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In 1783, when the Montgolfier brothers took off from Versailles in the first ever hot-air balloon, they were contributing to an innovative tradition that continues to this day. Like almost all achievements, however, theirs was not an isolated event. If they hadn't succeeded in flying their balloon, others would surely have done so within a few years. Breakthroughs in human attainment, it seems, often occur simultaneously at several places. This is partly due to Man's competitive spirit, but also perhaps to other factors. Breakthroughs occur only when the intellectual and technological climate of the age is right for them. They are, in effect, events just waiting to happen, and the right stimulus can occur at several places at the same time. This is probably as true today in the era of heavily-funded, directed research, as it was in the time of the Montgolfiers. And though directed research has accomplished a great deal, sometimes perhaps we expect too much of it. A trip in a modern hot-air balloon similar to the Montgolfiers' may help us keep our world and achievements in perspective. And if nothing else, the view will be quite spectacular.

Contents

A new generation of World SystemTeletext ICs

JOHN KINGHORN

Teletext can now be received in more than 35 countries by over 40 million TV sets, and the decoding ICs for most of them have been supplied by Philips Semiconductors. Ever since the inauguration of the first teletext service in the early 1970s, Philips has been actively involved in developing the service and introducing it throughout the world. For example, Philips helped to draw up the World System Teletext standard which is now adopted by many countries. Recent developments such as FLOF (Full Level-One Features)/Fastext, TOP (Table Of Pages) and enhanced language facilities have all been made possible by using the Philips-designed Computer-Controlled Teletext (CCT) approach to overcome the limitations of earlier teletext decoders.

Because teletext decoders built with Philips ICs are computer-controlled via the I^{2}C-bus, they add flexibility to TV set design by allowing decoders for different markets to be simply inserted into the same basic TV chassis or separate "plug-in" module.

To help TV set manufacturers meet the needs of specific market areas, Philips teletext ICs are backed by a comprehensive range of production-ready software packages.

The two-chip combination of our SAA5231 teletext Video Input Processor (VIP2) and an Enhanced Computer-Controlled Teletext (ECCT) IC from our SAA5243/45 series forms the heart of most existing World System Teletext decoders. These two ICs are recognized as industry standards and have outstanding performance, especially under adverse reception conditions.

Continued progress in IC technology has now allowed us to develop a new range of Integrated VIP and Teletext (IVT) ICs for decoding 625-line based World System Teletext (WST) transmissions. By implementing more functions on a single chip at economic cost, these IVT ICs allow TV manufacturers to reduce system cost by using fewer ICs, simpler interfaces and fewer adjustments. They also enhance reliability and allow PCB area and power consumption to be reduced.

We have taken a major step forward in the design of our IVT ICs by integrating the video processing and display PLL functions on the same chip as the data acquisition, timing and character generator circuits. Several versions are available to suit differing requirements in terms of function and cost. All, however, have low power consumption from a single 5 V supply, few peripheral components and no adjustments. One version also has an on-chip page memory making it a genuine single-chip add-on teletext decoder.

The IVT IC range comprises:

- **SAA5244P/A**: Integrated VIP and Teletext circuit IVT1.1 is a complete single-chip teletext decoder with on-chip 1.1 K × 7-bit SRAM for storing a single page and extension packets for Fastext
- **SAA5246P/E**: Integrated VIP and Teletext circuit IVT1.0 is equivalent to SAA5243 (ECCT) + SAA5231 (VIP2). It includes an interface to external 8 K × 8-bit SRAM providing a 4-page memory (extension packet mode) or 8-page memory (normal mode). This IC is also available in a range of other language options which will be extended in the near future
- **SAA5247P/B**: Integrated VIP and Teletext circuit IVT1.1BMC has an on-chip 1.1 K × 8-bit SRAM for storing a single page and extension packets for Fastext. It also has a Background Memory Controller for external DRAMs (one 256 K × 4-bit, two 256 K × 4-bit or one 1 M × 4-bit) which can be rapidly scanned on each page request, thereby giving near-instantaneous (200 ms max.) access to up to 512 pages.

Purchase of Philips I^{2}C components conveys a license under the Philips I^{2}C patent to use the components in the I^{2}C system, provided the system conforms to the I^{2}C specifications defined by Philips.

Figure 1 shows the basic teletext decoder configuration using our new range of I^2C-bus controlled single-chip Integrated VIP and Text (IVT) ICs. From the incoming composite video signal, the IVT IC extracts the teletext data, regenerates the teletext clock and produces video drive signals and a signal for synchronizing the text display to the TV syncs. An overview of teletext software packages for use with the IVT ICs is given later in this article.

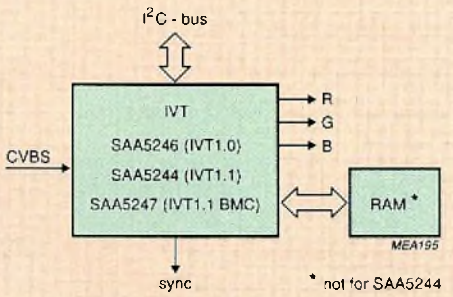


Fig.1 Single-chip teletext decoder configuration using an Integrated VIP and Text (IVT) IC. The SAA5246 (IVT1.0) has an interface for an 8 K × 8-bit SRAM for storing 4 pages (extension packet mode) or 8 pages (normal mode). The SAA5244 (IVT1.1) single-page decoder has an on-chip 1-page SRAM and doesn't therefore need an external memory. The SAA5247 (IVT1.1BMC) gives near-instantaneous access to up to 512 pages stored in external DRAM

FEATURES OF IVT ICs

Features common to all IVT ICs

All IVT ICs are based on a combination of our well-established ECCT circuit SAA5243, with some additional features, and Video Input Processor SAA5231 (VIP 2). They maintain backwards software-compatibility with their ECCT predecessors. The video input processing section of the IVT ICs uses new mixed analog and digital circuitry for data slicing and the display clock PLL functions. This has allowed us to considerably reduce the number of peripheral components required and to completely eliminate all close tolerance and adjustable components from the peripheral circuitry.

Other features that are common to the entire family of IVT circuits are:

- full production quantities available
- all teletext decoding functions on a single chip
- single +5 V power supply
- simple control via the I^2C-bus
- use of a digital data slicer and display clock PLL minimizes the number of peripheral components
- support both video and scan-related synchronization modes
- RGB interface to standard colour decoder ICs is simplified by push-pull output
- data capture performance is comparable to that of our Video Input Processor SAA5231 (VIP2)
- optional storage of packet 24 in the display memory
- teletext signal quality, video signal quality, 625/525-line video input, and the language/ROM variant in use can all be read via the I^2C-bus
- automatic odd/even field output with software override for de-interlacing circuits
- the display PLL can be made to free-run, and the rolling header can be disabled via the I^2C-bus
- VCS to SCS mode for stable 525-line status display
- 25th display row for software-generated status messages or FLOF/Fastext/TOP prompts
- software selection of field flyback or full-channel data acquisition
- cursor control available for videotex and VCR programming
- extension packets accepted
- facilitate on-screen display (OSD) of TV control functions
- mask-programmable character sets for different languages and symbols.

Features of single-chip integrated VIP and Teletext IC SAA5246 (IVT1.0)

The first member of our IVT family is the SAA5246 (IVT1.0), an evaluation board for which is shown in Fig.2. This IC is an ECCT look-alike which interfaces with an external 8 K × 8-bit SRAM for storing eight pages (normal mode) or four pages (extension packet mode). In addition to the previously listed features common to all IVT ICs, unique features of the SAA5246 are:

- available in a DIL-48, QFP-64 or SDIL-52 plastic package
- four independent acquisition circuits for four/eight page acquisition system backwards software-compatible with ECCT
- 8-bit data reception on all rows (for example TOP), or normal 7 bits plus parity (under software control)
- 192 characters (12 × 10 dot matrix)

- currently available language variants:
  - **SAA5246P/E**: West European
  - **SAA5246P/H**: East European
  - **SAA5246P/T**: Euro-Turkish (others in preparation)
- improved display of accented characters
- backwards software compatible with ECCT systems
- packet 8/30/2 mapped to different extension chapter to facilitate VCR programming
- suitable for Fastext and TOP
- automatic Hamming checking of Fastext extension packets
- extension packet capture for extended languages
- maximum supply current: 128 mA.

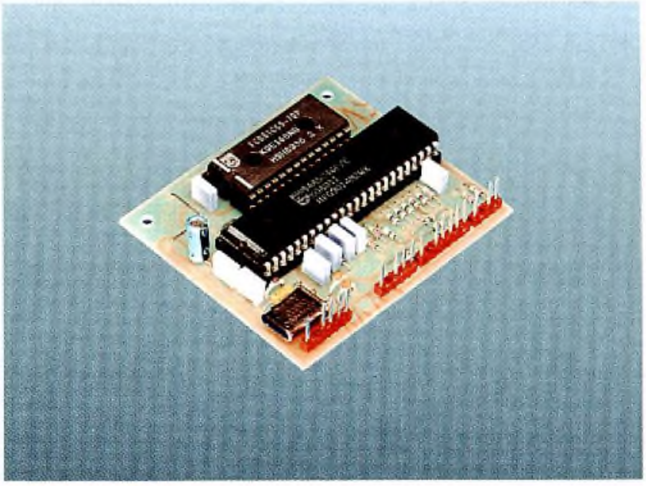


Fig.2 Evaluation board for a complete single-chip World System Teletext decoder (excluding microcontroller) using SAA5246 (IVT1.0) in a DIL package

Features of single-chip integrated VIP and Teletext IC SAA5244 (IVT1.1)

The second member of our IVT family is the SAA5244 (IVT1.1), an evaluation board for which is shown in Fig.3. Since it has a built-in 1.1 K x 7-bit SRAM which can store one teletext page plus extension packets for Fastext, this IC is a true 1-chip teletext system that offers space-saving, simple software control and reliability for small-screen TV sets. In addition to the previously listed features that are common to all IVT ICs, unique features of the SAA5244 are:

- DIL-40, QFP-44 or SDIL-42 plastic package. The DIL package is pin-aligned with that of the SAA5247 (IVT1.1BMC)
- pin-, function- and software-compatible with SAA5247 (IVT1.1BMC)
- some software-compatibility with SAA5246 (IVT1.0)
- single-page acquisition system
- automatic Hamming decoding of FLOF links simplifies control software
- no external RAM needed
- 148 characters (12 × 10 dot matrix) plus 32 supplementary characters for on-screen displays of TV analog control functions
- suitable for user-friendly FLOF/Fastext interface
- currently available language variant:
  - **SAA5244P/A**: West European (not Spain)
- maximum supply current: 148 mA.

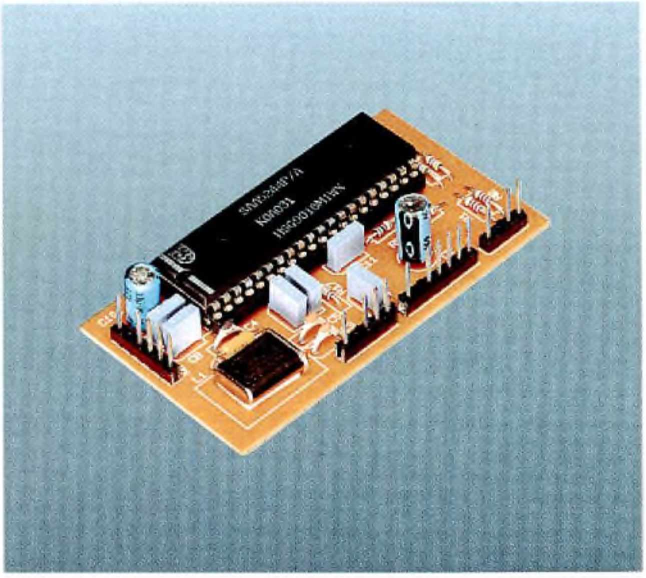


Fig.3 Evaluation board for a complete single-chip World System Teletext decoder (excluding microcontroller) using the SAA5244 (IVT1.1)

Features of single-chip integrated VIP and Teletext IC SAA5247 (IVT1.1BMC)

The third member of our IVT family is the SAA5247 (IVT1.1BMC), an evaluation board for which is shown in Fig.4. This IC is based on the SAA5244 (IVT1.1) with which it is pin-aligned and software compatible. The SAA5247, however, has the addition of a Background Memory Controller (BMC) with a direct interface to one 256 K × 4-bit, two 256 K × 4-bit or one 1 M × 4-bit DRAM. This DRAM, which contains up to the last 512 pages transmitted, is rapidly scanned at each page request giving near-instantaneous (200 ms max.) page access. This IC can be used to upgrade a TV set design using the

SAA5244 (IVT1.1) very easily. In addition to the previously listed features which are common to all IVT ICs, and the features listed for the SAA5244, the SAA5247 has the following unique features:

- DIL-48 plastic package which is pin-aligned with that of the SAA5244 (IVT1.1)
- automatically stores every page transmitted by the broadcaster
- 8-bit wide internal memory (for TOP applications)
- software compatible with the SAA5244 (IVT1.1)
- suitable for FLOF/Fastext and TOP
- currently available language variant:
  - **SAA5247P/B**: West European (not Spain)
- maximum supply current: 180 mA.

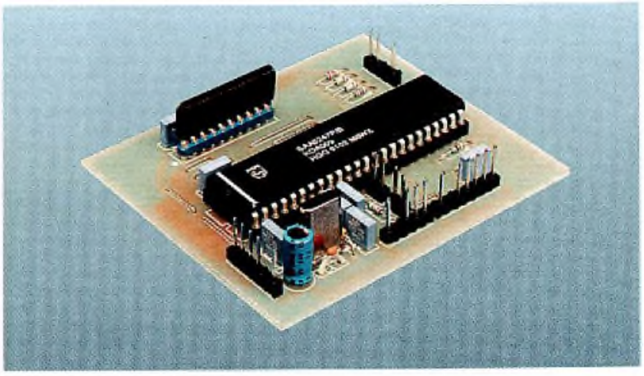


Fig.4 Evaluation board for a complete single-chip World System Teletext decoder (excluding microcontroller) using the SAA5247 (IVT1.1BMC)

WORLD SYSTEM TELETEXT DEVELOPMENTS

Characters for multiple languages

The World System Teletext standard (Ref.4), previously known as UK Standard Teletext, has now been adopted in more than 35 countries, making the language requirements increasingly complex.

Currently, individual languages or small groups of languages are catered for by mask-programmed variants of the character generator circuits of the teletext decoder. Although this has been satisfactory for national broadcasting, the availability of "national" broadcasts to an international audience via satellite transmissions, and the trend towards international broadcasting, make it desirable to be able to decode teletext transmissions correctly outside their country of origin.

As the reception of international TV broadcasts becomes more widespread, teletext can be used to subtitle programmes in many languages simultaneously as shown in Fig.5, making them comprehensible to a much wider audience – the desired translation being selected by the viewer and inserted in the normal picture

Some languages require many special characters; more than can be accommodated in the standard 96-character sets available with earlier teletext ICs. Spain was the first country in Europe to start a teletext service using an extended set of 128 characters. Other countries, for example Iceland, need a few special symbols which cannot be implemented economically in the decoder IC variant specific to the country because of the relatively small home-market for TV sets. The best solution here is to include the special symbols in a standard IC which can display a large group of languages.

