission relay link.

However, low cost cables have proved incompatible with conventional image signal transmission.

Some aspects of the invention are concerned with relatively long distance video signal transmission over moderate or low grade cable runs.

An objective to that end is to obviate the deleterious effects upon picture image quality of signal degradation through inherent transmission line (radiation) losses.

Another objective is to allow integration or interleaving of sound and video signals - without mutual interference.

An optional two-way sound link is also envisaged.

For example, the Applicants' earlier patent application no. PCT/GB95/01879 addressed low cost, high quality two-way radio sound link technology.

According to one aspect of the invention
a video image relay system,
for a hard-wired or transmission cable link,
between a remote camera and a base station VDU,
utilises a differential mode current signal,
passed along two cable conductor pathways or wires,
with two supplementary wires,
to supply DC power and ground return;
a video signal being generated
with very high speed data transmission through operational amplifiers laid out in integrated circuits.

Such a configuration allows long cable runs, yet with negligible picture image quality degradation,

despite the adoption of unscreened cable.

For audio relay,
from a remote microphone,
to a base station loudspeaker,
a so-called 'common mode' voltage signal
is superimposed upon the video cable pair,
effectively creating a so-called 'phantom' signal,
which cannot be detected
at the receiving base station
by the video differential amplifier.

This in turn obviates sound-vision interference.

An anti-tamper alarm facility may be incorporated
by configuring the supply and return ground cable pair
as a current loop,
with an excess or inadequate current signal
being sensed
at a base station control unit,
to trigger an alarm signal.

An audio link,
to a remote microphone,
at the or each video camera,
or other remote facilities,
such as a PIR (Passive Infrared Detector),
door (lock) operating latch,
bell push illumination, etc
may all be implemented,
through an additional pair of cables,
and the existing ground return.

Thus video, sound and additional facilities may all be incorporated with a low cost, 6-way cable.

A miniature observation camera may be integrated within a bell push switch housing.

In practice, for a four-wire or four-way cable system, the voltage drop attendant the inherent impedance losses limits cable runs to some 50 metres.

For a six-way cable, by paralleling a conductor pair for each of the DC power and ground return, over some 100 metres overall operational cable length for mono or colour pictures becomes feasible.

According to another aspect of the invention,
a wide-band(width) transconductance - voltage to current conversion - amplifier,
with 'true' differential high impedance inputs,
is used to achieve operational gain,

without negative feedback,
eliminating closed-loop phase shift
and attendant vulnerability to circuit oscillation,
to achieve an overall output current
proportional to an applied differential input voltage, providing inherent short-circuit protection
for the output;
the amplifier being deployed to relay
a high bandwidth video signal,
configured as a differential line voltage,
from a camera on-board chip sensor,
over a multi-way transmission line.

This represents a novel usage of such transconductance amplifiers - and indeed as such one not envisaged in their original development.

There now follows a description of particular embodiments of the invention, by way of example only, with reference to the accompanying diagrammatic and schematic drawings, in which:

Figure 1 show a basic transmission line layout for an audio-visual security surveillance system, using a remote camera and microphone;

Figure 2 shows power supply implementation for an observation camera, door opening latch and anti-tamper detection, for the surveillance system of Figure 1;

Figure 3 shows the implementation of an audio link between a remote bell push camera and base control unit, for the surveillance system of Figures 1 and 2;

Figure 4 shows the implementation of PIR movement detection in a remote observation camera, for the surveillance system of Figures 1 through 3;

Figure 5 shows the interconnection of principal units in the surveillance system of Figures 1 through 4;

Figures 6A, 6B, 6C and 6D show respectively, side and front elevations, longitudinal section and plan internal view of the mechanical integration of a miniaturised camera, microphone and loudspeaker in a common bell push switch housing, for the surveillance system of Figures 1 through 5;

Figure 7 shows and example of camera, microphone and loudspeaker circuitry for the surveillance system of Figures 1 through 6;

Figure 8 shows camera power and control circuitry, for the surveillance system of Figures 1 through 7;

Figure 9 shows audio features of a camera control, for the surveillance system of Figures 1 through 8;

Figure 10 shows video features of a camera control, for the surveillance system of Figures 1 through 9;

Figure 11 shows an example of an operational command logic flow sequence chart, for the surveillance system of Figures 1 through 10.

Referring to the drawings, Figures 1 through 4 are simplified schematics, evoking certain aspects of the circuitry detailed in Figures 7 through 10.

In that regard, generally, for a minimum audio visual security surveillance system of monochrome or colour pictures, one-way sound from a camera, and an anti-tamper loop, only low cost 4-way alarm cable is required.

This is usable for some 100 metres for monochrome cameras, and some 50 metres for colour.

