# CODED LOCKING CIRCUIT FOR SECURITY SYSTEMS

## GENERAL DECRIPTION

The TEA5500 is an encoder/decoder circuit, for security systems. The system has the ability to transmit a complex code between an encoding and decoding unit by infrared radiation. The device can operate as an encoder or decoder depending on the external circuitry connected to the data input. The code is made by the 10 input pins E1 to E10 by connecting them either to ground (LOW) or to the positive supply (HIGH), or leaving them floating ($\infty$). This allows $3^{10}-2$ combinations. Two combinations are prohibited; E1 to E10 = HIGH and E1 to E9 = HIGH, E10 = LOW.

### Encoding

In encoding mode the data input is connected to $V_P$ and both outputs (S1, S2) are connected to a pnp output transistor which drives (e.g.) an infrared radiation emitting diode.
After every start the encoder completes three coding runs then stops automatically.

### Decoding

In decoding mode an infrared sensitive diode (e.g.) is connected to the data input via an amplifier. If the input data is recognized, the data input of the decoder is temporarily closed (disregarding immediately following data) and one of the outputs is activated for a predetermined time after which the following start will activate the other output.
If the input data is not recognized, neither of the outputs are activated and after the third coding run is completed the data input of the decoder is temporarily closed.

### Output

The output is an open-collector configuration (npn), which is active LOW. It can handle a higher supply voltage than $V_P$ (i.e. 16 V max.).

## QUICK REFERENCE DATA

| parameter | conditions | symbol | min. | typ. | max. | unit |
|---|---|---|---|---|---|---|
| Supply voltage (pin 16) | | $V_P$ | 3.0 | 4.5 | 6.5 | V |
| Supply current (pin 16) | $V_P$ = 4.5 V | $I_P$ | 1.8 | 2.5 | 3.2 | mA |
| Operating ambient temperature range | | $T_{amb}$ | −40 | − | +80 | °C |
| Storage temperature range | | $T_{stg}$ | −50 | − | +150 | °C |
| Total power dissipation | | $P_{tot}$ | − | − | 500 | mW |
| Maximum voltage at outputs (pins 3,4 ) | | $V_O$ | − | − | 16 | V |

## PACKAGE OUTLINES

TEA5500:    16-lead DIL; plastic (SOT38).
TEA5500T:   16-lead mini-pack; plastic (SO16L; SOT162A).

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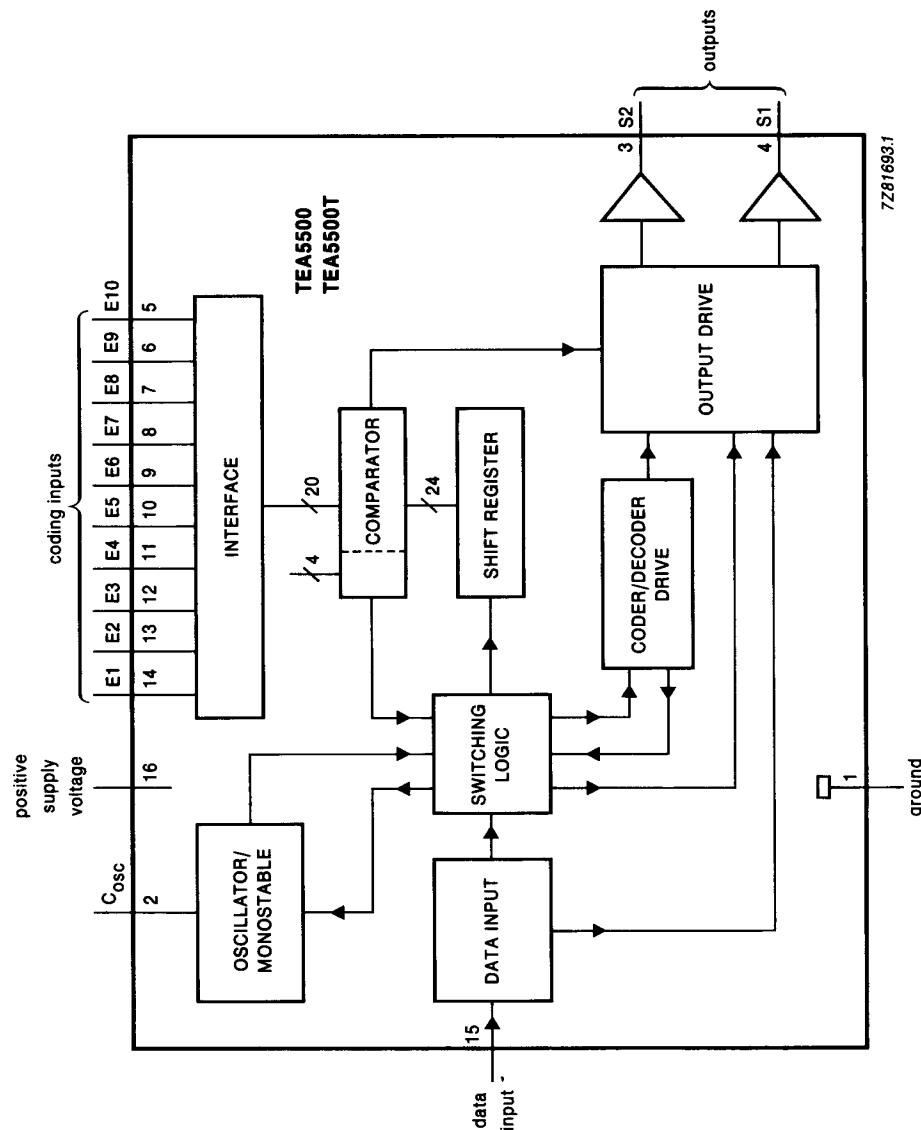
Fig. 1 Block diagram.