Using a set of 192 characters, the SAA5246 (IVT1.0) covers *all* the languages required in Western Europe. When controlled with suitable software, a teletext decoder using an IVT circuit can be used anywhere in Western Europe with the correct characters displayed automatically. Other language variants are available, or planned, for covering different geographical areas.

A further complication arises when more than one alphabet must be available from one IC. For example, English and Arabic may be required in the Middle East, and both Latin and Cyrillic alphabets are needed in the Baltic States and Yugoslavia. Furthermore, it may be necessary to use both alphabets on the same page, particularly when teletext is used for educational applications. Of course, this could be done by transmitting all the letters in one of the alphabets using extension packets X/26. However, this would waste transmission capacity and also result in prolonged processing time for the displayed page if economic software were used. An alternative solution called the TWIST function is used in IVT IC variants which contain two alphabets. The TWIST function responds to a control character to shift or "twist" from the currently used alphabet to the other one, in a similar manner to selecting alphanumeric or mosaic graphic characters. Figure 6 shows a page displayed by using the TWIST technique.

The page shown in Fig.6 is mostly in Russian which is selected by using the page header control bits. Whenever text using Latin characters is required (Estonian in this case but also suitable for English), a control character is inserted in the space before the text so that the character generator switches to the Latin alphabet. After the Latin character text, another control character switches the character generator back to Russian. Since words containing both Russian and Latin characters are not required, the space occupied by the TWIST control character is not a problem.

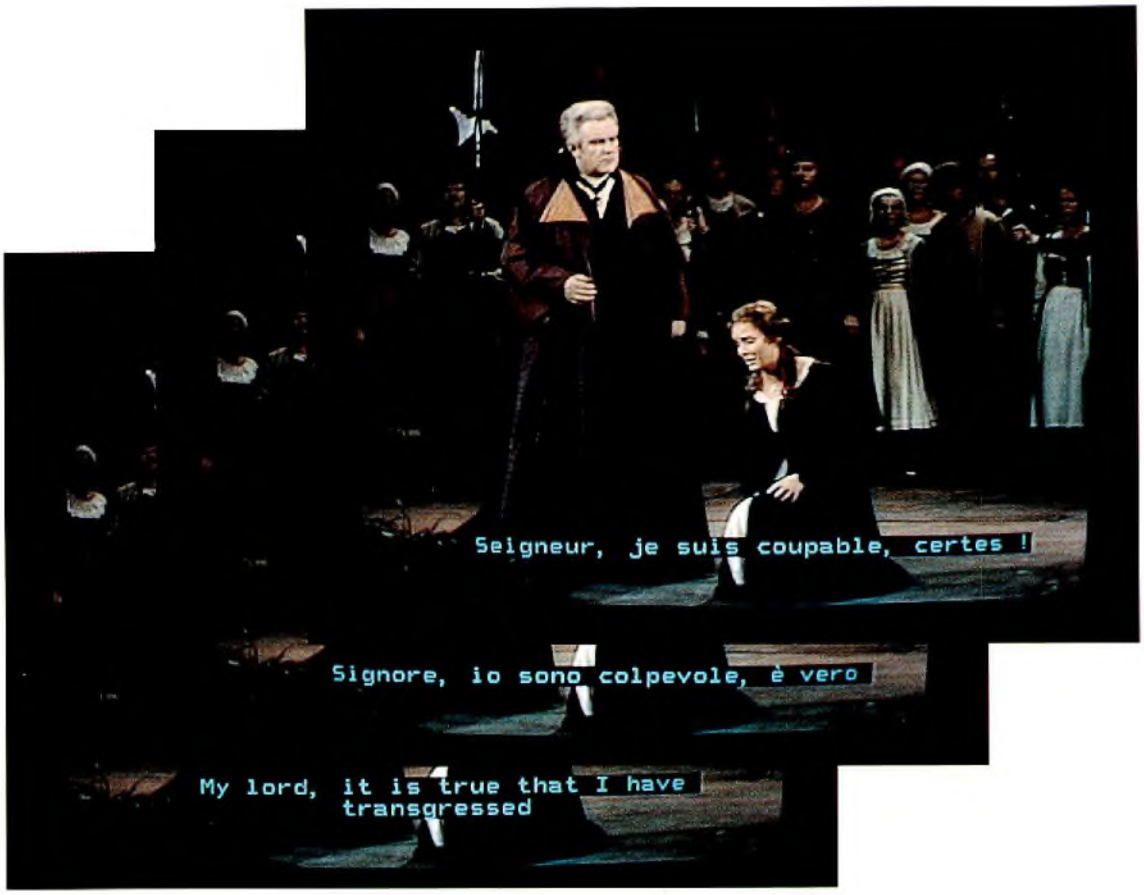


Fig.5 Multilingual subtitling makes more programmes comprehensible to a wider international audience and to those who are hard of hearing

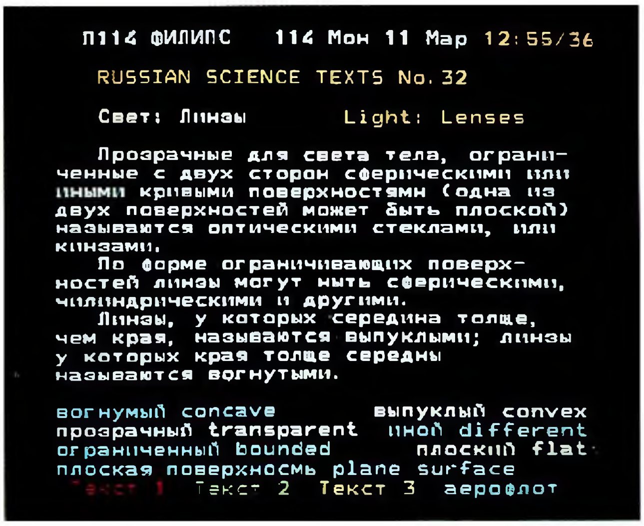


Fig.6 A page using the TWIST technique to display Russian and Latin alphabets

On-Screen Display (OSD) of TV functions

As teletext becomes a standard feature of mid- and top-range TV sets, cabinet design flexibility and user-friendliness can be increased by using the teletext screen display features for additional purposes. For example, the traditional LED display of programme/channel numbers can be made more legible by displaying them on the screen. TV analog control settings, timer/clock settings and viewer-programmed status titles can also be displayed in top-range sets. Of course, additional control software is required to make the teletext decoder generate these displays. However, the decoder hardware (IVT IC) remains the same; only the ROM of the microcontroller and perhaps some non-volatile memory needs to be added.

Multi-page decoding systems for reducing page access time

As the number of pages transmitted in a teletext database increases, more data lines must be used if the cycle time is to remain constant. However, some broadcasters are already using much of the available capacity (12 lines of the 17 available for example). There are also other uses for this valuable resource, such as professional data services, which may be more profitable for broadcasters than a public teletext service. There is therefore increasing pressure on teletext decoder designers to find ways of decreasing page access time. The solution lies in finding the optimum compromise, in terms of cost, between control software complexity and page memory capacity.

If the next page required can be predicted, and sufficient storage provided to capture it before it is requested, a relatively small memory can be used to provide instant page access, even though the database has a long cycle time. Obviously, the difficulty lies in predicting which page will be required next.

If the viewer can be encouraged to access the database in an orderly fashion, the number of pages to be pre-captured, and therefore the memory capacity required, is minimized because it becomes easier to predict which page will be required next. For example, if a news index page is being viewed, there is a very good chance that a page containing a news item will be required next so that only the pages containing news items need to be stored.

As teletext services mature and the total system cost decreases, new teletext user interface systems such as FLOF (Full Level-One Features)/Fastext and TOP (Table Of Pages) are being introduced to encourage viewers to use teletext in an orderly fashion. The control software can use the information in the Fastext or TOP database to make an optimum selection of pages to be captured, based on the available memory capacity and the pages already stored. However, the economy in page memory achieved by using this approach may be offset by the increased complexity of the control software.

If teletext pages are to be randomly accessed, instant access can only be provided by incorporating sufficient memory to store all the pages transmitted by the broadcaster; this may total several hundreds. Clearly, the cost of the memory for such a system will be increased but, since it is easier to decide which pages to capture, the control software is simplified. This approach is adopted by the SAA5247 (IVT1.1BMC) which can store up to 512 pages in external DRAM. Since the SAA5247 is pin-aligned and software-compatible with single-page decoder SAA5244 (IVT1.1), it is easy for TV manufacturers to incorporate a simple or high-performance teletext decoder in the same basic chassis design.

A complication that arises with all types of multi-page teletext decoder is caused by rolling pages in which several frames of information bear the same page number. There are two types of rolling pages. With the first type, not all the information changes from page to page (partial advertisements for example) and the order in which they are displayed is unimportant. The second type have completely different information on each frame (programme schedules for example) and ideally, should be displayed in sequence. This type is much more difficult to deal with because, although it is possible to devise software to recognize rolling pages and arrange for separate storage of the various versions, much more memory is required. The worst problem is that the time required to access the first page in the sequence when the TV channel is first selected may amount to several minutes regardless of how much memory is available. There is no absolute solution to this problem but decoders with more complex control software can give some improvement of performance. For example, the priority for retaining a page in memory might be increased if it is part of a series of rolling pages.

FLOF/Fastext

FLOF (Full Level-One Features)/Fastext provides single-keystroke access to teletext pages which is effectively instantaneous if a multi-page decoder is used. It eliminates the need to remember page numbers because the main index is automatically accessed, and subsequent pages are linked for access by colour-coded keys on the remote control which match the colours of keywords (prompts) at the bottom of the screen (Fig.7). An index key can be used to return to the most recently accessed local index, or to the main index.

FLOF/Fastext uses three of the teletext extension packets that allow broadcasters to transmit enhanced teletext services.

The initial page packet (packet 8/30) allows the decoder to acquire the magazine index or the introductory page for instant display when teletext is selected. This packet can also provide data about the TV broadcast such as station identification and current programme.

The page linking packet (packet X/27) is transmitted with each page and contains the numbers of pages that the broadcaster believes the viewer is most likely to request next. A multi-page decoder can acquire and store these pages prior to them being requested by the viewer.

The prompt packet (packet X/24) contains keywords indicating the nature of the information on the pages specified in the first four links of the page linking packet.

Fig.7 Full Level-One Features (FLOF) or Fastext decoders using IVT ICs simplify page selection and speed-up page access

This prompt packet is intended to be displayed as the extra 25th status row. Each keyword (prompt) is colour-coded (red, green, yellow or cyan) to match similarly coloured keys on the TV remote control.

FLOF/Fastext is now in service in several countries, with more countries expected to follow shortly. The IVT ICs have all the facilities necessary to implement a FLOF/ Fastext decoder economically.

Table Of Pages (TOP)

By using an IVT-based teletext decoder and appropriate software, it is possible to implement a teletext information filing system which allows easy access to desired teletext pages via special keys on the TV remote controller. This user interface, known as Table of Pages (TOP), works in a similar manner to FLOF/Fastext but the page linking information and titles of pages are transmitted on special page numbers instead of in extension packets as with FLOF/Fastext.

The TOP system divides teletext pages into blocks, groups and direct selection pages. For example, a block could be news, sport or TV programmes. Groups within the sport block could be tennis and football. A direct access page within the football group could be the football results.

There are three basic Tables of pages in the TOP system; the basic TOP Table (BTT), the multi-page Table (MPT) and the additional information Table (AIT).

A BTT is a teletext page which gives information about the structure of the database to the decoder software. Each page number is identified as a normal page, block, group, or not in transmission, together with an indication of rolling pages. There is also a page linking Table which contains the page numbers of all the other TOP Tables.

The structure of the MPT is similar to that of the BTT. It indicates how many multipages there are in a rolling page sequence.

An AIT displays the codes for direct selection pages and user guidance text such as titles of blocks, groups and direct selection pages.

In use, the TOP system indicates the category of the page being viewed. For example, Fig.8 is "Index" (top right of screen). Pressing an "overview" key gives the titles of the blocks in transmission (Fig.9), and a block can be selected by moving a cursor. The block "About ORACLE" has been chosen in Fig.9, and the starting page is displayed by pressing a "select" key. More details of this part of the database can be found by pressing a "contents" key (Fig.10), with individual pages selected by moving a cursor as before. In Fig.10, pressing the "select" key would display the "profitable teletext" page.

Fig.8 Main index with TOP title

Fig.9 TOP overview of database

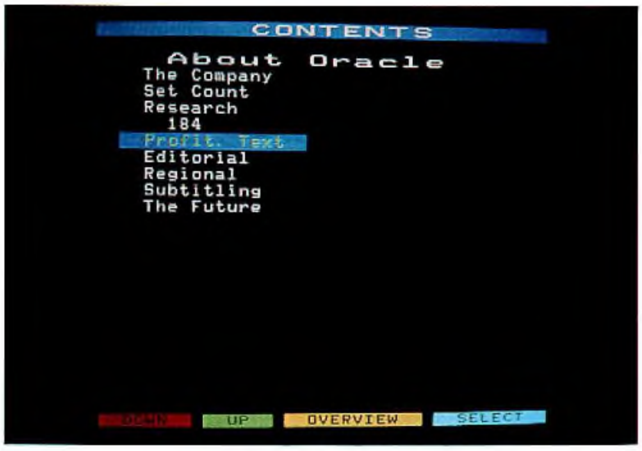


Fig.10 TOP contents of "About Oracle"

programme. A cursor appears beside the first programme and can be moved through the list to select the programme to be recorded by pressing buttons on the remote controller. It is then only necessary to press a "record this" button to cause all the necessary information to be loaded into the VCR automatically and the programme to be recorded when it is broadcast. Even if the programme is delayed, starts early, or overruns, a transmitted switching signal ensures that the VCR is not switched on until the programme starts and is not switched off again until it ends. Figure 11 shows a programme schedule page from a test VPT transmission.

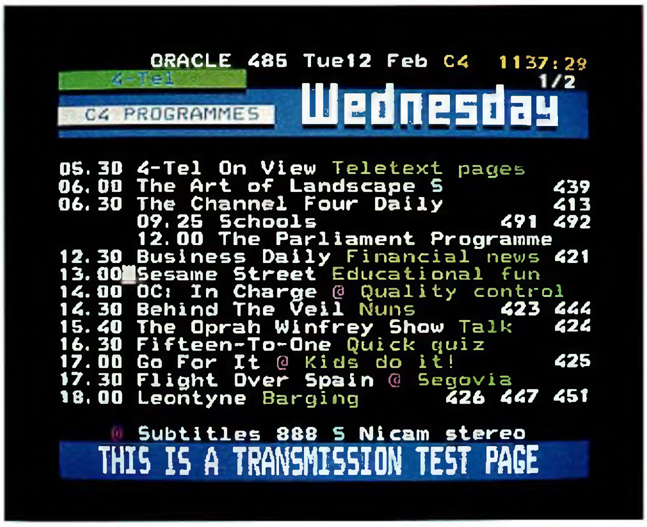


Fig.11 Programme schedule page from a test VPT transmission (data by courtesy of Oracle Teletext Limited)

VCR programming

To overcome the difficulty some viewers experience when programming a VCR, a system known as VCR Programming via Teletext (VPT) or Programme Delivery Control (PDC) has been developed. The VPT system uses a teletext decoder in the VCR to extract programme identification and timing data that has been inserted into the TV transmission by the broadcaster. This data is subsequently used to operate the VCR switches at the correct times. This is achieved automatically by the viewer simply using a remote control to select the TV programme to be recorded from a teletext programme schedule page. VPT transmissions are currently on trial in Germany and the UK with a view to starting public services later this year.