The length limitation is due to the excessive drop of the supply voltage.

By using standard 6-way cable, and paralleling the supply and ground cores, the effective range can be doubled to some 100 metre (colour) and some 200 metres (monochrome); the limit being over some 500 metres when using suitable multi-core cable.

Summarising the facilities achievable with a 4-way cable:

1. colour or monochrome video;
2. sound and speech from camera to control and TV/video;
3. switched DC power supplied from control unit; and
4. anti-tamper current loop.

By adding two cable ways to such a minimum 4-way system, extra facilities are enabled. Specifically, for a 6-way cable:

5. activation of electric door latch;
6. speech to camera from control unit;
7. constant DC power supplied from control unit;
8. sensing of bell push;
9. sensing of PIR activation;

Overall, the system features include:

- Monochrome or colour cameras with high quality video reproduction.
- Direct viewing on any TV or video monitor.
- Recording on low cost video recorders - with automated stop/start control.
- Automated camera selection and video start by bell push actuation or

movement detection.

- Time-out for recording - 30 seconds standard.
- Standardised connections and supply for movement detection PIR's.
- Choice of covert bell push or overt surveillance cameras.
- Surveillance cameras with flashing red warning lights.
- Wide angle 90 degree or narrow angle camera lenses.
- Low light operation capability.
- Interface with other video surveillance systems.

In particular, 'state-of-the-art' high frequency line drivers enable, in some embodiments:

1. use of low cost alarm cable;
2. over 150 metre range with standard 4 core cable; and
3. up to 500 metre range with premium (eg 'twisted pair') cable.

A multi-camera control microprocessor is automatically configured at switch on; for two cameras as standard and an option of up to eight - with future upgradability to sixty four.

Two way speech enables use for door entry systems and baby alarms.

Full door entry facilities include door bell chime, different tones for different (eg front and back/side) doors, covert video camera in bell push, remote electric door latch operation and bell push switch illumination.

Full anti-tamper facility detects and sounds for cut or shorted cables and removal or tampering with cameras or PIR's and works even if a camera is not selected.

Future upgradability is available through standard interface connections.

Low interference or pick up from relay cables.

The basic cameras require four way cable.

Alternatively, a standard PIR can be supplied and sensed by this additional cable pair.

Basic remote (observation) camera provision includes:

1. monochrome video with optional angle lenses;

2. a microphone for ambient sounds;

3. anti tamper alarm for the cable;

4. optional anti tamper case alarm;

5. optional active (flashing) warning LED indicator;

6. optional colour video.

The addition of a cable pair would provide a PIR detector interface and speech from a terminal unit (allowing a baby alarm).

Basic miniaturised covert (bell push) camera features include:

1. monochrome video with wide angle pin hole lens;

2. IR flood light for up to 2 metres;

3. microphone for visitor speech;

4. loudspeaker for speech from terminal unit;

5. bell push;

6. bell push illumination;

7. connections for standard door chime/bell;

8. connections for remote radio alarm;

9. anti tamper alarm for cable;

10. anti tamper alarm for case option.

A control unit connects to an observation camera or miniaturised bell push camera unit, via a six way communications connector, to supply DC power to a camera unit and interface the required facilities.

It will recover the video and audio signals and convert them to standard levels of 1 volt video into 75 ohms, and 600 mV audio into 1000 ohms.

In its simplest form, it would then provide these on a standard SCART socket - for connection to a TV, video recorder or video switcher.

DC power could be provided by a low cost plug-in transformer unit.

At additional cost, the following system facilities could be provided:

1. UHF modulator and loop through for aerial and TV;

2. internal power supply, for direct connection to mains socket;

3. supply on indicator light; microphone to talk to door, activated by 'push to talk' button;

4. internal speaker to monitor door microphone, muted when not in use;

5. door bell push sounder;

6. anti tamper alarm sounder;

7. multi camera selection.

With the incorporation of a microprocessor in a control unit, further development could enable additional facilities, such as:

8. different bell push and alarm sounds (front and back doors say);

9. sequential switching of cameras;

10. auto selection of bell push camera;

11. PIR detector interface for each camera;

12. auto select and start of normal video recorder via IR link; and

13. time, date and camera number display in picture.

In due course, it is envisaged that cameras using serial digital technology could be substituted for linear analogue versions to enable:

14. picture in picture on TV;

15. storage of images (say, on pushing bell push);

16. relay on request of images via telephone, stored in real time;

17. intelligent movement detection via camera image; and

18. PC interface for larger surveillance system.

The principal hardware features of a remote camera system include:

A medium size observation camera unit for area surveillance and mounted out of an intruder's reach.

It is intended to have a deterrent effect and has the appearance of a conventional

camera.