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## PINNING

### Pin functions

| pin | mnemonic | description |
|-----|----------|-------------|
| 1 | GND | ground |
| 2 | $C_{osc}$ | oscillator capacitor |
| 3 | S2 | output 2 |
| 4 | S1 | output 1 |
| 5 | E10 | ⎫ |
| 6 | E9 | |
| 7 | E8 | |
| 8 | E7 | |
| 9 | E6 | |
| 10 | E5 | ⎬ coding inputs |
| 11 | E4 | |
| 12 | E3 | |
| 13 | E2 | |
| 14 | E1 | ⎭ |
| 15 | DATA | data input |
| 16 | $V_P$ | positive supply voltage |
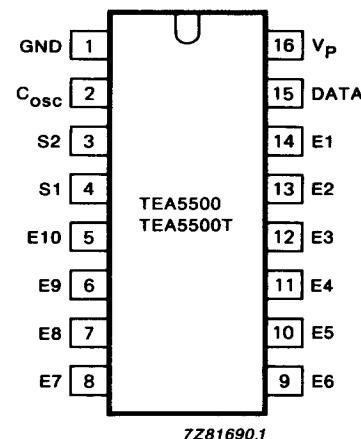
Fig. 2 Pinning diagram.

## RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

| parameter | symbol | min. | max. | unit |
|-----------|--------|------|------|------|
| Supply voltage (pin 16) | $V_P$ | – | 7 | V |
| Supply current (pin 16) | $I_P$ | 0 | 50 | mA |
| Input voltage (pins 2 and 5 to 15) | $V_I$ | −0.3 | $V_P + 0.3$ | V |
| Voltage at outputs (pins 3 and 4) | $V_O$ | −0.3 | 16 | V |
| Total power dissipation | $P_{tot}$ | – | 500 | mW |
| Storage temperature range | $T_{stg}$ | −50 | + 150 | $^oC$ |
| Operating ambient temperature range | $T_{amb}$ | −40 | + 80 | $^oC$ |

## THERMAL RESISTANCE

From junction to ambient

TEA5500: 16-lead DIL $\qquad$ $R_{th\,j\text{-}a}$ = 125 K/W
TEA5500T: 16-lead mini-pack $\qquad$ $R_{th\,j\text{-}a}$ = 160 K/W

## CHARACTERISTICS

$T_{amb}$ = 25 $^o$C; voltages with respect to pin 1; unless otherwise specified.