To use VPT, the viewer uses a remote controller to select a teletext display from the VCR and calls up a TV programme schedule page which includes hidden codes identifying the network and the scheduled times of each

The data for the programme schedule page is displayed in the usual way, and is available for consultation by all teletext viewers. However, extra information is transmitted to mark the positions of the programmes which can be recorded and each position has the corresponding schedule data defined. When a VCR equipped with VPT/PDC recognizes this data, it causes a cursor to be displayed at the first position. The cursor can be moved through the programme schedule by the viewer pressing keys on the remote controller. In Fig.11, the cursor has been moved to select "Sesame Street". After a programme has been selected, it is only necessary to press a single key on the remote controller to cause reliable recording when the programme is broadcast.

Even if a full VPT service is not available, it is still possible to provide a similar facility using the starting times displayed on the programme schedule page. In this case, some manual intervention may be required and there will be no compensation for unscheduled variation of programme screening times. However, the simplification of VCR programming achieved is still worthwhile. This approach, sometimes called "poor man's VPT", is already being used in some top-range VCRs.

The new teletext IC SAA5246 (IVT1.0) is particularly suitable for use in VCRs with VPT/PDC. Its 5 V supply and low current consumption, together with the availability of a small package option, make it ideal for the VCR environment. Its extension packet mode allows for transmissions according to the EBU's PDC method "B", whereas method "A" can be accommodated by using the normal mode. Separate storage of extension packet 8/30 format 2 (used for the VCR switching signal) simplifies the control software without causing speed problems. A cursor facility to indicate the selected programme is built-in to the IC, and it also has multi-page capability to provide fast access to subsequent programme schedule pages. Using teletext to program a VCR represents a major step forward in the sales appeal, comprehensibility and "user-friendliness" of video recorders. In the future, teletext may become as common a feature in VCRs as it is in today's TV sets.

FUNCTIONAL DESCRIPTION OF IVT ICs

SAA5246 (IVT1.0) in a simple WST decoder

Figure 12 is the circuit diagram of a simple single-chip World System Teletext decoder using the SAA5246 (IVT1.0) and a few peripheral components. The SAA5246 performs all the teletext decoding functions and interfaces to a standard 8 K × 8-bit SRAM page memory. The SAA5246 is controlled, via the 2-wire I²C-bus, by the main TV microcontroller.

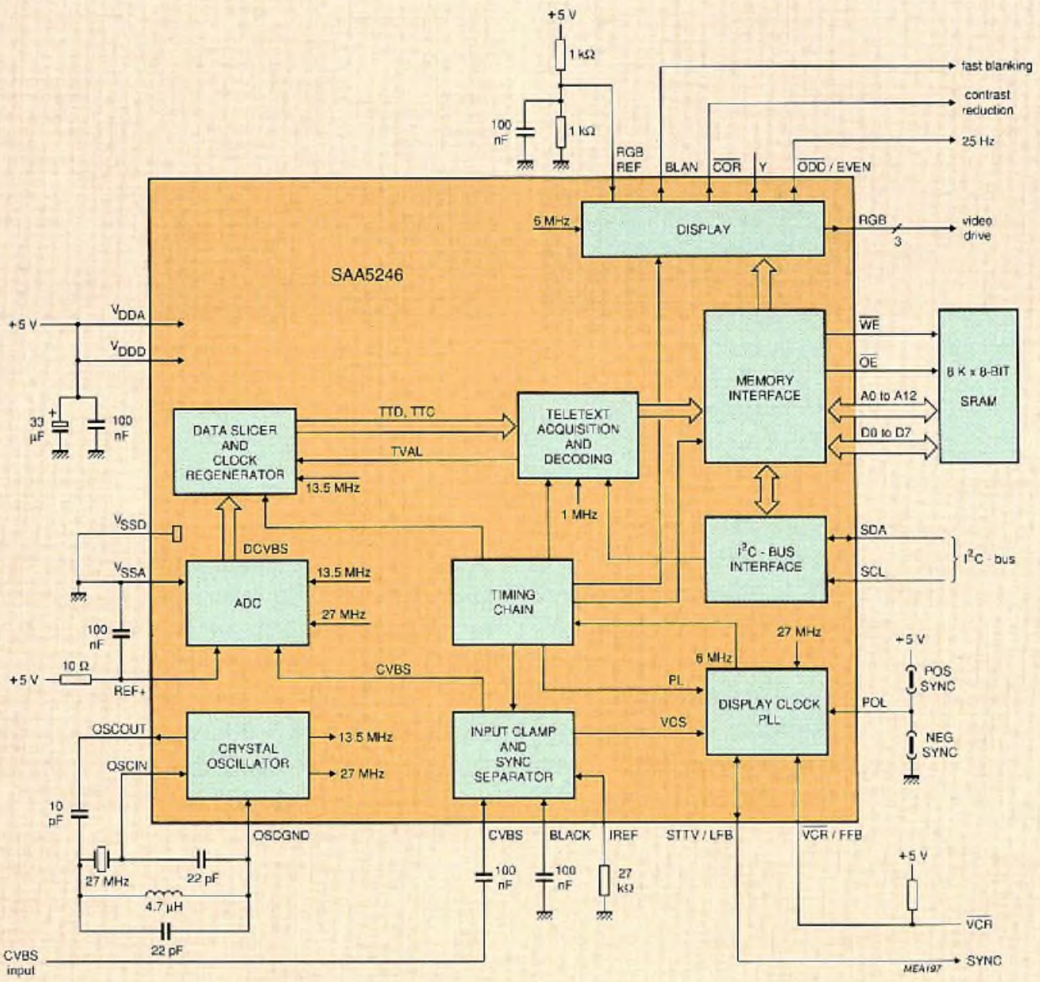


Fig.12 Circuit diagram of a simple single-chip World System Teletext decoder using the SAA5246 (IVT1.0)

Video input processing and display clock regeneration

The video input processing section of the SAA5246 first extracts the composite sync signal (VCS) for synchronizing the display clock PLL. This is achieved by adaptively slicing the VCS from the composite video signal derived from the TV video demodulator or peri-TV connector. A buffered sync output (STTV) allows the TV set to be synchronized from the teletext decoder sync when displaying text.

The composite video signal is converted to digital form (DCVBS) by a successive approximation A to D converter with sample and hold inputs before the teletext data (TTD) is extracted by a data slicer. The teletext display clock is regenerated by a digital PLL. These digital circuit functions minimize peripheral components and eliminate adjustments.

Timing chain

Timing signals for the entire decoder are provided by the timing chain circuity, which operates from a 27 MHz crystal-controlled oscillator. A composite sync signal provides field synchronization for the data acquisition timing and also for the display timing when interlaced display is selected. The timing chain also generates a composite sync waveform with interlaced or non-interlaced format for driving the display timebase. Here are some of the main features of the timing chain circuitry:

- display line counter can operate in interlaced or non-interlaced 312/312, 312/313 (news flash or subtitle) lines mode or slaved timing mode (display synchronized to FFB input) under control of the broadcaster or the microcontroller
- composite sync generator provides TCS waveforms appropriate to the selected display line counter mode
- flash counter for deriving the on/off signals for flashing characters
- software control of data entry period (window) for normal field flyback and full-channel data acquisition
- internal video signal quality detector
- 25 Hz odd/even field output for connection to deflection circuit for de-interlacing.

Teletext data acquisition and decoding

The teletext data acquisition section is enabled by a signal from the timing chain during lines 2 to 22 inclusive for field-flyback transmissions, or during all lines for full-channel transmissions. Serial data from the TTD (TeleText Data) line is clocked in with the 6.9375 MHz TeleText Clock (TTC). The serial data stream is converted to 8-bit wide parallel data bytes. A byte counter keeps track of the incoming data and allocates it to the correct function.

The data acquisition section can search for, store in memory and continuously update four pages simultaneously because there are four different acquisition circuits. If extension packet processing is not required, up to eight pages can be stored, although only four of them will be continuously updated.

Each teletext page is numbered using seven digits one for magazine, two for page number and four for sub-pages (rolling pages). The acquisition circuits of the SAA5246 can receive pages by checking any combination of these seven digits, ignoring those not required by using a 'don't care' facility. In addition to decimal page numbers for use with conventional teletext broadcasts, the full hexadecimal range of page numbers can be requested for maximum flexibility in specialized data distribution systems.

Here are the main features of the data acquisition section:

- accepts 625-line World System Teletext transmissions
- national character sets automatically selected by decoding bits C12, C13, and C14 of the page header
- accepts up to 25 extension packets for processing by the control microcontroller; in this mode, each page requires 2 Kbytes of memory, giving a maximum of 4 pages
- receives extension packets X/24, X/25, X/26/0 to X/26/14, X27/0, X27/1, X27/4, X27/5, X/28/0, X/28/1, X28/2 and 8/30
- the microcontroller can read all transmitted control bits and addresses (after hardware Hamming checks) for the stored page
- allows up to 4 simultaneous page requests in either field-flyback or full-channel mode
- 'don't care' facility is available on magazine, page, and sub-code digits
- in field-flyback mode, automatic clearing of old page on first reception of new page, and clearing when page header bit C4 is set
- in full-channel mode, the clear memory functions are not available so pages should be transmitted non row-adaptively
- central part of the page header rolls, in green, when the page in the display chapter is being looked for
- the last 8 characters of page headers are written to the display memory (rolling time-of-day)
- optional inhibit for rolling headers and time-of-day
- broadcast (rolling) time is always directed to the display memory

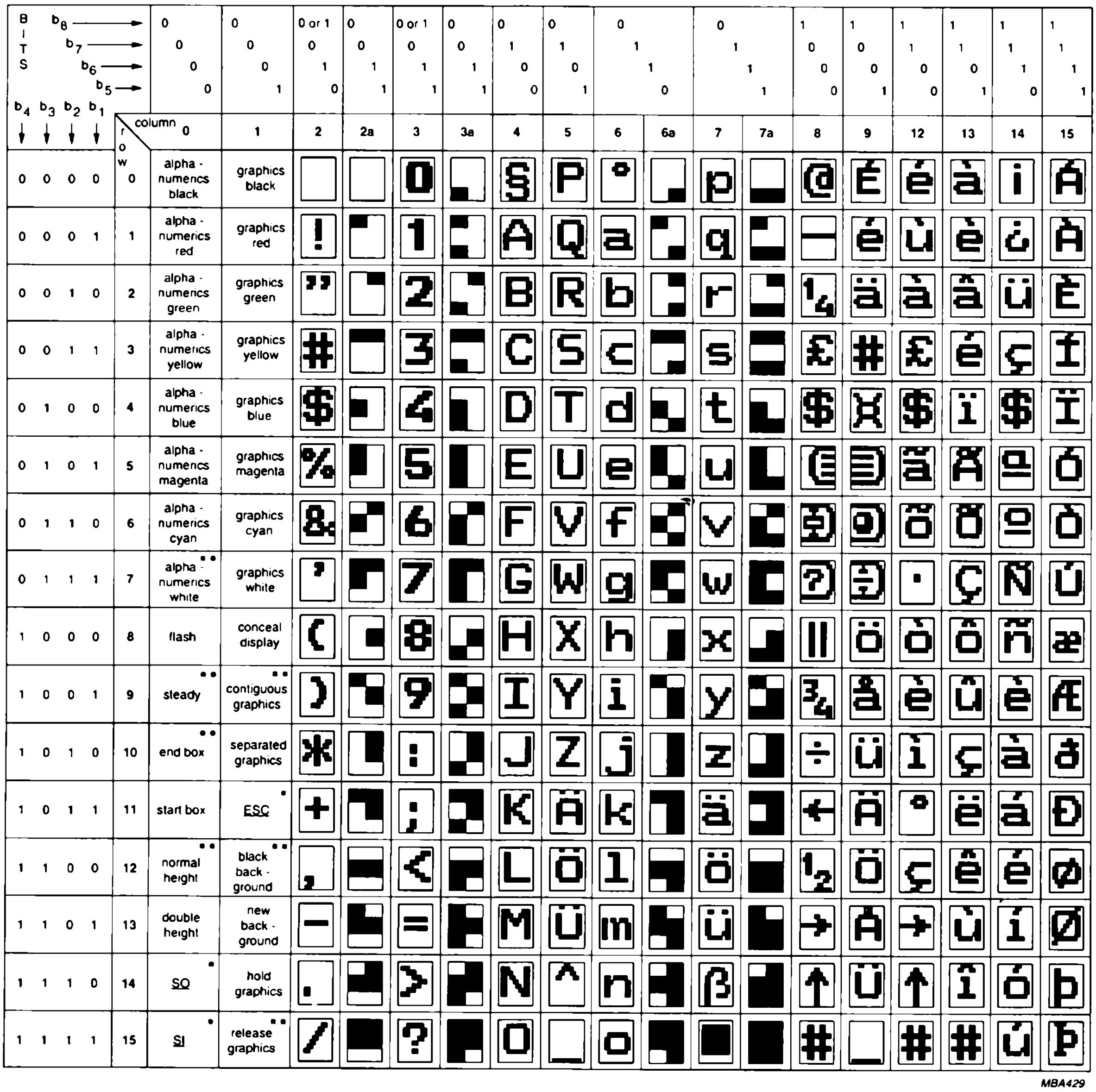
- 8-bit data reception option on all rows (for example, TOP), or normal 7-bits plus parity (under software control)
- acquisition function can be switched off under software control
- a good quality signal containing teletext is indicated by a flag which can be read via the I^2C-bus.

Character generator

As shown in the character data input decoding Table for the SAA5246P/E (Table 1), a total of 256 different characters can be displayed. The 192 alphanumeric characters in columns 2 to 15 are stored in a ROM. Ninety six characters are used at a time in a national character set. Thirteen of these alphanumeric characters can be changed to suit the requirements of English, German, Swedish, Italian, French or Spanish. The remaining 64 graphics characters in columns 2a, 3a, 6a and 7a are derived from a graphics decoder.

Each alphanumeric character is formed from a matrix of 12 dots horizontally and 10 dots vertically for good legibility and display performance. The characters in the ROM are selected by character address decoding and the ten TV lines for each character are selected by ROM line address decoding. The ROM is accessed once per

TABLE 1
Character data input decoding for the SAA5246P/E (IVT1.0)



microsecond providing 12 outputs corresponding to the 12 dots in each line of a character. A 64 μs rate signal from the timing chain clocks a lines-per-row counter, which divides by ten (or by 20 when double-height characters are selected). The counter output is used to select the appropriate line of 12 dots in the ROM.