The camera is mounted in a weatherproof case and has a pan and tilt mounting facility.

The camera lens has a 10 to 90 degree viewing angle and is protected by a clear viewing panel.

A microphone conveys ambient noise, through a 3mm opening in the camera housing, as a companion to the image, both for reproduction on a domestic TV.

A red indicator is illuminated as a deterrent, showing a steady light in normal brightness, with extra bright flashes when the PIR movement detector is activated.

An optional PIR movement detector signals a control unit via the two additional cable ways, using a six way cable.

A loudspeaker, to implement two-way speech could also be provided.

Overall, the camera is connected to a basic four wire system, or six wire if provision is made for PIR.

One cable pair is used for the DC supply of between 12 and 22 volts at a maximum of 200 mA for a monochrome camera, and 222 mA for colour.

A 500 mA series 5 volt regulator with its ground reference connected to a 5.1 volt zener is used to supply a 12 volt camera chip board and two associated IC's.

A proprietary (MAX) line driver takes the 1 volt p-p output of the camera module and provides a differential current drive to the other cable pair.

Essentially, a camera video output voltage signal is duplicated, the original signal inverted, and the duplicated and inverted signals applied to respective line drivers.

The latter comprise very high performance transconductance amplifiers, that convert voltage to current, thus providing a dual opposed or differential current drive for the transmission line formed by the dual video cable ways (plus ground).

In practice, the dual voltage or current transitions can both be positive, but with one signal negative (or reduced positive) - going, and the other signal positive (or increased positive) - going, between a zero or ground voltage and a threshold or limit voltage.

The output of an electret microphone is amplified and limited by a dual operational (OP) amplifier and applied to the cable pair as a common mode signal of up to 3 volts peak-to-peak (p-p).

When the camera is not selected by the terminal unit, its positive supply is replaced by a 10mA anti-tamper loop current, to detect camera disconnection or a cut cable way.

In a covert bell push camera system, a miniaturised camera is fitted into a bell push switch assembly, with a companion microphone and speaker to allow two-way speech and alarm facilities, housed in a single common unit, as detailed in Figure 6, mounted at eye level on the surface of an access door or its surround.

A similar housing may be employed for additional bell push switches, even without camera etc.

The camera 28 can be mounted at an optional offset angle of some 10 to 20 degrees left or right, to improve viewing to one side.

The camera 28 has a pin-hole lens, with a 90 degree viewing angle through a covert aperture 34, some 3mm round or square diameter, in the bell push casing 39.

A bell push loudspeaker 37 is a waterproof 8 or 16 ohm impedance unit, with a large driver magnet and is located behind the apertures 32 in the bell push housing 39.

A bell push microphone 36 is a standard electret unit, with an airtight mounting to reduce feedback, is located behind the apertures 35 in the bell push housing 39.

A bell push switch 21 has a large button, actioned through a weatherproof membrane and illuminated by two dedicated LED's (not shown).

A flood light for the camera 28 is provided by an array of four 5mm diameter LED lamps 38.

The foregoing is implemented with the following circuitry, referring to the drawings.

Figure 1 shows a standard 1 volt video signal from a remote camera module 29 fed to an amplifier A1.

Amplifier A1 is configured as a current mode differential line driver, with two current outputs used respectively to drive discrete individual cable ways W2 and W3 - of a 4-way cable.

Bridging resistor Ra matches the impedance of the cable pair W2 and W3, that is between 100 and 200 ohms, to minimise reflected signals up and down the cable.

These would otherwise produce multiple images on the TV screen.

At the control unit end, cable ways W2 and W3 are terminated with a similar bridging resistor Rb, which converts the current signal down the cable into a voltage and which is in turn sensed by an amplifier A2.

The output of A2 is a single-ended voltage signal.

This is the same signal that was output by the camera module 29, and is fed to a TV and/or video recorder 65.

An advantage of using a current amplitude signal down the cable is that the voltage recovered at the control unit (ie base station) end is independent of the variable and sometimes considerable cable way resistance.

Rather, it is always proportional to the current from amplifier A1 and the resistor Rb.

By using a differential (current) signal, only the capacitance between ways W2 and W3 has to be driven; there being no net signal across the much larger capacitance of the pair of ways to ground and to other cables.

This minimises the loss in high frequencies normally experienced, and also minimises the interference generated by, or picked up by, the cable pair.

Speech and sound are monitored at a remote camera 29, using a microphone 57 and voltage amplifier A3, whose output is fed to the centre tap or a resistor Ra, across the pair of cable ways W2 and W3.

This effectively imposes an identical voltage mode signal upon each of those two cable ways W2, W3 with respect to a common ground way W4.