| parameter | conditions | symbol | min. | typ. | max. | unit |
|---|---|---|---|---|---|---|
| **Supply** | | | | | | |
| Supply voltage (pin 16) | | $V_P$ | 3 | 4.5 | 6.5 | V |
| Supply current | $V_P$ = 4.5 V | $I_P$ | 1.8 | 2.5 | 3.2 | mA |
| Zener diode voltage across supply | note 1 | $V_Z$ | – | – | 8 | V |
| **Inputs E1 to E10** | | | | | | |
| Input voltage HIGH | | $V_{IH}$ | $V_P$ –0.3 | – | – | V |
| Input voltage LOW | | $V_{IL}$ | – | – | 0.3 | V |
| Input voltage floating | | $V_{IFL}$ | 1 | – | $V_P$ –1 | V |
| Input current HIGH | | $I_{IH}$ | 2 | 7 | 12 | $\mu$A |
| Input current LOW | | $I_{IL}$ | –4 | –9 | –15 | $\mu$A |
| Input current floating | | $I_{IFL}$ | – | – | 2 | $\mu$A |
| **Data input** | | | | | | |
| Input voltage | | | | | | |
|   for encoding mode | | $V_{de}$ | $V_P$ –0.6 | $V_P$ | $V_P$ +0.3 | V |
|   for decoding mode HIGH | | $V_{ddH}$ | 0.8 | – | 0.5 $V_P$ | V |
|   for decoding mode LOW | | $V_{ddL}$ | – | – | 0.5 | V |
| Input current | | | | | | |
|   in encoding mode | $V_{15}$ = $V_P$ = 4.5 V | $I_{de}$ | 8 | 16 | 25 | $\mu$A |
|   in decoding mode HIGH | $V_{15}$ = 2 V; $V_P$ = 4.5 V | $I_{ddH}$ | – | – | 2 | $\mu$A |
|   in decoding mode LOW | $V_{15}$ = 0.3 V; $V_P$ = 4.5 V | $I_{ddL}$ | –8 | –16 | –25 | $\mu$A |
| Minimum pulse width of DATA input signal | | $r_{dp}$ | 2 | – | – | $\mu$s |
| **Output** (pins 3 and 4) | | | | | | |
| Output sink current | output active; $V_P$ = 4.5 V | $I_{O (sink)}$ | 25 | – | – | mA |
| Voltage at output | | $V_O$ | – | – | 16 | V |

**Note to the supply characteristics**

1. Maximum Zener diode current 10 mA.

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| parameter | conditions | symbol | min. | typ. | max. | unit |
|---|---|---|---|---|---|---|
| **Oscillator characteristics** | $V_P = 4.5$ V | | | | | |
| Switching voltage thresholds | | | | | | |
|    high level | | $V_{th}$ | 3.10 | 3.32 | 3.50 | V |
|    low level | | $V_{tl}$ | 0.65 | 0.71 | 0.90 | V |
| Input current | | | | | | |
|    after switching high level | | $I_{th}$ | 27 | 36 | 45 | $\mu$A |
|    after switching low level | | $I_{tl}$ | −6.7 | −9 | −11.3 | $\mu$A |
| Ratio $I_{th}/I_{tl}$ | | $\Delta I_{osc}$ | 3 | 4 | 5 | |
| Duration of oscillator pulse | | | | | | |
|    in coding mode | note 1 | $\tau_c$ | 20 | $0.4 \cdot C_{osc}(pF)$ | — | $\mu$s |
|    in decoding mode | | $\tau_d$ | $3 \cdot \tau_c$ | $0.4 \cdot C_{osc}(pF)$ | $5 \cdot \tau_c$ | $\mu$s |
| Oscillator capacitor | | | | | | |
|    in coding mode | notes 1 and 2 | $C_{osc}$ | 56 | — | — | pF |
| Duration of | | | | | | |
|    output active status | | $\tau_o$ | — | $384 \cdot \tau_d$ | — | |
|    data input disabled status | | $\tau_x$ | — | $576 \cdot \tau_d$ | — | |
| Influence of temperature on | | | | | | |
|    duration of oscillator pulse | | $\dfrac{\Delta \tau_c / \tau_c}{\Delta T}$ | — | 0.002 | — | $K^{-1}$ |
| Influence of supply voltage on | | | | | | |
|    duration of oscillator pulse | | $\dfrac{\Delta \tau_c / \tau_c}{\Delta V_P}$ | — | — | 0.16 | $V^{-1}$ |