The push-pull R, G and B outputs from the character generator allow simple interfacing to the TV set colour decoder. The Y output is for controlling a printer and is active for the character foreground only, regardless of colours, and does not contain the flashing function. The blanking signal from the push-pull BLAN output provides combined character, box, and full-screen blanking of the TV display. The software-controlled COR output allows selective contrast reduction of the TV picture to enhance a mixed teletext/TV picture display (subtitles or news flash for example). Here are other features of the character generator:

- interlaced/non-interlaced display format – 625 lines (two fields of 287 active TV lines) divided into 25 ten-line rows, each capable of displaying forty 1 μs-wide characters
- boxing function can be enabled for part of the display
- serial attributes only
- repetitive over-writing of packet X/26 accented characters by default characters is prevented to eliminate flicker
- with suitable control software, all the major languages in Western Europe can be covered
- option of black text on a coloured background
- double-height characters can be selected by the viewer under software control; in the case of simultaneous broadcast of double-height characters, the characters are displayed quadruple-height
- double-height characters inhibited in row 23
- separate status row, always in single height, is available for software-generated messages; this may be displayed at the top or bottom of the screen (under software control)
- internal cursor inverts background and foreground colours; it can be made to flash using a software loop in the control microcontroller.

Memory interface

The memory interface has 8 parallel data I/Os (D0 to D7) and 13 address outputs (A0 to A12) which interface directly up to 8 Kbytes of SRAM providing up to 8 stored pages in normal mode or up to 4 stored pages in extension packet mode. Reading and writing data to the SRAM is controlled by the $\overline{OE}$ (Output Enable) and $\overline{WE}$ (Write Enable) signals. The RAM cycle time is 500 ns with, in general, one write and one read cycle every microsecond. Here are other features of the memory interface:

- timings for 150 ns access time SRAMs
- I^2C-bus can address any RAM location for reading and writing
- address mapping circuit converts the 5 row and 6 column addresses to 10 bits addressing all 1024 locations in a memory chapter (page)
- all memory automatically cleared to "space" at power-on
- separate addressing arrangements for display, data acquisition, and I^2C-bus; I^2C-bus address counters allow incrementing and presetting
- SRAM locations not used for display or data acquisition purposes are available for use by the control microcontroller
- all SRAM accesses (display, acquisition and I^2C-bus) are synchronous with the system clock
- all pages can be cleared, one at a time, under software control.

I^2C-bus interface and control

The I^2C-bus and control section controls the variable functions of the IVT IC directly by altering the mode register bits, or indirectly via the external page memory. The I^2C-bus slave transceiver accepts commands from the control microcontroller via the SDA (serial data) and SCL (serial clock) pins.

A command to one of the mode registers follows the normal I^2C-bus protocol (Ref.5). The first byte contains the slave address (0010001), with the R/W bit set to 0 to indicate 'write'. The second byte is interpreted as the register address required (R0 to R11B), and the third byte is data to be loaded into that register. Subsequent bytes in the same I^2C transmission can be interpreted as data for the following register because the register address auto-increments.

Register map of the SAA5246

In the register map for the SAA5246 (Table 2), auto-increment is indicated by the arrows on the right of the Table. The auto-increment allows several conditions to be set up by just one I^2C-bus transmission. Register 11 is the address for accessing the external page memory. It is read/write because any RAM location can be read as well as written by the control software. Registers R0 to R10 are write only. Register 11B is read only.

TABLE 2
Register map for the SAA5246 (IVT1.0)

register	bit							
	D7	D6	D5	D4	D3	D2	D1	D0
R0 advanced control	X24 POS.	FREE RUN PLL	AUTO ODD-EVEN	DISABLE HDR ROLL	-	DISABLE ODD-EVEN	-	$\overline{R11}$/ R11B SELECT
R1 mode	VCS TO SCS	$\overline{7+P}$/ 8-BIT	ACQ. $\overline{ON}$/OFF	EXTENSION PACKET ENABLE	$\overline{DEW}$/ FULL FIELD	TCS ON	T1	T0
R2 page request address	-	BANK SELECT A2	ACQ. CIRCUIT A1	ACQ. CIRCUIT A0	TB	START COL. SC2	START COL. SC1	START COL. SC0
R3 page request data	-	-	-	PRD4	PRD3	PRD2	PRD1	PRD0
R4 display chapter	-	-	-	-	-	A2	A1	A0
R5 display control (normal)	BKGND OUT	BKGND IN	COR OUT	COR IN	TEXT OUT	TEXT IN	PON OUT	PON IN
R6 display control (newsflash/subtitle)	BKGND OUT	BKGND IN	COR OUT	COR IN	TEXT OUT	TEXT IN	PON OUT	PON IN
R7 display mode	STATUS ROW $\overline{BTM}$/TOP	CURSOR ON	$\overline{CONCEAL}$/ REVEAL	$\overline{TOP}$/ BOTTOM	$\overline{SINGLE}$/ DOUBLE HEIGHT	BOX ON 24	BOX ON 1 - 23	BOX ON 0
R8 active chapter	-	-	-	-	CLEAR MEM.	A2	A1	A0
R9 active row	-	-	-	R4	R3	R2	R1	R0
R10 active column	-	-	C5	C4	C3	C2	C1	C0
R11 active data	D7 (R/W)	D6 (R/W)	D5 (R/W)	D4 (R/W)	D3 (R/W)	D2 (R/W)	D1 (R/W)	D0 (R/W)
R11B device status	$\overline{625}$/ 525 SYNC	ROM VER R4	ROM VER R3	ROM VER R2	ROM VER R1	ROM VER R0	TEXT SIG. QUAL.	VCS SIG. QUAL.

The TB bit in register R2 must be logic 0 for normal operation. All bits in registers R1 to R10 are cleared to logic 0 on power-up except bits D0 and D1 of registers R1, R5 and R6 which are set to logic 1. All memory is cleared to 'space' (00100000) at power-up, except row 0, column 7 chapter 0, which is 'alpha white' (00000111) as the acquisition circuit is enabled but all pages are on hold.

The register bits in Table 2 have the following functions:

Register R0: Advanced control

D0	Selects reading of register R11 or R11B on addressing
D2	Forces $\overline{ODD}$/EVEN output LOW when = 1
D4	Disables green rolling header and time
D5	When set, forces $\overline{ODD}$/EVEN LOW if a TV picture is displayed
D6	Forces the PLL to free-run under all conditions
D7	Automatic Fastext prompt display when = 1

Register R1: Mode

DO, D1	Interlace/non-interlace 312/313 line control
D2	Text composite sync or direct sync select
D3	Field-flyback or full-channel mode select
D4	Extension packet enable
D5	Data acquisition circuit enable/disable
D6	Data reception select: 7-bit with parity check or 8-bit
D7	Enables display of messages with 60 Hz input signal when = 1

Register R2: Page request address

DO to D2	Defines the start column for page request data
D3	Should be 0 for normal operation
D4, D5	Selects one of four acquisition circuits
D6	Selects the bank of 4 pages being addressed for acquisition

Register R3: page request data

DO to D4	Contains four groups of data (one for each acquisition circuit), allowing four simultaneous page requests (see Table 3)

Register R4: Display chapter

D0 to D2	Determines which of 8 pages is displayed

Register R5: Control of normal display

Register R6: Control of newsflash/subtitle display

D0, D1	Picture on: inside (D0) and outside (D1) the boxed area
D2, D3	Text on: inside (D2) and outside (D3) the boxed area
D4, D5	Contrast reduction on: inside (D4) and outside (D5) the boxed area
D6, D7	Background colour on: inside (D6) and outside (D7) the boxed area

Register R7: Display mode

D0 to D2	Boxing function allowed on: row 0 (DO), rows 1 to 23 (D1), row 24 (D2)
D3	Selects single or double height characters
D4	Selects the top or bottom parts of the display
D5	Used to reveal concealed areas of text
D6	Cursor enable for reversing background and foreground colours
D7	Determines whether row 25 is displayed below or above the main text

Registers R8 to R11: Active chapter, row, column data

These registers contain active chapter, row, column, and data information written to or read from the page memory via the I^{2}C-bus

Register R11B: Device status

D0	CVBS signal quality; good = 1
D1	Identifies whether there is valid teletext on CVBS
D2 to D6	Identifies which ROM code is present
D7	Identifies whether the incoming signal is 525 or 625 lines

Register map for page requests

Register R3 (Table 3) contains four sets of data (one for each acquisition circuit) allowing four simultaneous page requests. The columns auto-increment on receipt of successive bytes of an I^{2}C transmission. When the 'Do care' bit (PRD4) is set to logic 1, the corresponding digit for each group is taken into account for page requests. If the 'Do care' bit is set to logic 0, each digit is ignored. This allows, for example, 'normal' or 'timed page' selection. If $\overline{\text{HOLD}}$ is set to logic 0, the page is held and not updated.

TABLE 3
Register map for page requests (R3)

start column	PRD4	PRD3	PRD2	PRD1	PRD0
0	do care magazine	$\overline{\text{HOLD}}$	MAG2	MAG1	MAG0
1	do care page tens	PT3	PT2	PT1	PT0
2	do care page units	PU3	PU2	PU1	PU0
3	do care hours tens	X	X	HT1	HT0
4	do care hours units	HU3	HU2	HU1	HU0
5	do care minutes tens	X	MT2	MT1	MT0
6	do care minutes units	MU3	MU2	MU1	MU0

To summarize, here are the main features of the I^{2}C-bus interface are:

- standard I^{2}C-bus slave transceiver
- operates from 0 to 100 kHz
- acknowledge function

- position registers (R9 and R10) auto-increment after certain commands or may be directly addressed
- auto-increment between certain command registers as well as direct addressing
- all RAM locations accessible via the I²C-bus for reading and writing.

SAA5244 (IVT1.1) in a simple WST decoder

Figure 13 is the circuit diagram of a simple single-chip World System Teletext decoder using the SAA5244 (IVT1.1) and a few peripheral components. The SAA5244 performs all the teletext decoding functions and, since it also includes a 1.1 K × 7-bit SRAM which can store one teletext page plus extension packets for Fastext, it is a true single-chip 1-page decoder. The SAA5244 is controlled, via the 2-wire I²C-bus, by the main TV microcontroller. Since many of the functions previously described for the SAA5246 (IVT1.0) also apply to the SAA5244, only the differences between the two ICs will be described in this section.

Teletext data acquisition and decoding

The teletext data acquisition section of the SAA5244 is similar to that previously described for the SAA5246 except that it contains only one acquisition circuit instead of four. There are facilities for receiving and storing extension packets X/24, X/27/0 and 8/30/0 to 15 only for implementing Fastext. Extension packets for multiple languages are not catered for.

Character generator

As shown in the character data input decoding Table for the SAA5244P/A (Table 4), a total of 244 different characters can be displayed. The 96 alphanumeric characters in columns 2 to 7 plus the 52 national option characters plus the 32 On-Screen Display (OSD) characters in columns 4b and 5b are stored in a ROM. Thirteen of the alphanumeric characters can be changed to suit the requirements of English, German, Swedish, Italian or French. The remaining 64 graphics characters in columns 2a, 3a, 6a and 7a are derived from a graphics decoder.

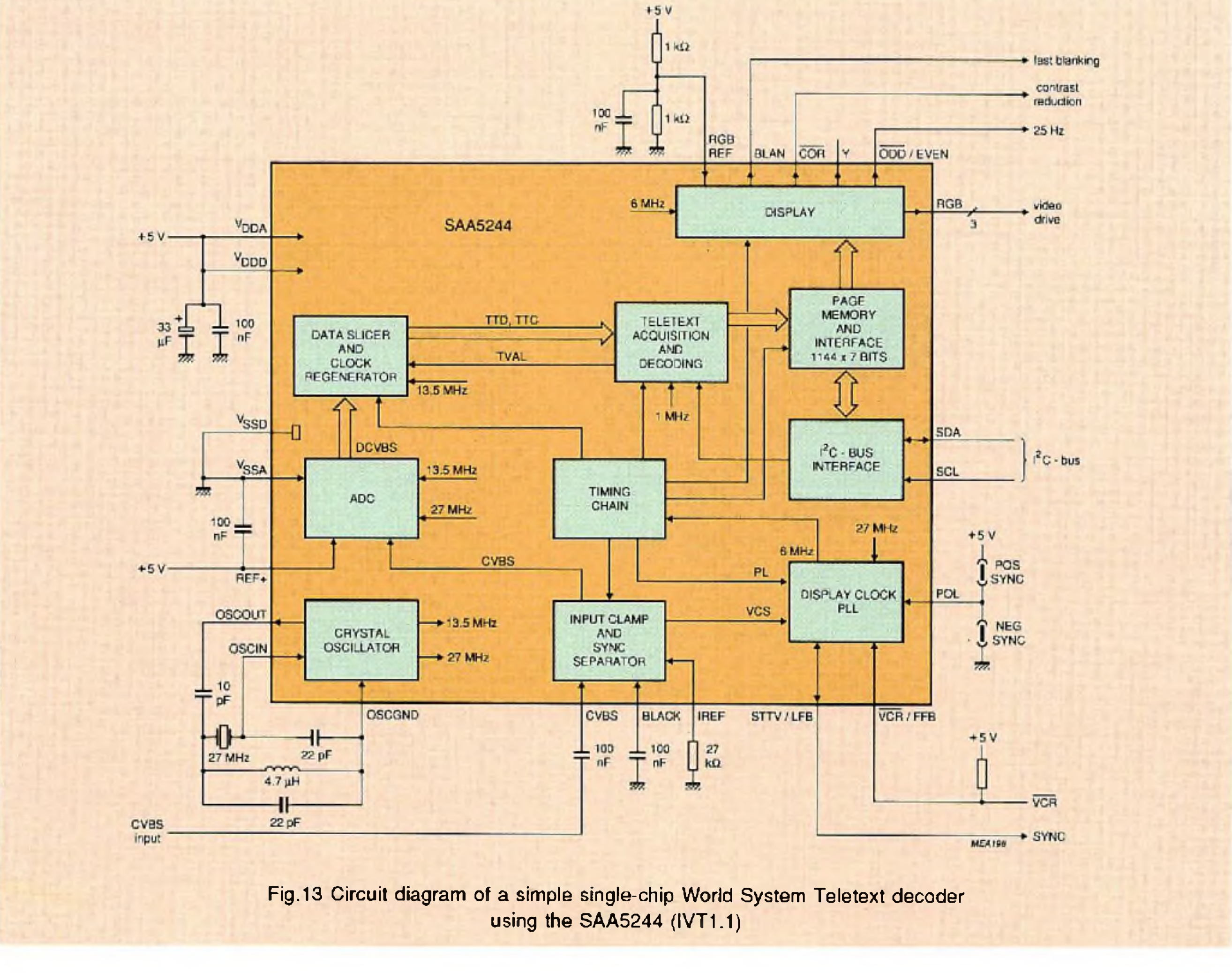
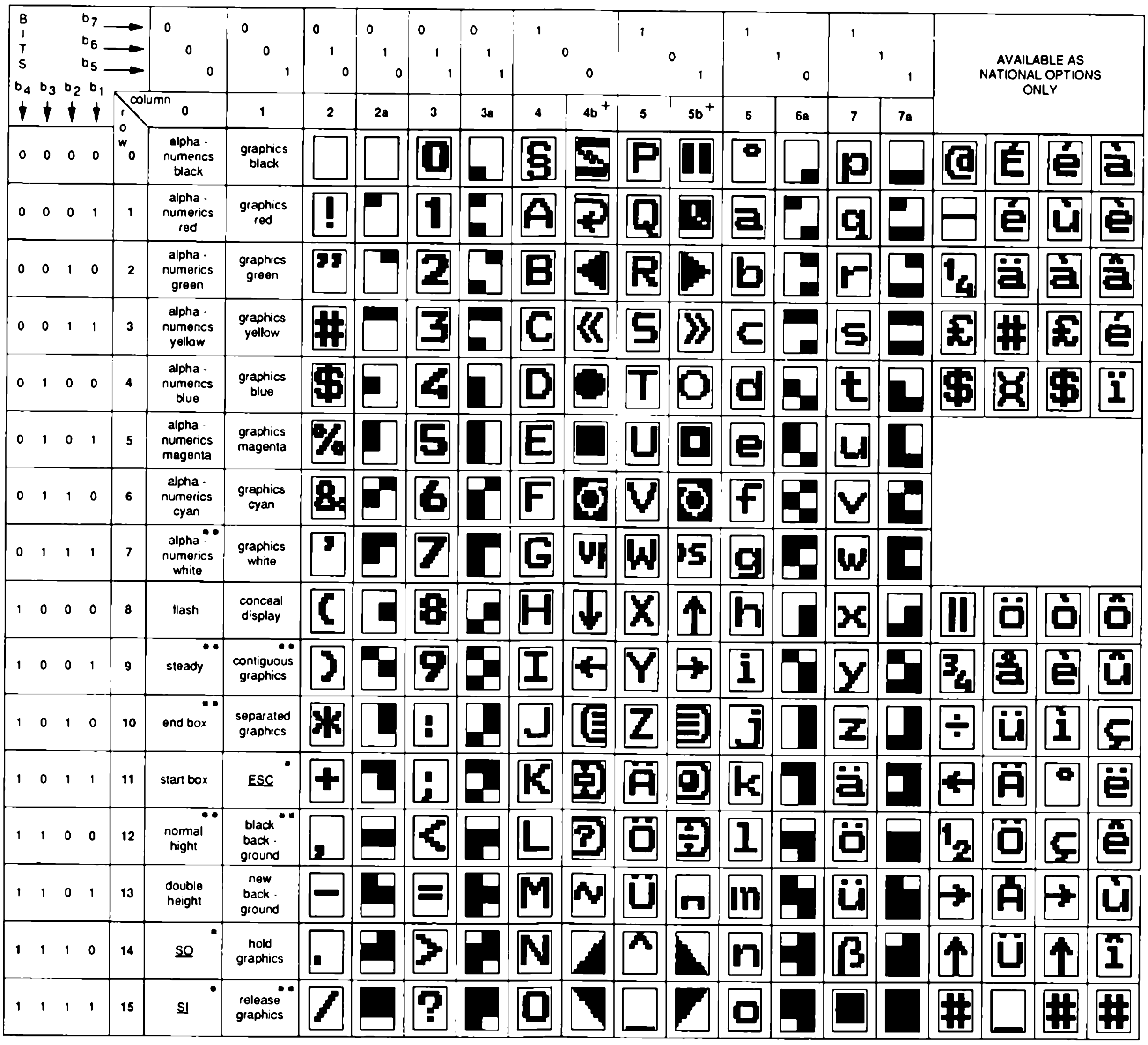