At the control unit (or base station) end, the voltage common mode signal is recovered from the centre tap of a terminating resistor Rb and fed to a speaker coil 64, via a power amplifier A4.

As the video signal at each end of Rb is equal and opposite in amplitude, being a differential signal, none of it is present at the centre tap.

As the amplifier A2 only senses the differential signal at its inputs, and rejects the common mode signals, only the video signal originated by the camera is present.

Thus speech and picture information can be combined on the cable, and separated at the receiving end.

Figure 2 shows the DC power supply for the remote camera electronics through a fourth cable way, W1.

Typically, this DC supply voltage is between 11 and 15 volts, at up to 300mA.

The DC supply on way W4 is switched by a transistor switch S1, in turn controlled by a logic signal, 'SELECT' from a microprocessor (see Figures 7 through 10).

The supply current drawn by a remote camera unit 29 is sensed by a comparator C1 across a resistor Rc in series with the DC supply to the camera.

If this current is not present, because, say, the cable has been cut, a logic signal 'ANTI-TAMPER' is output.

This also arranged to happen for a short-circuited cable.

When a camera is not selected or powered, with S1 open, a small bleed current is fed to the camera unit by a shunt resistor Rd across the switch contacts, to allow the anti-tamper detector to operate.

This bleed current is typically some 10mA.

The cable way W1 is also looped through the camera case, and junction box lid switches, in order to sense any tampering.

By momentarily pulsing the camera supply switch off, with the logic signal 'DOOR OPEN' to switch S1, the supply on cable way 1 can be pulsed off, say, for 1mS in every 20.

This will have minimal effect on the supply to the camera, only a drop of 5%, due to the action of diode D1.

In practice D1 is also a voltage regulator for the 10 volt camera supply.

These negative-going (ie voltage fall-off) pulses are detected in the door opener unit, or junction box, by the detector D2 and D3.

The recovered voltage is then used, via a transistor or relay, to operate an electric door latch.

The DC supply on cable way W1 is used to power this function.

Figure 3 shows a microphone 89 at a control unit end fed to a power amplifier A5, which feeds a high level signal between cable ways W5 and W6.

At a camera unit end, these ways W5 and W6 are connected directly to a loudspeaker 37.

The common ground return way W4 is not used as one of these ways, in order to minimise the cross-talk that would occur between the outgoing audio speech and the incoming picture and sound.

As an extra way, W5 is used to return the high currents for the bell push camera unit, and can be connected to any fixed or steady voltage.

An auxiliary supply of 11 to 15 volts is always connected to this way W5 and is used to supply the bell push illumination LED's 38.

Up to 100mA of current is available, even when the camera supply is turned off, to supply any other auxiliary function.

At the bell push end, the bell push button 21 connects a resistor Rf, across the supply cable way W5 and the common ground return way W4.

This causes approximately 150mA to be taken from the supply on way W5.

At the control unit, the supply current cable way W5 is sensed by a series resistor Rg and comparator C2, which outputs a logic signal 'BELL PUSH' when the current exceeds 100mA, and so in turn signalling to alert the microprocessor.

Referring to Figure 4, when the bell push camera unit is replaced by an observation camera 29, cable ways W5 and W6 have modified functions.

Specifically, the 15 volt DC supply on way W5 is used to power a PIR (passive infra red detector) movement detector and warning LED module 30.

Operation of the detector 30 is signalled back to the control unit by pulling the normally high level on way W6, due to a shunt resistor Rh, to ground.

By placing an extra resistor in parallel with this in a junction box, a current in excess of 150mA is made to flow.

This can be sensed by the bell push detector and so the observation camera unit 29 can be used in place of a bell push unit - as, say, a 'hands off' door entry system for commercial premises.

Reviewing the circuitry overall:

A bell push camera is connected to a control unit via a six way cable.

Two additional connections are provided to activate a normal battery driven door chime or bell.

Two are also provided for connection to a standardised control panel.

These ten connections are made via a two by five connector header block (Figure 7).

A bell push camera unit contains the same basic circuitry as an observation camera unit, with the following exceptions:

The microphone gain is reduced.

A 5.1 volt zener is replaced by 4 IR flood light diodes with 30mA current providing a bias of 4.8 to 5.5 volts.

A loudspeaker is added and connected to the output header. This is driven from pin 6, with a DC supply of 10 volts on pin 5.

A bell push button switch 21 grounds this supply via a 50 ohm resistor to signal the terminal unit.

The push button for switch 21 is back-illuminated by two LED's driven from this supply.

Camera control

With or without a modulator (to address a TV tuner), a camera control unit need have no external control adjustment and so can be installed behind a domestic TV or in, say, loft space.

Power is provided by a built-in or plug-in transformer unit.