**Notes to the oscillator characteristics**

1. Minimum value encoder − capacitor must provide minimum pulse width of DATA pulse $\tau_{dp}$ ($= 0.2\,\tau_c$).

2. Ratio encoder/decoder capacitor 1 : 4.

## Code

The code consists of 24 bits. Each bit is represented by presence or absence of a data pulse following a clock pulse. The first 10 pairs of bits are determined by the connections of the input pins (E1 to E10). The last 4 bits form the recognition code. For the corresponding code in decoding mode the order of the input pins is reversed and connections "low" (L) and "floating" ($\infty$) are interchanged.



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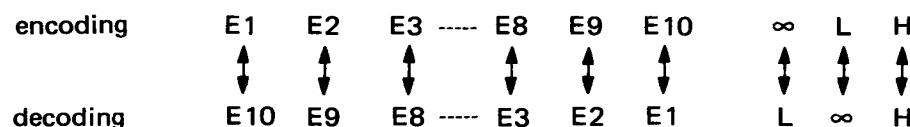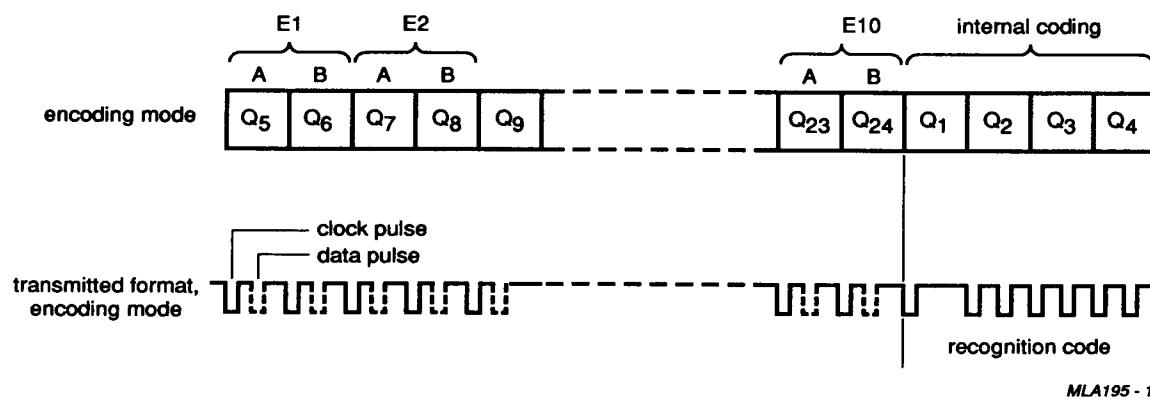
| encoding | E1 | E2 | E3 ----- E8 | E9 | E10 | $\infty$ | L | H |
|----------|----|----|-----------|----|-----|----------|---|---|
| decoding | E10 | E9 | E8 ----- E3 | E2 | E1 | L | $\infty$ | H |

| E | A | B | $Q_A$ | $Q_B$ |
|---|---|---|-------|-------|
| L | 1 | 0 | 0 | 1 |
| $\infty$ | 0 | 1 | 1 | 0 |
| H | 1 | 1 | 0 | 0 |

example

| encoding | E1 = L | E2 = H | E3 = $\infty$ | E4 = H | ----- | E9 = L | E10 = $\infty$ |
|----------|--------|--------|---------------|--------|-------|--------|----------------|
| decoding | E10 = $\infty$ | E9 = H | E8 = L | E7 = H | ----- | E2 = $\infty$ | E1 = L |