Fig.13 Circuit diagram of a simple single-chip World System Teletext decoder using the SAA5244 (IVT1.1)

TABLE 4
Character data input decoding table for the SAA5244P/E (IVT1.1)



MBA266 - 1

Memory interface

Since the SAA5244 is a true single-chip decoder, it doesn't include an interface to external SRAM. The locations in the 1.1 K × 7-bit internal page memory are addressed by column (0 to 39) and row (0 to 25) by the I²C-bus. However, a transparent internal addressing algorithm allows all 1144 memory locations to be addressed via 11 internal address lines.

I²C-bus interface and control

The I²C-bus and control section of the SAA5244 is the same as that for the SAA5246. Only the register map is different because there is no external RAM.

SAA5247 (IVT1.1BMC) in a simple WST decoder

Figure 14 is the circuit diagram of a simple single-chip World System Teletext decoder using the SAA5247 (IVT1.1BMC) and a few peripheral components. The decoding circuits of the SAA5247 are identical to those in the SAA5244 (IVT1.1); only the memory functions are different. The SAA5247 includes a 1.1 K × 8-bit SRAM which can store one teletext page, and a Background Memory Control (BMC) and interface for up to 1 M × 4-bit DRAM for storing up to 512 pages to give near-instantaneous page access. Only the BMC and DRAM interface will be described in this section.

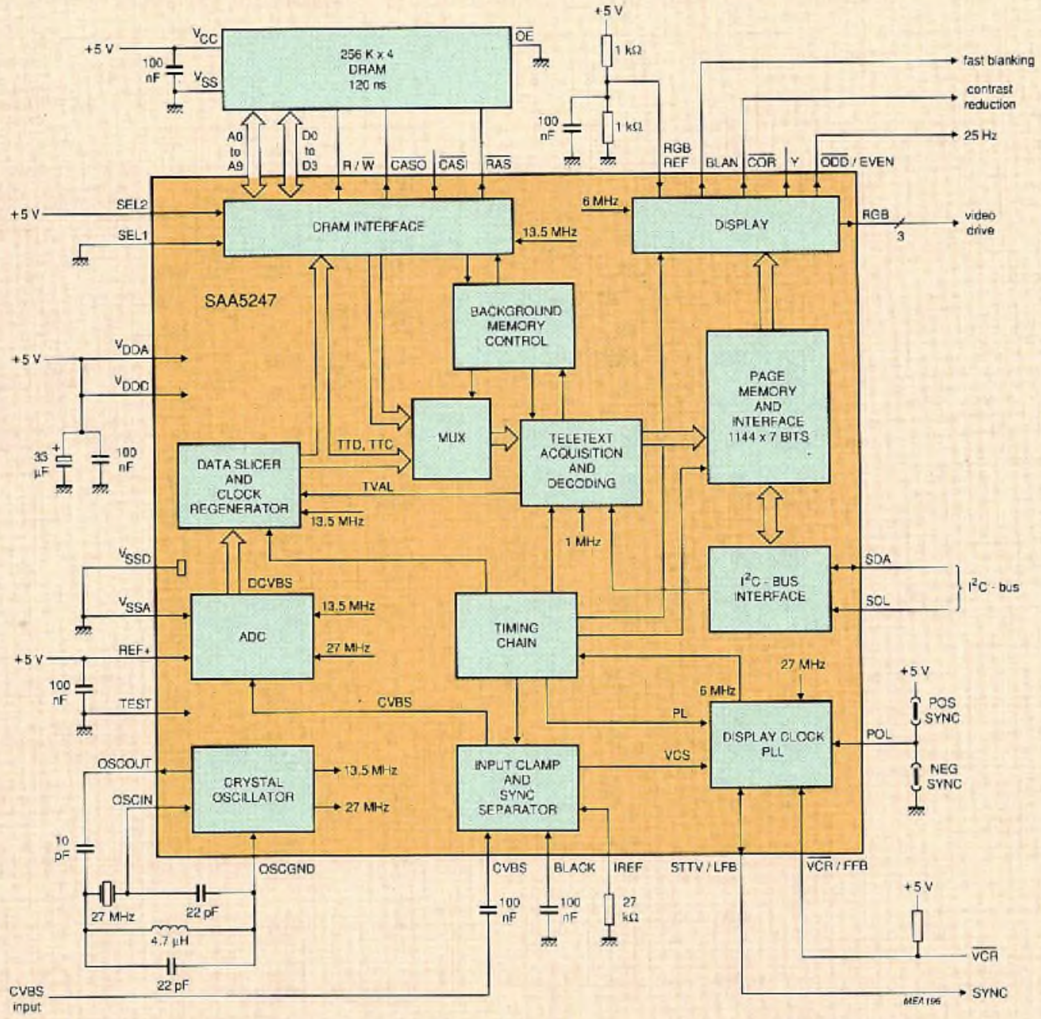


Fig.14 Circuit diagram of a simple single-chip World System Teletext decoder using the SAA5247 (IVT1.1BMC)

Background memory controller (BMC) and DRAM interface

Incoming teletext data in packets 0 to 24, 27/0 and 8/30 is stored in the background memory in exactly the same order that it is transmitted. This makes most efficient use of the background memory and ensures that it is not cluttered with unreadable pages such as packet 31 (datacast).

When a page request is made, the page store (up to 512 pages) is first scanned rapidly in full-field mode which takes up to 200 ms. The scan is speeded up by restricting it to the area of memory reserved for storing the magazine and page header information. Since the requested page will usually be found in the background memory during this scan, page access is almost instantaneous.

To ensure that the most up-to-date page is always displayed, the memory is scanned in reverse order, that is, from the most recently received page to the oldest. When the requested page has been found, the memory is searched forward to read-in the data. This forward scan continues until the most recently transmitted data has been scanned and the end of the memory reached.

After the memory scan, the circuit reverts to looking at currently broadcast data as in a normal teletext application so that a page not found can be located or a found page updated. Updating of the rolling time indication is disabled during scanning to avoid unnecessary disturbance of the display.

The capacity of the DRAM in use must be indicated by programming the logic states of pins SEL1 and SEL2 respectively as follows: 00 = no DRAM, 01 = one 256 K × 4-bit DRAM, 10 = two 256 K × 4-bit DRAMs, 11 = one 1 M × 4-bit DRAM. If the SEL1 and SEL2 pins are both connected to ground (0 V), the background memory controller is disabled, no external RAM is required and the IC operates as a single-page decoder in exactly the same way as the SAA5244 (IVT1.1).

TELETEXT DECODER SOFTWARE

The hardware of a teletext decoder based on one of our IVT circuits is similar for many applications; it is the control software which determines how the decoder operates, from the simplest stand-alone single-page teletext decoder to a sophisticated multi-page teletext decoder fully integrated into the design of the TV set.

Software can interact with the programmable mode register bits in the IVT circuit or with the contents of the page memories. The I^2C-bus interface allows the decoder to be controlled by one microcontroller or, in more complex systems, by several microcontrollers, each performing a defined set of tasks. Other ICs can be connected to the I^2C-bus, depending on the facilities required, e.g. non-volatile memory, clock/calendar, display driver, switching circuits, analog control circuits. The way in which these ICs are used depends entirely on the control software.

Many TV set manufacturers will prefer to write their own software to satisfy their own requirements. This also provides the opportunity to make a TV set different from those of other manufacturers. However, for those wishing to avoid the development costs of a custom design, Philips Semiconductors supply software to support design-in by allowing quick and inexpensive evaluation of new teletext products and features.

Stand-alone software packages for teletext

Since the volume of software required for a modern TV set is constantly increasing, its cost, relative to the cost of the hardware, is also increasing. This is why we now offer TV set manufacturers a range of production-ready teletext software packages as shown in Table 5.

These software packages incorporate built-in options that can be "link"-selected by the TV set manufacturer to allow design of a range of high-performance, state-of the-art teletext decoders covering numerous market requirements.

TABLE 5
Software packages for IVT ICs

Package	Features
CTV971S	Basic Fastext + LIST
CTV972S	As CTV971S + X/26 decoding (European)
CTV974S	CTV972S variant (W.European + Turkish)
CTV976S	CTV971S + TWIST + X/26 decoding (Baltic/Russian, Yugoslav, Greek)
CTV990S	TOP (Table Of Pages) decoding

Here are the features of the software packages:

- display all the standard World System Teletext pages currently transmitted
- translate all the language extension packet information for displaying on the screen
- decode Full Level One Features (FLOF/Fastext) teletext
- automatic page pre-capture
- index and page up/down function
- user-controlled LIST mode option can store four favourite page numbers for each channel stored in a non-volatile memory
- pages n–1, n+1 and n+2 requested in non-FLOF/Fastext transmission
- browse function
- on-screen status display
- automatic switching to full-field operation (via packet 8/30)
- incorporate factory test facilities
- interface to many TV tuning and control software packages.

CONCLUSION

Although IVT ICs cater for a variety of applications, their design ensures that there is no cost penalty for the normal mass-market application. In the design of the IVT-based teletext decoder, two types of function have been distinguished:

- standard functions fixed by broadcast specifications, for example, data slicing, sync generation and data acquisition – performed by dedicated circuitry in the IVT IC.
- functions that vary depending on the application, for example the control functions and displayed language, are performed by software in the teletext decoder's associated microcontroller.

Advanced teletext decoders for professional applications are made mainly by using more sophisticated software than that used in teletext decoders for the mass-market; often, the hardware can remain unchanged.

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NICAM-728 two-channel digital TV sound

PAUL DOUBLE

Most present-day stereo/dual- channel TV sound transmissions in Europe are based on a two-carrier FM system. However, the requirements of such systems are stringent – the slightest imperfection can cause consid- erable crosstalk between the channels, which is particularly detrimental to dual-language broadcasts.

NICAM-728 (Near-Instantaneously Companded Audio Multiplexing at a rate of 728 kbit/s) was developed in the United Kingdom to overcome these crosstalk problems. It allows terrestrial TV broadcasts in accordance with PAL-B/G and -I, or SECAM D/K transmission standards to incorporate digitally-coded stereo/dual-channel hi-fi sound with quality comparable to that obtained from a compact disc player. NICAM-728 has now been adopted by the European Broadcasting Union (EBU) as the standard system for broadcasting stereo/two-channel digital TV sound, and is used by broadcasting companies in Belgium, Denmark, Finland, Hong Kong, New Zealand, Norway, Spain, Sweden and the United- Kingdom. Countries such as Yugoslavia, India and Singapore which use the PAL B/G system, and Hungary which uses SECAM D/K, are currently expressing interest in the NICAM-728 system.

NICAM-728 offers two digital sound channels. Furthermore, for compatibility with current TV sound transmissions, it also offers an additional analog sound channel. The two digital sound channels can be used for digital stereo sound, dual-channel digital mono sound, or data.

To ensure maximum customer appeal and market penetration for NICAM-728 sound, TV/VTR manufacturers require the most cost-effective NICAM-728 receiver circuitry and a guarantee of performance, quality and reliability.

As a renowned TV and audio set maker, and as Europe's leading IC manufacturer, Philips is in a unique position to understand this. Our know-how and innovative approach to designing ICs for TV and digital audio has already allowed us to meet the demand for NICAM-728 circuitry for more than a year with a set of three ICs that have a well-earned reputation for their quality and performance.

Our continuing efforts to implement NICAM-728 receiver circuitry with the largest feasible scale of integration, the highest quality, and at the lowest possible price have now allowed us to develop a new highly-integrated CMOS decoder that also incorporates D to A conversion and audio switching facilities. This 1has allowed us to reduce the NICAM-728 sound circuitry to just two ICs which require fewer peripheral components, occupy less PCB area and result in even higher reliability for TV sets with NICAM-728 sound.