The control unit is connected by four wires to an observation camera 29 or bell push camera 28.

If a bell push camera 28 is used, a standardised system unit can also be connected - for example to interface with a remote radio link.

Three supplies are generated from a 9VA internal or plug-top mains transformer 59 (Figure 5).

A 200 mA current limited 22 volt is provided for the camera module.

A stabilised 10 volt supply is provided for the microprocessor IC (integrated circuit) at 35 mA and a stabilised 5 volt supply is provided for the modulator and as a reference for the IC.

A proprietary (MAX436) line receiver IC is connected to the video signal pair from the camera unit and its output is terminated and fed as 1 volt video to a UHF modulator.

A common mode audio signal is extracted at the input of the (MAX 436) receiver and fed directly to the modulator.

As indicated, no controls are required or provided.

Twin camera door access control can be positioned on top of a domestic TV, or wall mounted, with provision at least for a microphone and 'push to talk' button.

The circuitry contains the same circuit as the basic terminal unit, with additions to allow for communication to the door, door chime, anti-tamper alarm and electric door latch operation.

The unit is controlled with a PIC micro-controller.

A microphone feeds the bell push loudspeaker via a power or driver amplifier (TBA 820) with the speaker connected to its positive supply, which is fed via a 10 ohm resistor.

The voltage drop across this resistor is monitored by a comparator to sense the 160mA increase due to the bell push being operated.

This is fed to the microprocessor as a logic 'BELL_P' signal.

A transistor is also connected to this supply, via a 10 ohm resistor - and by pulsing it on repetitively, the door latch circuit is activated.

An internal speaker is driven by a power amplifier from the recovered audio at (MAX 436) receiver input.

Three separate mutes on the audio signals are controlled by the microprocessor.

A current limited regulator provides a 15 volt camera supply and a comparator monitors for no current taken or short circuit, to detect that the camera unit has been interfered with and this is in turn fed to the microprocessor as a logic 'ANTI-T' signal.

Door chime and alarm sound are generated by the microprocessor and fed to the two power amplifiers.

Voice communication to the door is initiated by a 'push to talk' button.

The bell push, or optional observation camera, is selected via analogue matrix switches by the micro controller.

A multi-camera terminal facility enables selection of different cameras, initially with a capability of some six discrete observation and two bell push cameras.

These cameras are not powered when not in use.

The circuit depicted has a two camera capability with a facility to integrate and selectively deploy additional observation cameras.

Only a single bell push camera is provided for, the other cameras being connected by a four wire system, or six with PIR's.

When a camera is not selected, its positive supply is switched off by a high-side switch.

The cameras are selected sequentially by a single push button control, which only steps through the cameras connected.

By holding the control button down, the unit will cycle through each camera in turn for a preset time, of say 10 seconds.

Once the bell push is activated, the unit selects and holds the bell push camera output - and optionally switches on a video recorder.

When a camera is not selected, its supply is turned off, but a 10mA loop current is maintained.

Each camera supply has an anti-tamper detector.

By this means, the alarm can be sounded for a set time and, at initial power on, the active cameras can be detected and the system configured.

Four cameras would require an extra four control ports, compared to the two camera

version.

The door latch unit acts as a junction between the bell push camera unit and the 6-wire cable going to the control unit.

This door latch also allows for the connection of a standard battery operated door chime.

Otherwise, DC power must be supplied by a suitable plug-in transformer unit.

Facilities are also included for the connection of a 12 volt DC electric door latch (powered actuator) assembly.

A nominal 15 to 11 volt at 200mA is supplied from the control unit via the 6-way cable.

The door latch is activated by a button on the door latch unit, and remotely via a simple circuit from the control unit.

The circuit is powered from the 5 volt amplifier supply to the door loudspeaker.

When the door latch is to be operated, short negative-going pluses of at least 5 volts are added to this supply repetitively.

Initially, these are pulses some 1mS wide (duration), spaced every 10mS.

These are DC restored above 0 volt and fed to a comparator with an input threshold of about 3 volts and 20% positive hysteresis, via a 2 second low pass filter.

This eliminates spurious operation when the circuit is powered up, or when the bell push is operated.

The output of the comparator turns on a PNP power transistor.

Figure 5 depicts the general inter-relationship of principal circuit elements.

A bell push 21, with (intentionally) much the (reassuring) outward appearance of a conventional bell push, but with much more sophisticated multi-functional innards (shown in Figure 6), is fitted to a reception point, such as a main entrance door threshold 60 to a (domestic) dwelling or other property.

The bell push 21 could thus replace a conventional unit in a conversion installation.

As such, the bell push 21 is thus the prime point of initial active contact and communication encountered by a caller - who will expect its operation to sound an internal audible alarm, such as a bell or chime 22, as indeed it does.