Fig. 3 Coding diagram.
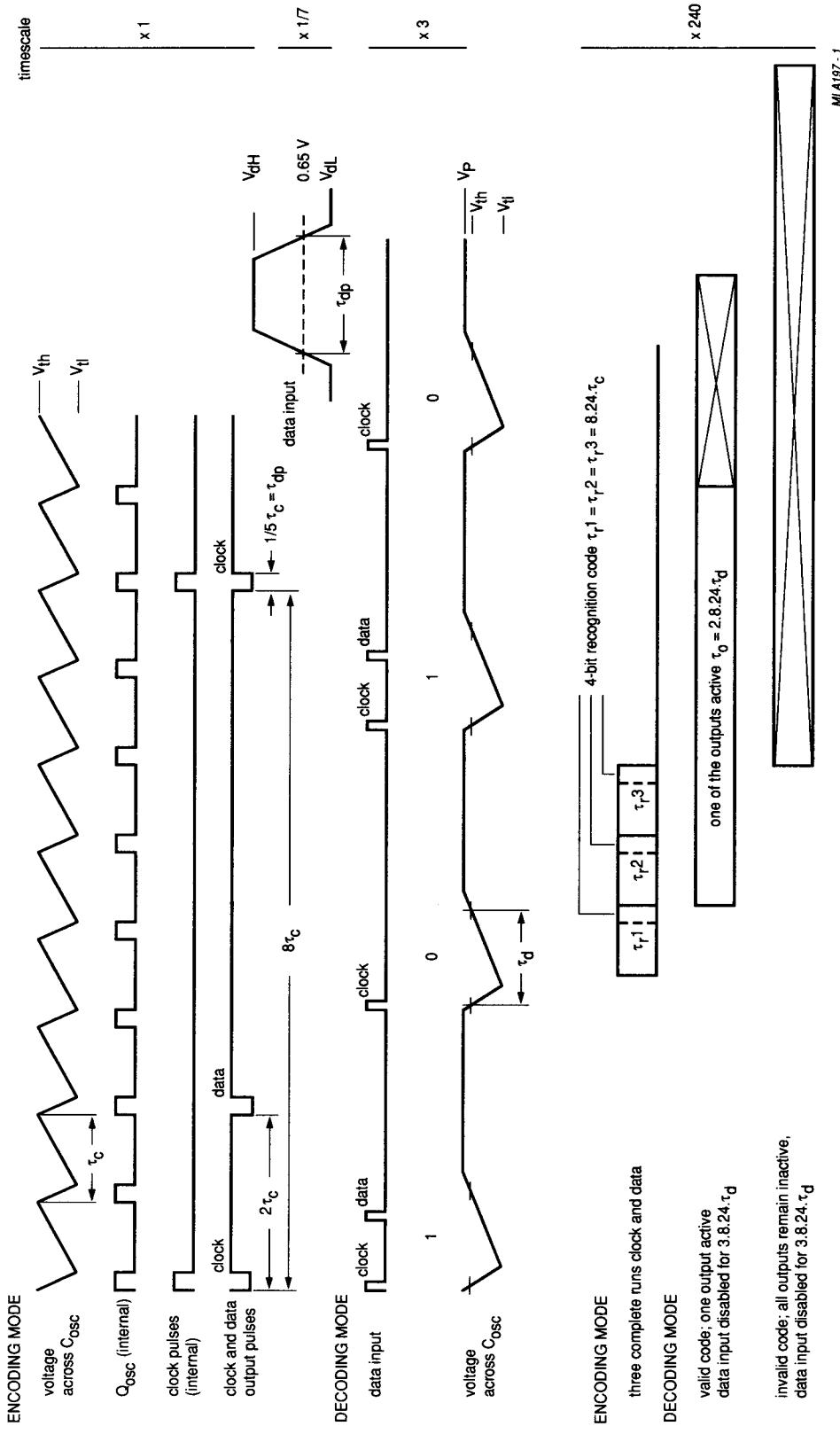
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TIMING



Fig. 4 Timing diagram of TEA5500.