Unlike some other chip-sets, the two Philips' ICs implement the entire NICAM-728 receiver circuitry except the intercarrier bandpass filter. Moreover, a unique feature of the new decoder IC is an IEC/EBU 958 digital audio interface that allows the NICAM-728 digital TV sound signals to be transferred to external digital recording/reproduction equipment. This allows manufacturers to make their TV sets compatible with emerging digital hi-fi equipment which uses digital signal processing techniques for functions such as listening room simulation and equalization.

NICAM-728 – DIGITAL TV SOUND FOR THE NINETIES

NICAM-728 works by alternately sampling the L and R sound channel signals at a frequency of 32 kHz, with a resolution of 14 bits per sample. For transmission, this is compressed to 10 bits by a technique known as Near Instantaneous Companding (NIC). For this to work effectively, the digital audio signal must be transmitted together with "scale-factor" code that tells the TV receiver how much the signal has been compressed. This is a 3-bit word incorporating some error-protection functions which is added, together with a parity bit, to each 10-bit compressed sample.

As shown in Fig.1, the digital data is transmitted in "frames", each containing the following bit-sequence:

- an 8-bit "frame" alignment block FAW = 01001110, the left-most bit of which is transmitted first
- a 5-bit control information block (C), the first bit of which (C_0) is a frame flag which changes state after every eight frames, thereby defining a 16-frame sequence to allow synchronization of changes in the type of information (sound or data) being carried in the channel; the next three bits (C_1 to C_3) are application control bits that indicate the type of digital information being transmitted (stereo sound = 000, dual-channel mono sound = 010, mono sound + 352 kbit/s data = 100, or 704 kbit/s data = 110); the fifth control bit (C_4) is a reserve sound switching flag that allows switching to FM sound in the event of NICAM-728 sound failure by indicating whether the FM and NICAM-728 sound channels are transmitting the same information ($C_4 = 1$)
- an 11-bit block (AD_0 to AD_{10}) reserved for ancillary data (AD) for use in future applications
- a 704-bit sound/data block containing sixty-four 11-bit (10-bit sound/data + 1-bit parity) words, D_1 to D_{64}, assigned as samples A1, B1....A32, B32 for stereo or n_1 to n_{32} ....$n+1_1$ to $n+1_{32}$ for mono); for stereo, the odd-numbered samples carry the A (left) channel information; for dual-channel mono, the odd-numbered samples carry the primary channel information; for mono sound + data, the odd-numbered samples carry the sound information.

There are therefore 728 bits in each data "frame" – hence the name NICAM-728. Since a complete 728-bit data "frame" lasts 1 ms, the data transmission rate is 728 kbit/s.

As in a CD system, further error protection for NICAM-728 sound transmissions is ensured by using a cross-indexing (interleaving) system which "shuffles" the 704 sound bits in each 728-bit data "frame" in a pre-determined manner, the reverse process being performed at the receiver to restore the correct order of the sound data. After interleaving, but before transmission, the bit-stream (except the 8-bit "frame" alignment word) is scrambled to obtain more even energy distribution. This shapes the transmitted spectrum to avoid unnecessary sidebands. The scrambling is synchronized with the "frame" alignment word which controls a pseudo-random sequence generator in the receiver for de-scrambling the signal. In the receiver, de-scrambling precedes de-interleaving.

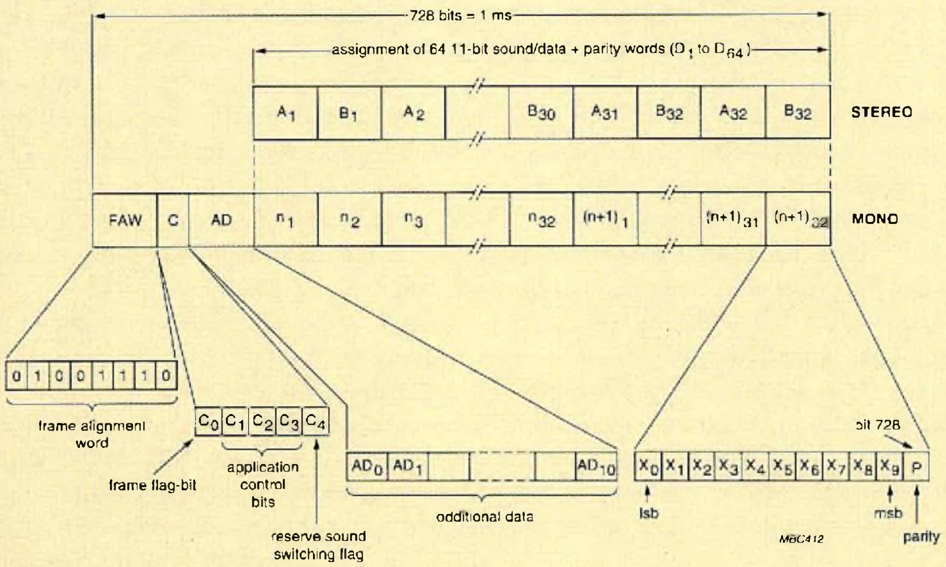


Fig.1 Frame format for NICAM-728 stereo digital sound signals (before interleaving)

For transmission, the serial sound data is converted into 2-bit parallel form. The four possible states of this 2-bit parallel data each determines one of four possible carrier phase changes. As shown in Table 1, the carrier phase can therefore dwell in one of four possible rest states, each separated by 90°. Each input-bit pair shifts the phase of the carrier by the designated angle from the previous rest state. This is known as Differentially encoded Quadrature Phase-Shift Keyed (DQPSK) modulation. At the receiver, the NICAM-728 sound data is recovered by comparing the phase shifts of consecutive bit pairs.

Figure 2 shows the spectrum of the transmitted NICAM-728 signal. Table 2 lists the principal characteristics of the system.

TABLE 1
Carrier phase shift caused by input-bit pairs

input-bit pair A_n	B_n	Carrier phase shift (°)
0	0	0 (no change)
0	1	−90
1	1	−180
1	0	−270

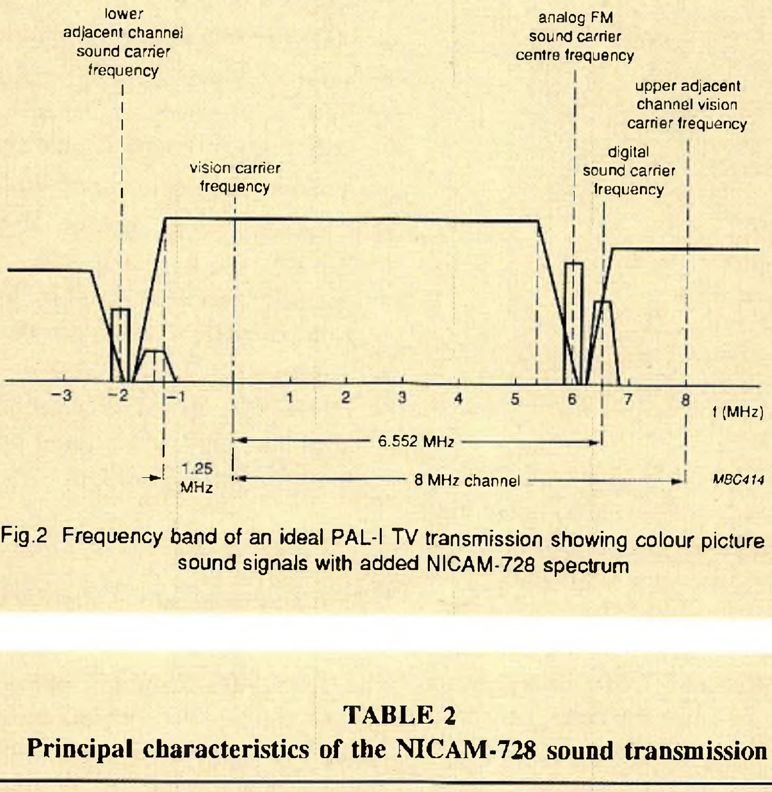


Fig.2 Frequency band of an ideal PAL-I TV transmission showing colour picture and sound signals with added NICAM-728 spectrum

TABLE 2
Principal characteristics of the NICAM-728 sound transmission

Characteristic	Value
Frequency difference between second sound carrier and vision carrier	6.552 MHz (I), 5.85 MHz (B, G)
Level of second sound carrier with respect to peak vision carrier	−20 dB
Modulation of second sound carrier	DQPSK
Bandwidth of transmitted PSK signal	700 kHz
Overall bit rate	728 kbit/s
Two-channel signal options	stereo
	2 independent mono
	1 mono + 352 kbit/s data
	one 704 kbit/s data
Audio sampling frequency	32 kHz
Audio coding	14 to 10-bit NIC
Ancillary data capacity	11 bits

PHILIPS' ICs FOR NICAM-728 SOUND SYSTEMS

Philips offers a new approach to decoding NICAM-728 two-channel digital sound signals for TV sets and video recorders. As shown in Fig.3, this new approach uses only two ICs, both of which are specifically developed for NICAM-728 receivers.

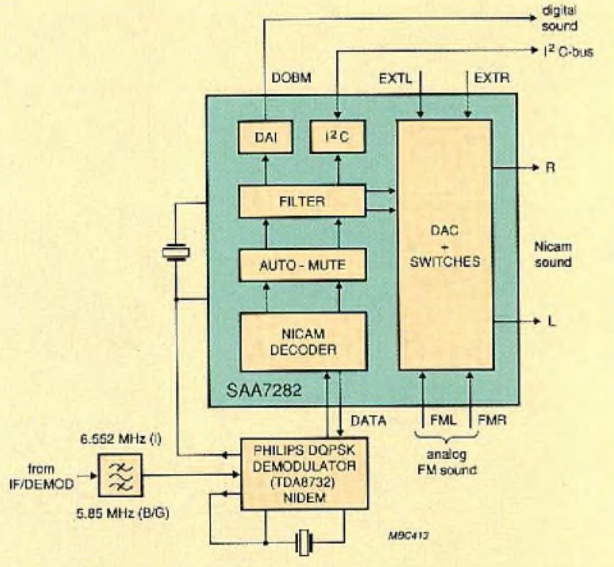


Fig.3 Philips two-chip approach for two-channel NICAM-728 digital sound in TV sets and video recorders

The first IC is Philips' TDA8732 NIDEM (*NI*CAM-728 *DEM*odulator) which has been well-proven for more than a year in systems using our earlier 3-chip approach. The second IC is Philips' second-generation CMOS

Terrestrial Digital Sound Decoder (TDSD2) SAA7282. This highly-integrated circuit replaces our first-generation Terrestrial Digital Sound Decoder (TDSD) SAA7280, an integrated dual DAC, four op-amps for deemphasis/low-pass analog filtering, and audio switches. The SAA7282 combines the entire decoding, digital filtering, selectable digital deemphasis, one-bit D to A conversion and audio switching functions for NICAM-728 two-channel digital sound into a single IC with I^2C-bus control. Furthermore, it also includes an IEC/EBU 958 digital audio interface for connection to external digital recording/ reproduction equipment.

Together, the Philips' TDA8732 and SAA7282 form a complete 2-chip full-featured digital TV sound system capable of high-performance demodulation, decoding and D to A conversion of NICAM-728 sound signals in accordance with the EBU specification, even though they require very few peripheral components and occupy only a small area on the PCB.

NICAM-728 demodulator (NIDEM) TDA8732

This 5 V bipolar IC in a 20-pin DIL or SO package is a dedicated DQPSK demodulator for NICAM-728 sound systems in TV sets and video recorders. Figure 4 is a block diagram of the TDA8732. A limiting amplifier at its input accepts the DQPSK modulated intercarrier TV sound signal which conveys the NICAM-728 sound information. The output is a NICAM-encoded data stream, synchronized to a 728 kHz clock, for a NICAM-728 decoder such as Philips' second-generation Terrestrial Digital Sound Decoder (TDSD2) SAA7282.

The TDA8732 contains:

- a quadrature demodulator based on a costas-loop which uses a single-pin crystal-controlled oscillator operating at twice the carrier frequency (11.7 MHz crystal for operation with PAL-B, -G, or 13.104 MHz crystal for operation with PAL-I TV transmission standards)
- a carrier phase recovery PLL, with single-pin loop filter, to synchronize the sine and cosine reference carrier signals for quadrature demodulation
- a bit-rate crystal-controlled VCO (11.648 MHz crystal)
- a bit-rate clock recovery PLL to synchronize the 728 kHz clock generated by the SAA7282, or the internally generated 728 kHz clock when the IC is used with other NICAM-728 decoders
- a differential decoder with parallel-to-serial converter for decoding the demodulated NICAM-728 data signal and reforming it into a serial bit stream for application to a NICAM-728 decoder.

Second-generation Terrestrial Digital Sound Decoder (TDSD2) SAA7282

This 5 V CMOS IC in a 32-pin shrink-DIL package, or a QFP-44 package for surface mounting, performs all the digital decoding functions for two-channel NICAM-728 digital sound systems in TV sets and video recorders. Together with the previously mentioned well-established TDA8732 NICAM-728 demodulator (NIDEM), it forms a complete 2-chip full-featured system capable of high-performance demodulation and D to A conversion of NICAM-728 sound signals in accordance with the EBU NICAM-728 specification.

The SAA7282, shown in block form in Fig.5, demodulates the serial bit-stream from Philips' NICAM demodulator TDA8732, descrambles and de-interleaves it before checking it for errors and reformatting it to recover the original digital sound samples. It also performs selectable digital deemphasis, one-bit D to A conversion and internal/external sound switching functions in a single

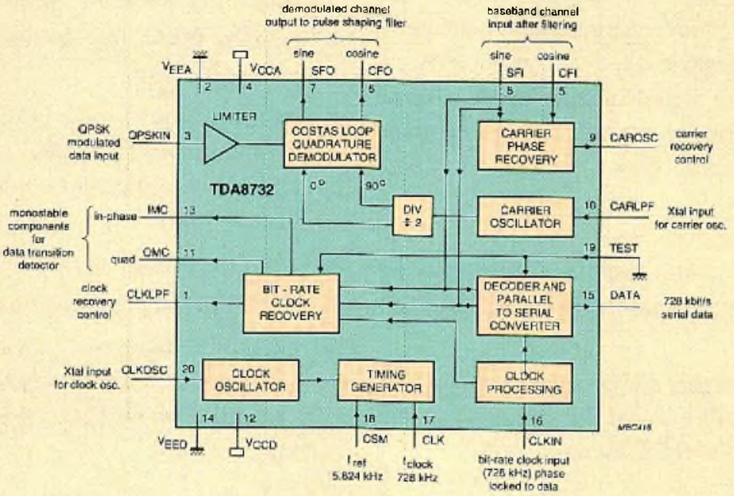


Fig.4 Block diagram of NICAM-728 demodulator (NIDEM) TDA8732.
Pin numbering is for the DIL package

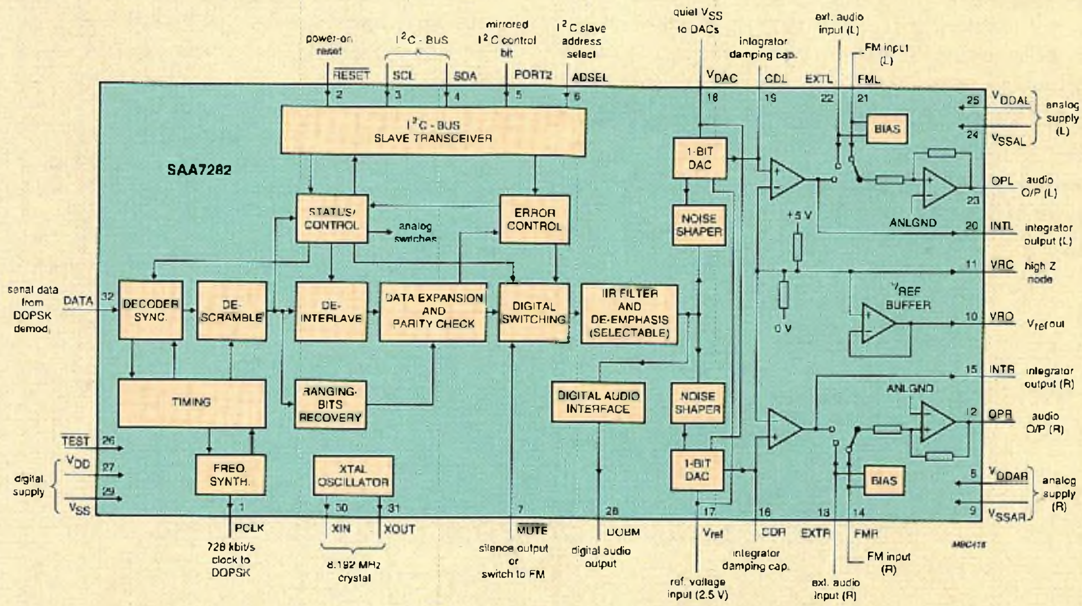


Fig.5 Block diagram of second-generation terrestrial digital sound decoder (TDSD2) SAA7282.
Pin numbering is for the DIL package

CMOS IC with I²C-bus control. The SAA7282 can be controlled by using I²C-bus software which is part of the package used to control the entire TV set via a central microcontroller.