Thus no special introduction, instruction or training is required to preface operation of the concealed supplementary audio-visual link described later.

However, to assist the operational protocol, provision could be made for pre-recorded announcement, for example stored on an internal sound chip in the bell push unit, to be replayed upon operation of the bell push switch 21.

To this end, the internal electrical switch in the bell push 21 can trigger an electronically simulated chime generated by a sound chip within the unit and relayed through an internal loudspeaker 37.

Alternatively, or even additionally, the bell push 21 could be linked to an existing door bell or chime 22.

The bell push call operation also 'wakes up' or alerts a master control unit 26 - which otherwise defaults to a low power consumption quiescent or 'sleep' mode, in which power consumption is minimal.

Aside from initiatives by a caller operating the bell push, caller monitoring does not merely await operation of the bell push 21.

Rather a caller's approach to the property is monitored through an observation camera 29.

The camera 29 may run continuously or be activated by a sensor (not shown), such as a passive infra-red (PIR) detector reacting to body heat, or by an ultrasonic proximity beam deflection/reflection transmitter/receiver.

Moreover, a flood light 58 may be illuminated along camera activation, to provide night surveillance.

Similarly, covert night surveillance may be achieved by using an infra-red flood light.

When the caller is on the property threshold, at the bell push 21, visual caller monitoring is taken over by a miniaturised camera 28, fitted with a pin-hole aperture lens 34, within the bell push unit housing 39.

This provides covert surveillance - that is of which the caller is generally unaware.

The control unit 26 selectively relays video images from the remote observation camera 29 or covert bell push camera 28, through a VDU cable 46 to an internal TV monitor 65, which may be the normal domestic TV using an appropriate signal modulator for the TV tuner.

The TV can still receive TV broadcast transmissions normally through an aerial coupler 63 and TV pictures would be interrupted automatically or selectively upon a bell push 21 signal.

Marginal overlay of surveillance and broadcast images could also be contrived.

A TV remote controller could be adapted to enable the surveillance image to be displayed upon demand and to control camera movement and zoom, if fitted.

The remote camera video signal may also be applied to a video recorder - activated by, say, operation of the bell push 21 and timed-out, for economy of tape usage.

For economy, the surveillance camera 29 is a monochrome unit, connected by a 4 way cable 42 to the control unit 26.

A general purpose wide-angle lens is fitted, but motorised camera mounts and zoom lenses could fitted for a more sophisticated surveillance system.

The camera 29 could also be fitted with an ambient nose microphone 57, to supplement interpretation of the viewing image.

Provision may also be made to enable automatic door opening, with a dedicated door (opening) switch 51 connected in circuit with a solenoid operated door latch 53.

For ease of installation, door latch operating power may be derived locally, through a mains transformer plug 59, to fit a convenient local mains outlet socket to the doorway.

A command cable 43 connects the door switch 51 with the control unit 26 to enable door opening - otherwise the door switch 51 is disabled for security.

Audio command signals may be relayed through the bell push microphone 36 to instruct operation of the door switch 51.

The caller can be provided with active or pre-recorded guidance messages upon such door opening.

Thus a property keeper may speak to the door push using an internal microphone (not shown) over the existing hard wired link.

Alternatively, a two-way radio link, such as taught in our patent application no. PCT/GB95/01879 , could be integrated with the hard wired unit.

The control unit 26 is a self-contained unit with a control console and is powered through a power lead 69 plugged into a convenient local mains supply outlet socket.

Colour video is an option for any or all of the cameras employed.

A microphone 36 is integrated within the bell push housing 39 to relay ambient sounds from the pinhole camera 28 surveillance area.

In particular, the microphone 36 relays the caller's voice to the control unit 26, which may in turn reproduce it over the sound speaker system within the TV 65.

An anti-tamper alarm may be provided for any of the feed cables 41,42,49, so that the control of cameras and door latch cannot be disabled, bypassed, over-ridden or subverted.

An anti-tamper alarm may be provided for the housing 39 to deter removal of the front

cover over the critical camera, microphone, loudspeaker and switch units.

An active, say flashing, warning indicator (not shown) could be fitted as an option to any of the critical components visible to a caller, such as in particular the bell push 21 and surveillance camera 29.

Employment of an additional cable pair could enable provision (not shown) of, say, a Passive Infrared Detector (PIR) and speech data from a terminal unit (in the manner of a baby alarm).

The pinhole door camera 28 can utilise a 6 way cable 41 with an effective range of some 100 metres.

Alternatively, an 8-way cable would extend the range.

Advances in camera module technology could enable extended range with a 6 way cable.