### APPLICATION INFORMATION
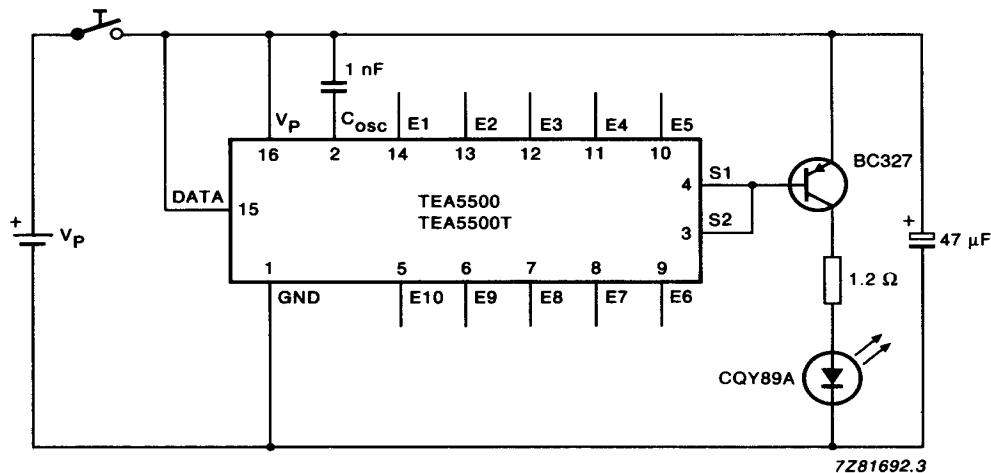


E1 — E10: code (H,L, ∞).

Fig. 5 Application diagram; coding mode.
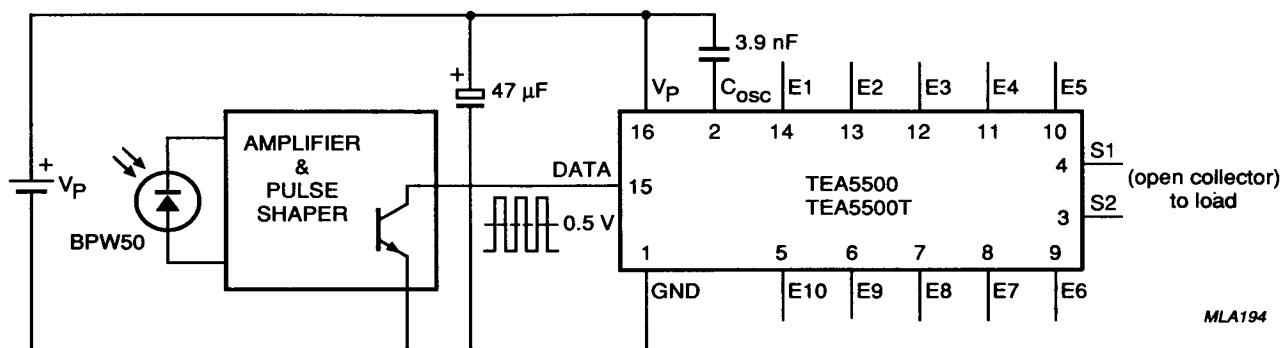


E10 — E1: code (H, ∞, L).