Because of the high scale of integration and the architecture used, this IC requires the minimum number of peripheral components. Component count is further reduced by built-in 4× oversampling digital filtering which ensures that minimum analog filtering is required. Other important features of the SAA7282 are:

- IEC/EBU 958 digital audio interface for applying digital audio signals to external recording/reproduction equipment
- an automatic mute function which silences the digital data and switches to FM sound (if valid) when the error rate exceeds a user-definable limit
- user-defined upper and lower error rate limits can be written via the I²C-bus
- a user mute function ($\overline{\text{MUTE}}$ pin) to allow muting on occurrence of a user-defined error rate if required or, simply silencing the output
- on-chip RAM for de-interleaving and 10- to 14-bit word expansion
- transmission-dependent automatic decoding and output configuration for digital stereo sound, digital dual-channel mono sound or digital mono sound +352 kbit/s data
- 256× oversampling noise shapers
- two fully-integrated one-bit DACs
- click-free integrated switching networks to allow selection between internal NICAM-728 digital sound, external FM analog sound or external "daisy-chain" input.

APPENDIX – PROTOCOL FOR DIGITAL AUDIO INTERFACE IEC/EBU 958

Digital output data format

The digital output for each sound channel from the digital audio interface (DOBM pin) of the SAA7282 (TDSD2) is formed into sequential sub-frames, each comprising a 4-bit sync preamble, a 24-bit sound sample for one channel, a channel status bit and 3 control bits. Pairs of these sub-frames (one for each channel) are transmitted sequentially as frames. Since there are a total of 192 channel status bits, a total block of sound data consists of 192 consecutive frames (0 to 191) as shown in Fig.A1. Frames are transmitted at the source sampling rate (32 kHz).

The channel nomenclature is:

- **channel A** is the left stereo channel, or the primary channel of dual-channel mono
- **channel B** is the right stereo channel, or the secondary channel of dual-channel mono.

Bi-phase mark data coding

The sound information from the digital audio interface is encoded as bi-phase mark data in which each bit is represented by a symbol consisting of two consecutive logic states. As shown in Table A1, the first state of a symbol is always different from the second state of the symbol preceding it so that each symbol starts with a logic level transition. If the value of the bit is logic 0, the two states of the symbol are the same (no mid-symbol logic level transition). If the bit value is logic 1, the two states of the symbol are different (a mid-symbol logic level transition).

TABLE A1
Bi-phase mark data encoding

	Preceding state	
Bit value	0	1
	Symbol states	
0	11	00
1	10	01

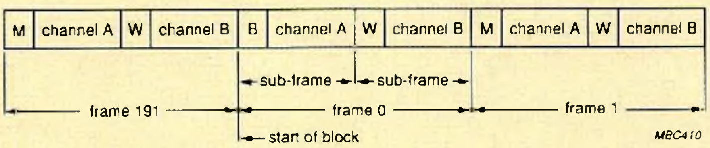


Fig.A1 Frame format for signals from the IEC/EBU 958 digital audio interface of the SAA7282

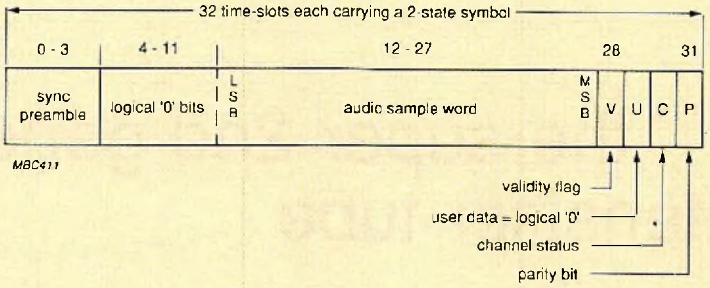


Fig.A2 Sub-frame format for signals from the IEC/EBU 958 digital audio interface of the SAA7282

Sub-frame structure

As shown in Fig.A2, each frame is divided into 32 time-slots (each accommodating the two logic states of a symbol) numbered 0 to 31.

Time-slots 0 to 3 carry one of the three permitted 4-symbol preambles (8 logic states) shown in Table A2 that are used to identify and synchronize sub-frames, frames and blocks.

TABLE A2
Preambles

code	Preceding state 0	Preceding state 1
	Preambles	
B	11101000	00010111
M	11100010	00011101
W	11100100	00011011

The preambles indicate the beginning of a sub-frame containing a sound sample as follows:

- **preamble B** indicates the start of channel A data and the beginning of a block
- **preamble M** indicates the start of channel A data but not the beginning of a block
- **preamble W** indicates the start of channel B data.

Time-slots 4 to 27 carry the 16-bit sound sample for the associated channel in linear 2's-complement representation with the MSB in time-slot 27. Since only 16-bit coding is used, the eight LSBs are set to logic 0.

Time-slot 28 carries the validity flag associated with the sound sample. This flag is set to logic 0 if the sound sample is reliable, or to logic 1 if it is unreliable.

Time-slot 29 carries one bit of the user data channel. Since this facility is not used for NICAM-728 sound in TV sets, this bit is set to logic 0.

Time-slot 30 carries one bit of the 192-bit channel status word associated with the sound channel in the same sub-frame. The first bit of the channel status word is carried in the first of the 192 sub-frames per channel of a block (following preamble B for channel A). The 192-bit channel status word is organized as shown in Table A3.

Time-slot 31 carries a parity bit with a binary value such that time-slots 4 to 31 inclusive will carry an even number of logic 1s and an even number of logic 0s.

TABLE A3
Channel status codes carried in time-slot 30

Bit	Code	Description
0	0	consumer
1	0	sound data
2	1	digital copy permitted
3, 4	00	two sound channels without pre-emphasis
	11	two sound channels with J.17 pre-emphasis
5	0	
6, 7	00	
8 to 15	00110001	digital audio interface in 2-channel direct broadcast satellite receiver (Europe)
16 to 19	0000	source code (don't care)
20 to 23	0000	channel number (don't care)
24 to 27	1100	sampling frequency (32 kHz)
28, 29	00	clock accuracy (level II)
30 to 191	all 0s	

XX1610 – the super 2nd generation image intensifier tube

JACQUES DUPUY

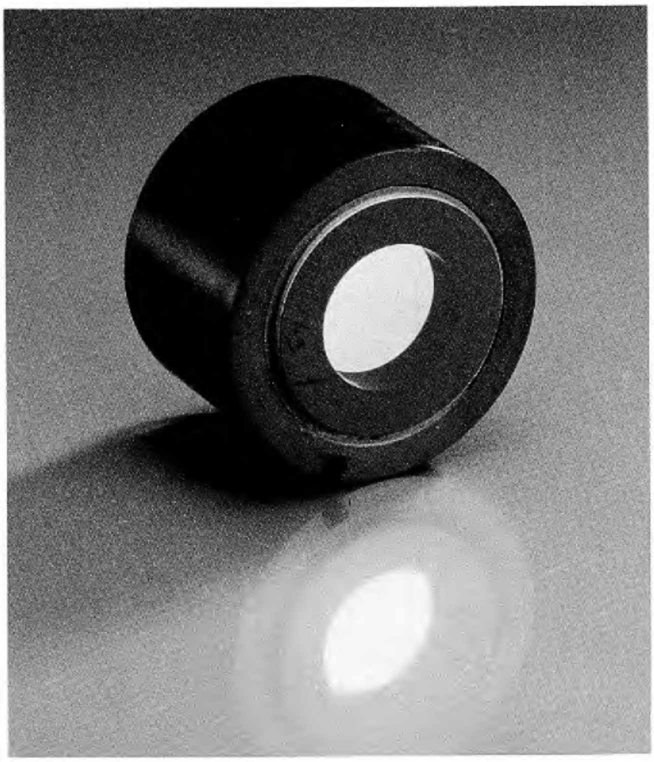
The introduction of the XX1610 by Philips Components, marks a step forward in the development of image intensifier tubes. By using greatly enhanced 2nd generation technology, the XX1610 achieves a performance close to that of a 3rd generation tube. Because of its far superior performance to other 2nd generation types, the XX1610 is now universally known as the *super 2nd generation* tube.

In the quest to see greater detail in gloomy conditions, image intensifiers have developed from early 1st generation tubes to today's more advanced 2nd and 3rd generation types (see Box 1). But, as with most technology, new developments result in greater cost. If a whole army is to be equipped with image intensifying rifle sights, then 3rd generation tubes will prove too expensive. At Philips Components we've continued to develop 2nd generation technology to make a very high performance tube at an affordable price.

In fact for double proximity tubes, the difference in performance between 3rd and 2nd generation tubes is not as great as is at first apparent. Although photocathodes using GaAs have much greater sensitivity than tri-alkali types, this benefit does have its own performance price to pay. In double-proximity tubes, ions emitted from the microchannel plate (MCP) during operation can travel to the photocathode. The disadvantage for 3rd generation tubes is that GaAs photocathodes are far more sensitive to ion bombardment than a tri-alkali type and will be damaged after only a short period of operation. To improve the lifetime of 3rd generation tubes, damaging ions are prevented from reaching the photocathode by applying an ion barrier film to the MCP. Unfortunately, because it absorbs electrons as well as ions, this film increases noise (observed as scintillations) and limits the tube's ability to image objects in the dark.

New developments in tri-alkali photocathode manufacture and MCP design allow us to achieve a low-light performance close to that of 3rd generation tubes with tubes using 2nd generation technology. Because of their low cost, these *super 2nd generation* tubes open up new applications for image intensifiers. The main features and operation of the XX1610 double-proximity super 2nd generation image intensifier tube are described in Box 2.

To fully appreciate the capabilities of this tube, it's useful to understand how low-light performance is measured.



1. DEVELOPMENT STEPS IN IMAGE INTENSIFIER TUBES

From 1st to 3rd generation tubes
The first *passive* image intensifier tubes (earlier *active* tubes required the scene to be illuminated with infrared radiation) were introduced in the 1960's. In these 1st generation tubes, light is converted by a tri-alkali photocathode into electrons which are accelerated and focused onto a phosphor screen which produces an intensified image. Later, much greater intensification was achieved with 2nd generation tubes which have a microchannel plate (MCP) mounted close to the phosphor screen. The MCP multiplies the number of electrons emitted from the photocathode to achieve very high gain. More recently, technology moved on a stage further with the development of 3rd generation tubes which use a gallium arsenide (GaAs) photocathode for greater sensitivity.

Double-proximity tubes
Double-proximity tubes were developed for applications such as integrated rifle sights and night-vision goggles which require low profile tubes. In double-proximity tubes, the photocathode is mounted close to the MCP. This eliminates the need for a lens system to focus the electrons onto the MCP and gives the tube a very low profile.

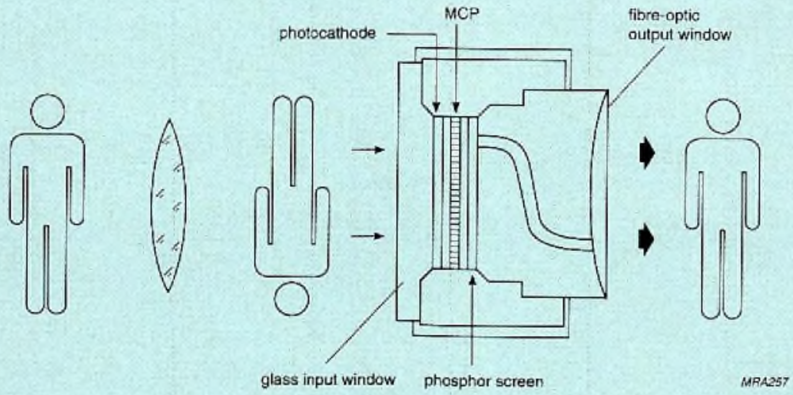
2. THE XX1610 SUPER SECOND GENERATION IMAGE INTENSIFIER AND ITS OPERATION

With double electrostatic proximity focusing (both the photocathode and phosphor screen are close to the MCP), the XX1610 has a very low profile and produces a distortion free intensified image. It has a clear-glass anti-veiling input window, and built-in power supply with automatic gain control (AGC). In addition, it features point highlight saturation protection and automatic brightness control. Its operation is as follows:

An inverted image of the scene is focused onto a multi-alkali photocathode deposited on the inside of a glass input window. Electrons are emitted from the photocathode at an intensity that depends on the brightness of the light. A microchannel plate (MCP) (a glass plate containing millions of tiny parallel cylindrical channels tilted at a slight angle to the plate axis) is located close to the photocathode. An electric field focuses the electrons onto the MCP so that they enter the channels and collide with their electrically conductive walls. This collision causes secondary electrons to be emitted which travel along the channels under the influence of an electric field. More collisions produce further electrons and the process continues as an avalanche effect to provide gain. On reaching the end of the MCP channels, the electrons are accelerated across a narrow gap to a phosphor screen which displays an intensified inverted image. Finally, a twisted fibre-optic window produces an erect image.

FEATURES

input:	
photocathode	S25
useful diameter	17.5 mm
material	clear glass, anti-veiling-glare
refractive index	1.49
output:	
phosphor type	P20
useful diameter	17.5 mm
material	fibre-optic (twisted or straight)
recommended supply voltage	2.7 V
supply current	typ. 10 mA max. 16 mA
mass	100 g



DETERMINING NIGHT VISION PERFORMANCE

Looking down the eyepiece of an image intensifier tube, it's not easy to make an objective judgement of its night vision performance. In fact the range at which a particular object can be seen will vary from person to person, given the same equipment and conditions. In addition to the characteristics of the image intensifier tube itself, the following factors influence night vision:

- size and shape of the object
- spectral reflectivity of the object and background
- sky irradiance
- weather conditions
- optical equipment: focal length, aperture setting, lens resolution and transmission factor
- eye response of observer.