The sensitivity of the pinhole camera 28 embraces the infra-red spectrum, so that imaging can continue in poor ambient light, with the assistance of a low-level infra-red light source, provided by a miniature LED array 38, of some four 5mm diameter individual lamps, giving a flood beam with range of up to 2 metres.

Illumination for the bell push switch could also be provided.

Anti-tamper alarm provision could embrace the cable and optionally the case itself.

A miniature microphone 36 senses ambient noise to complement the picture, a 3mm hooded (for weather protection) aperture 37 being provided in the housing 39 to allow sound transmission.

The observation camera 29 is connected on a four-way cable 42, one cable pair being used for DC supply of 12-22 volts, at some 200 mA for a monochrome camera, or 225 mA for colour.

The optional microphone 57 may be fitted internally of the camera case, with access through a 3mm diameter aperture in the case, to convey ambient noise.

The camera lens is a 30 to 90 degree vision angle lens unit, protected by a clear panel.

A red LED warning indicator can be fitted, for illumination (optionally flashing) when the camera is active.

A loudspeaker might also be fitted to the observation camera - eg to relay warning or instruction messages.

The operational protocol is generally as follows:

Control firmware for single camera terminal unit provides for the operating conditions:

Inputs

'BELL-P'
A0 HIGH when depressed

'ANTI-T1'
A1 LOW for tamper = alarm

'TALK-B'
A2 HIGH when depressed

'OPEN I/O'
A3 HIGH when door open depressed
pulse high to operate door latch

Outputs

'SOUND-0'
B4 Active HIGH

'SOUND-1'
B5 Active HIGH

LED (speaker enable)
B0 HIGH for LED bright, SCART +12V, internal speaker enabled

'MUTE'
B2 HIGH to mute Door Bell speaker and enable door enable bell microphone

'TIME-C I/O'
B6 100mS to ground

Spare B1, B3 and B7

'BELL-P'
This goes HIGH if the bell push is operated. The door chime sound is then set up on SOUND-0 and SOUND-1.

'OPEN'
This goes HIGH when open door button is pushed, and initiates the door open pulses on same port, but only during conversation 30 second time out period. Pulsed 1mS High every 10mS, for a total of 4 seconds when door open action is requested.

'ANTI-T'
This goes LOW if the camera is not connected or cable short-circuited, and is used to initiate the alarm sound for 60 seconds.

'TALK-R'
This goes HIGH when the Push to talk button is depressed and initiates communication by setting MUTE-U-LK low and MUTE-D-LK high. On release these are reset, and MUTE-SPK is set low for a 30 second time out.

'TIME-C'
This is toggled as an input/output with a long time constant RC to generate the Chime sound.

'SOUND-0'
Normally tri-state, has first bit of chime and alarm sound.

'SOUND-1'
Second bit of sound.

LED
HIGH during time out, also mutes internal speaker when low.

MUTE
Mutes down link sound from bell push mic. when high, and enables up link voice.

Dual Camera System

Inputs

'CAM'
Goes HIGH when camera select button pushed

'ANTI-T2'
Goes LOW if observation camera is not connected or cable short-circuited, and is used to initiate the alarm sound for 60 seconds. Also used at power on to detect if camera 2 is present.

Outputs

'SELECT'
Selects observation camera when high

Inputs

'BELL-P'
OPEN
ANTI-T1
ANTI-T2
ANTI-T3
ANTI-T4
TALK-B
TIME-C

Outputs

SOUND-0
SOUND-1
LED-1
LED-2
LED-3
LED-4 LED/SPK
MUTE
SELECT-0
SELECT-2

In Figure 7 circuitry a CCTV camera module 28/29 is connected through a wide-band amplifier to an interface connector, along with microphone(s) 36/57, a loudspeaker 37 and a push switch 21.

In the Figure 8 circuitry, a power supply transformer output is rectified through a bridge and tappings achieve alternative DC voltage outputs.

Control circuits for two cameras are also depicted, with attendant command selection and anti-tamper provision.

The master interface connector block lines are also designated.

In the Figure 9 circuitry, the audio channel is detailed, providing speaker output signals

The door opening enable provision is also depicted.

In Figure 10, the video circuitry is detailed.