Fig. 6 Application diagram; decoding mode.
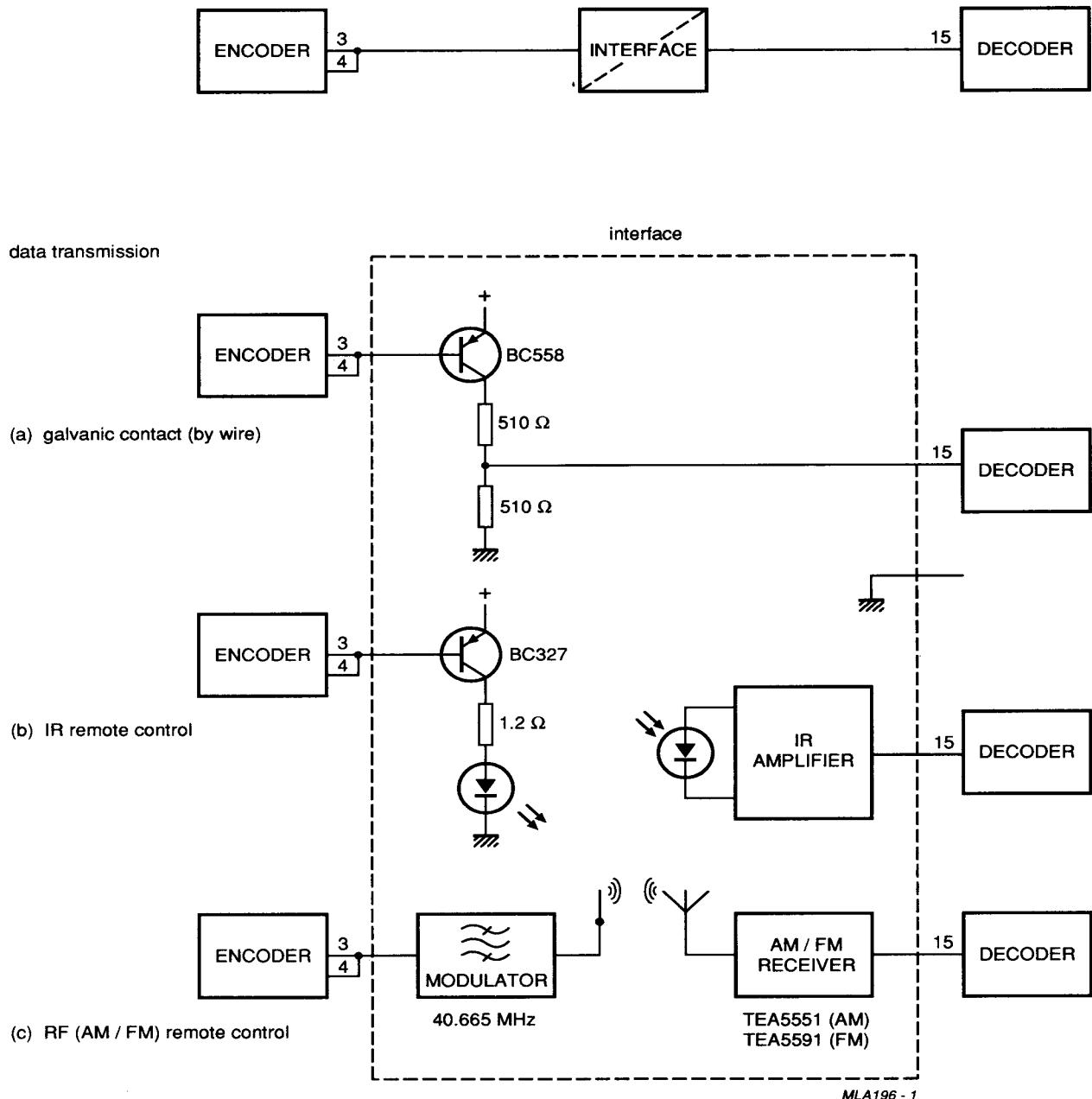
Fig. 7 Application diagram; types of data transmission possible by using different interfaces.