Component List

W1	cable way
W2	cable way
W3	cable way
W4	cable way
W5	cable way
W6	cable way
A1	differential amplifier
A2	receiver amplifier
A3	driver amplifier
A4	driver amplifier
A5	amplifier
C1	comparator
C2	comparator (Rg voltage drop)
C3	comparator
D1	diode
D2	diode

	D3	diode
	Ra	resistor (impedance matching)
	Rb	resistor (output shunt)
	Rc	resistor
5	Rd	resistor (shunt to S1)
	Re	resistor (LED feed)
	Rf	resistor (bell push feed)
	Rg	resistor (shunt to C2)
	Rh	resistor (feed to C3)
10	S1	switch
	21	switch (bell push)
	22	door bell/chime
	26	control unit (base station)
	28	miniaturised pin-hole camera sensor (chip module)
15	29	(observation) camera
	32	(loudspeaker) aperture (housing 39)
	34	(pin-hole) viewing aperture (housing 39)
	35	(microphone sound) aperture (housing 39)
	36	microphone
20	37	loudspeaker
	38	LED lamp array
	39	housing (bell push)
	41	feed
	42	four-way cable
25	43	feed from door latch 26
	49	feed to TV monitor
	51	door latch actuator switch
	53	door latch actuator
	57	microphone (observation camera 29)
30	58	floodlight (observation camera 29)
	59	mains transformer
	60	(door entrance) threshold
	63	aerial splitter
	65	TV monitor
35	66	aerial
	69	mains supply
	81	microphone (control unit)

Claims

1.

An image remote relay comprising
an image sensor (28, 29),
a multi-way transmission line (41, 42),
with a plurality of conductor ways (W1 - W4/W6),
two conductor ways (W1, W4) used to convey
a power supply to the image sensor,
two conductor ways (W2, W3) used to convey
a picture signal from the image sensor
to a remote viewing screen (65),
a differential current (mode) generator (A1),
representing the image signal,
to allow long distance transmission,
without undue signal degradation
or interference.

2.

An image remote relay, as claimed in Claim 1,
incorporating a wide band operational amplifier (A1),
converting a dual opposed input voltage,
representing the video signal,
into a differential output line driver current,
for a cable transmission line.

3.

An image relay,
for use over a multiple, eg four, way cable;
and in which two ways are used for video,
plus a common 'ground' way;
two ways, including a common ground,
are used for power supply;
a line driver amplifier being used to convert
a video voltage from an image sensor
into dual current drive signals;
dual 'opposed' current drive video signals
being applied respectively to two different ways,
- *so that these dual video signals suffer losses*
which effectively cancel one another out -
an audio signal,
superimposed upon the dual opposed video signals,

as a common mode voltage;
the video line currents on each way
and being converted to voltage,
across a load resistor,
at the output or receiver end of the cable;
a differential amplifier at the receiver end
extracting the audio signal from the video,
by cancelling out or disregarding
the two video signals.

4.

An image relay,
in which a video signal is split
into two complementary signals,
of opposite polarity,
by application to an inverting amplifier,
to produce
a 'negative-going' signal in relation to ground,
whilst preserving a 'positive-going' signal,
the split being achieved in practice,
with so-called 'transconductance',
or voltage-to-current drive, amplifiers;
signal transmission being over four cables,
used respectively as
a positive line,
a zero voltage line,
and a video pair.

5.

A video image relay system,
for a hard-wired or transmission cable link,
between a remote camera and a base station VDU,
utilises a differential mode current signal,
passed along two cable conductor pathways or wires,
with two supplementary wires,
to supply DC power and ground return;
a video signal being handled
as very high speed data transmission,
through operational amplifiers,
laid out in integrated circuits.

6.

A video image relay system,

as claimed in Claim 5,
including an audio relay link,
from a remote microphone,
to a base station loudspeaker,
the audio being applied
as a so-called 'common mode' voltage signal,
superimposed upon the video cable pair,
effectively creating a so-called 'phantom' signal,
which cannot be detected
at the receiving base station
by the video differential amplifier.

7.

An image relay system,
including a wide-band(width) transconductance
- voltage to current conversion - amplifier,
with 'true' differential high impedance inputs,
to achieve operational gain,
without negative feedback,
eliminating closed-loop phase shift
and attendant vulnerability to circuit oscillation,
to achieve an overall output current
proportional to an applied differential input voltage,
providing inherent short-circuit protection
for the output;
the amplifier being deployed to relay
a high bandwidth video signal,
configured as a differential line voltage,
from a camera on-board chip sensor,
over a multi-way transmission line.

8.

An image remote relay,
substantially as hereinbefore described with reference to,
and as shown in, the accompanying drawings.

9.

A security surveillance system,
incorporating an image remote relay,
as claimed in any of the preceding claims.

Patent Office

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Claims searched: ALL

Examiner: Mr.SAT SATKURUNATH
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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): H04B, H04H, H04N

Other: Online: WPI, JAPIO, INSPEC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2295073 A	McDERMOTT - see especially figures 1, 2	1, 3-5 and 7
A	WO 88/05979 A1	COMPAGNIE - see especially figure 2	1, 3-5 and 7
A	US 4054910	TEL-E-TEL - see especially figure 1	1, 3-5 and 7

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.