**16-LEAD DUAL IN-LINE; PLASTIC (SOT38)**
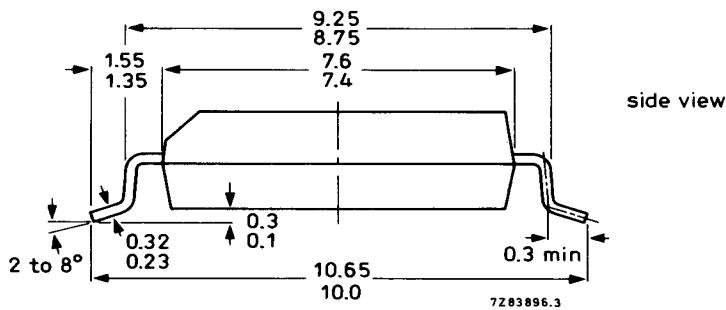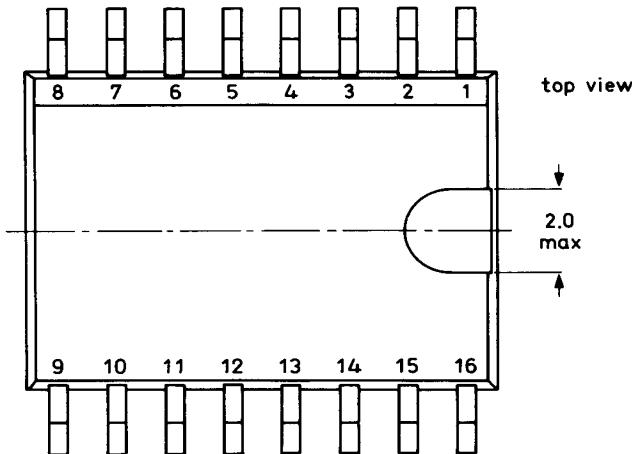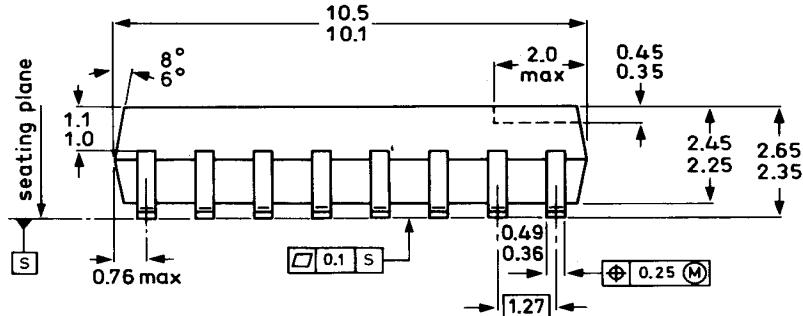


22 max

seating plane

4,7 max

0,51 min

0,76 (2)

0,53 max

◆ 0,254 Ⓜ (1)

3,9
3,4

14x

2,54

2,2 max

8,25max

0,32 max

7,62

9,5
8,3

7Z55041.8

1,4 max

| 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 |

top view

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

**Dimensions in mm**

⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ±0,127 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by ±0,254 mm.

(2) Lead spacing tolerances apply from seating plane to the line indicated.

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## 16-LEAD MINI-PACK; PLASTIC (SO16L; SOT162A)



Dimensions in mm

⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

## SOLDERING PLASTIC MINI-PACKS

### 1. By hand-held soldering iron or pulse-heated solder tool

Fix the component by first soldering two, diagonally opposite end leads. Apply the heating tool to the flat part of the lead only. Contact time must be limited to 10 seconds at up to 300 °C. When using proper tools, all other leads can be soldered in one operation within 2 to 5 seconds at between 270 and 320 °C. (Pulse-heated soldering is not recommended for SO packages).

For pulse-heated solder tool (resistance) soldering of VSO packages, solder is applied to substrate by dipping or by an extra thick tin/lead plating before package placement.

### 2. By wave

During placement and before soldering, the component must be fixed with a droplet of adhesive. After curing the adhesive, the component can be soldered. The adhesive can be applied by screen printing, pin transfer or syringe dispensing.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder bath is 10 seconds, if allowed to cool to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

### 3. By solder paste reflow

Reflow soldering requires the solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the substrate by screen printing, stencilling or pressure-syringe dispensing before device placement.

Several techniques exist for reflowing, for example, thermal conduction by heated belt, infrared, and vapour-phase reflow. Dwell times vary between 50 and 300 seconds according to method. Typical reflow temperatures range from 215 to 250 °C.

Pre-heating is necessary to dry paste and evaporate binding agent.

Pre-heating duration: 45 minutes at 45 °C.

### 4. Repairing soldered joints

The same precaution and limits apply as in (1) above.

## SOLDERING PLASTIC DUAL IN-LINE PACKAGES

### 1. By hand

Apply the soldering iron below the seating plane (or not more than 2 mm above it). If its temperature is below 300 °C it must not be in contact for more than 10 seconds; if between 300 and 400 °C, for not more than 5 seconds.

### 2. By dip or wave

The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

### 3. Repairing soldered joints

The same precautions and limits apply as in (1) above.

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