For a particular set of the above conditions, the range at which an object can be seen is determined by three image intensifier parameters as follows:

$$\text{range} \propto \text{resolution} \sqrt{\frac{\text{sensitivity}}{\text{noise power factor}}}$$

The design of our super 2nd generation tube, the XX1610, significantly improves all three parameters compared to standard 2nd generation types.

SENSITIVITY

In an image intensifier, light falling on the photocathode causes electrons to be emitted at a rate that increases with light intensity according to the sensitivity of the photocathode. New techniques at Philips Components produce an enhanced tri-alkali photocathode with a much higher sensitivity than is possible with conventional methods.

Table 1 and Fig.1 compare the spectral response of the XX1610 super 2nd generation tube with that of standard 2nd generation tubes and 3rd generation ANVIS (Aviator's Night Vision Imaging System) tubes. Clearly, our enhanced photocathode has significantly improved white light sensitivity – increased by a factor of 1.85. What's more, the sensitivity improvement in the near infrared is even greater – increased by a factor of 2 at 830 nm. This is crucial since night sky illumination is greatest in this part of the spectrum. Also, the reflectivity of materials varies more widely in the near infrared, so the picture has greater contrast. Figure 2 shows the typical spectral characteristics of night sky illumination along with reflectance curves for various materials at night.

Although the sensitivity of the XX1610 is still less than half that of a 3rd generation ANVIS tube, its noise power factor is lower which means that the difference in night vision performance is small.

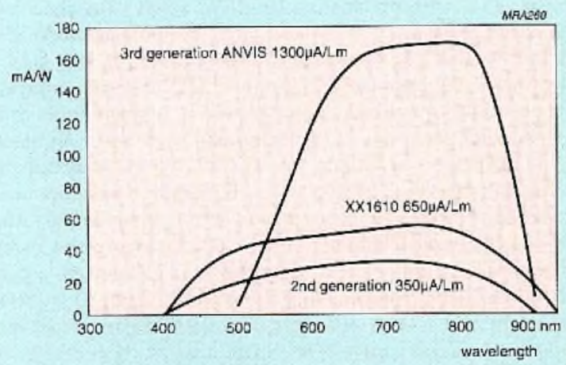


Fig.1 Spectral response of image intensifier tubes

TABLE 1
Typical sensitivity characteristics

tube type	white light sensitivity (μA/lm)	spectral sensitivity (mA/W) @ wavelength (nm)						
		450	500	600	700	800	830	880
2nd generation	350	15	25	35	40	35	30	10
XX1610	650	25	50	60	65	65	60	35
3rd generation ANVIS	1300	0	0	120	150	160	100	85

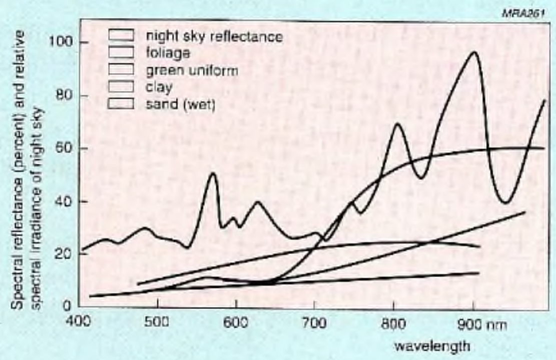


Fig.2 Spectral characteristics of night sky and materials

NOISE

A feature of image intensifier tubes is that, even when the scene is at a constant light level, the intensity of every point in the image at the phosphor screen will vary at random. This scintillation is the main form of noise in image intensifiers and limits night vision performance.

At the low light levels under which image intensifiers operate, the rate of photon to electron conversion in the photocathode fluctuates significantly. This is one cause of scintillation. Scintillation due to the MCP and screen is quantified by the *noise power factor*.

Noise power factor

The noise power factor is influenced by the following:

- the loss of electrons between the photocathode and the MCP channels
- the random nature of electron multiplication in the MCP – the number of secondary electrons emitted when electrons collide with the MCP channel walls varies significantly when the number of primary electrons is small
- the decay time of the screen phosphor – using phosphor with a longer decay time reduces scintillation but increases lag.

Tests show that 3rd generation tubes have a high noise power factor. This is due to high electron losses at the MCP entrance.

Figure 3 compares electron behaviour at the photocathode/MCP interface in 2nd and 3rd generation tubes. As shown, the ion barrier film in 3rd generation tubes (needed to prevent ions from the MCP from damaging the delicate GaAs photocathode) prevents some electrons from reaching the channels in the MCP. Some electrons are trapped in the barrier film. Others strike the area surrounding the channels and are lost. In 2nd generation tubes most of these electrons are reflected back and land inside an adjacent channel (re-entry). The total effect of the ion barrier film in 3rd generation tubes is that 50% of electrons emitted from the photocathode are absorbed.

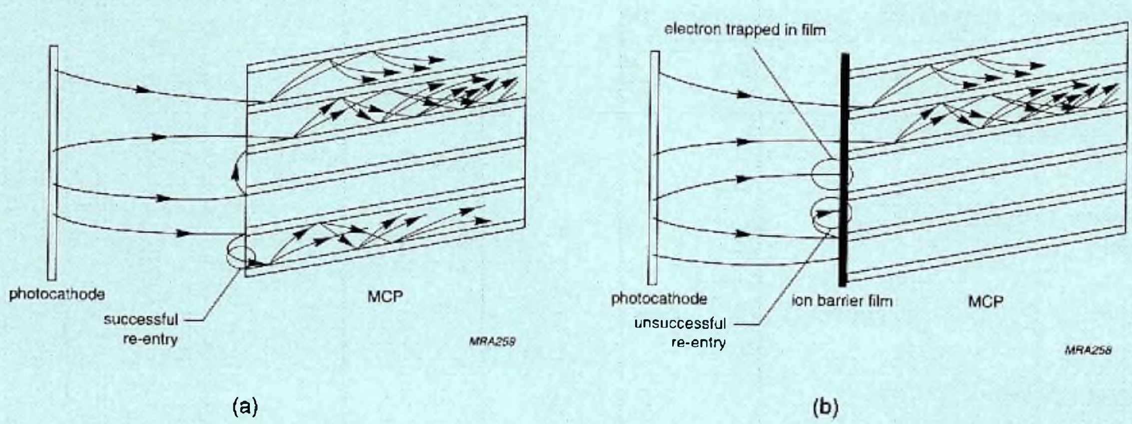


Fig.3 In 2nd generation tubes (a) most electrons emitted from the photocathode enter channels in the MCP. In 3rd generation tubes (b), an ion barrier film absorbs 50% of electrons from the photocathode. This increases noise at the phosphor screen.

Super 2nd generation tubes have a very low noise power factor due to two major improvements in the MCP:

- *increased open area ratio* – by using new glass technology our MCPs have a higher open-area-ratio than conventional types. This leaves less closed space surrounding the holes where electrons can be lost
- *increased secondary emission coefficient* – thanks to special glass and improved treatment, the number of electrons generated from collisions in the MCP channels is increased. Because there are more electrons, the random nature of MCP operation is less significant and scintillation is reduced.

Signal-to-noise ratio

The effect of scintillation and other noise on the image at the phosphor screen depends on the combined influence of sensitivity and the noise power factor. The signal-to-noise (S/N) ratio is a measure of this effect and is related to sensitivity and noise power factor by:

$$\frac{S}{N} \propto \sqrt{\frac{\text{sensitivity}}{\text{noise power factor}}}$$

In Table 2 the combined effect of sensitivity and noise power factor on the S/N ratio in 2nd, super 2nd (XX1610) and 3rd generation (ANVIS) tubes is compared for white light and near infrared. Clearly the improved photocathode sensitivity and reduced noise power factor of super 2nd generation tubes very nearly compensates for the high sensitivity of 3rd generation tubes.

TABLE 2
Characteristics determining signal-to-noise ratio

characteristics	2nd gen.	XX1610	3rd gen. ANVIS
typical noise power factor (F)	2.2	1.9	3.8
white light:			
typical luminous sensitivity (Σ_w) (μAlm)	350	650	1300
$\sqrt{\frac{\Sigma_w}{F}}$	12.6	18.5	18.5
infrared light (880 nm):			
typical radiant sensitivity (Σ_{880}) (mA/W)	10	35	85
$\sqrt{\frac{\Sigma_{880}}{N}}$	2.1	4.3	4.7
specified minimum S/N	12.7	15.5	16.2

RESOLUTION

Night vision equipment is only useful when it can pick out objects in the dark in sufficient detail for the operator to recognise them. Resolution is the ability of the tube to reproduce fine details. The XX1610 features several design improvements on standard 2nd generation tubes that give it a resolution equivalent to that of a 3rd generation ANVIS tube:

- *MCP pitch reduced to just 12.5 μm* – since the MCP splits the electron output from the photocathode into separate channels, having more channels improves resolution
- *reduced photocathode-to-MCP spacing* – thanks to high tolerance machining techniques, the photocathode and MCP in the XX1610 are positioned closer together than in standard double-proximity tubes. This allows a greater electric field to be applied between the photocathode and MCP which reduces electron spread at the photocathode/MCP interface, and improves resolution
- *reduced MCP-to-screen spacing* – this reduces electron spread at the MCP/screen interface and hence improves resolution.

3. MEASURING RESOLUTION

Limiting resolution
A black-and-white bar pattern with a mark-space ratio of 1:1 and contrast approaching 100% is focused onto the image intensifier. The density of lines at the phosphor screen is adjusted so that the line pattern is just visible. The number of line pairs (lp) per mm focused at the photocathode then defines the limiting resolution.

Modulation transfer function (MTF)
Using special equipment, the MTF curve showing the percentage drop in contrast verses the spatial frequency can be plotted for image intensifiers. This is a reliable way of comparing the picture sharpness of different tubes.

The resolution of an image intensifier is generally specified as the limiting resolution or the modulation transfer function (MTF). Two methods used to measure these specifications are outlined in Box 3. Table 3 compares the limiting resolution and the modulation transfer function (MTF) of 2nd and 3rd generation tubes with the XX1610.

TABLE 3
Resolution

tube type	minimum limiting resolution (lp/mm)	modulation transfer function: typical contrast (%) at			
		7.5 lp/mm	15 lp/mm	25 lp/mm	36 lp/mm
2nd generation	25	59	26	8	0
XX1610	36	70	41	19	9
3rd generation ANVIS	36	70	41	19	9

NIGHT VISION PERFORMANCE

As explained, improvements in sensitivity, noise power factor and resolution all contribute to increasing the range at which an object can be seen in the dark. Table 4 shows the results of a field experiment using different image intensifier tubes. To make this table, a number of experienced night vision equipment operators were asked to pick out a target painted with NATO paint against a background of vegetation in different light levels. The table shows just how close the night vision performance of the XX1610 is to that of a 3rd generation ANVIS tube.

TABLE 4
Field test results

scene illumination	relative range		
	2nd generation	XX1610	3rd generation ANVIS
7×10^{-4} lux	1	1.41	1.51
10^{-3} lux	1	1.35	1.42
10^{-2} lux	1	1.12	1.15

LIFETIME

The main cause of failure in proximity image intensifier tubes is damage to the photocathode from ion bombardment. The effect of ions emitted from the MCP can only be reduced by using a barrier film which, as with 3rd generation tubes, degrades night vision performance by increasing the noise power factor. However, our proprietary manufacturing process significantly reduces gases in the MCP by baking and scrubbing (bombarding with electrons). This new high quality MCP reduces ion bombardment and gives the XX1610 a very long lifetime, with a mean time to failure (MTTF) of 7500 hours.

SHOCK RESISTANCE

Though they contain fragile parts, image intensifiers must be built to withstand rough treatment. The ruggedized design of the XX1610 strengthens MCP mounting and allows it to withstand shocks of up to 500g. This is significantly better than all other proximity image intensifiers which can withstand shocks up to only 75g. Together with its high night-vision-performance, this makes the XX1610 ideal for use in rifle sights.

PICTURE QUALITY

In all image intensifiers, some minor blemishes are present in the picture that have a minimal effect on night vision performance. Picture quality is a measure of the number of spots of significant contrast on the phosphor screen. Our new photocathode fabrication process not only offers better sensitivity but improves picture quality to the high standard set by the ANVIS 3rd generation tube.

IMPROVED ALL-ROUND PERFORMANCE

New production techniques and design innovations give the XX1610 a significantly better performance than standard 2nd generation image intensifier tubes. Not only is the night vision performance close to that of 3rd generation tubes, but reliability, shock resistance, and picture quality are significantly better than for standard 2nd generation tubes.

And this high all-round performance is available at a much lower cost than with 3rd generation tubes. The 3rd generation tube is intrinsically more expensive because of the cost of making a GaAs photocathode and an MCP with an ion barrier film. So the super 2nd generation XX1610 is ideal for new application areas which require high performance but do not merit the expenditure needed for 3rd generation tubes. Today, the XX1610 is used in the following applications:

- integrated rifle sights
- night-vision goggles
- infantry weapon sights
- surveillance cameras
- low light level television.

Table 5 compares the performance of 2nd and 3rd generation tubes with the XX1610.

TABLE 5
Overview of image intensifier specifications

characteristic	2nd generation	XX1610	3rd generation ANPVS7	3rd generation ANVIS
sensitivity (min.):				
white light (μA/lm)	240	500	800	1000
λ = 830 nm (mA/W)	15	45	–	100
λ = 880 nm (mA/W)	–	15	40	60
S/N ratio at 10^{-4} lux (min.)	12.7	15.5	14.5	16.2
MTF (min.) @:				
2.5 lp/mm	86%	83%	83%	83%
7.5 lp/mm	58%	58%	58%	58%
15 lp/mm	20%	28%	20%	28%
25 lp/mm	–	8%	–	8%
limiting resolution (min.) (lp/lm)	25	36	28	36
picture quality	2nd generation	as ANVIS	as 2nd generation	ANVIS
lifetime (min.) (h)	1000	3500	–	–
MTTF (min.)	–	7500	7500	7500
gain (max.)	7500	25 000	30 000	30 000
equivalent background illumination (EBI) (max.) (μlux)	0.25	0.25	0.25	0.25
shock (max.) (g)	75	500	75	75

Guidelines for soldering surface-mount ICs in SSO packages

This article outlines the methods of soldering surface-mount ICs in Shrink Small Outline (SSO) packages onto PCBs. Although the SSO-20 package is used as an example throughout the publication, the same principles apply to all SSO packages.

SSO IC PACKAGES

Advantages

Integrated circuits in SSO packages are the most recent extension to our range of miniature electronic components for surface-mount assembly. They contain the same chips as their DIL and SO counterparts but occupy less space and offer all the well-known advantages of surface-mount technology. Obviously, PCBs populated with SSO-packaged ICs are smaller, or can perform more functions than boards with equivalent DIL or SO-packaged ICs. The lower lead inductance of ICs in SSO packages also makes them more suitable for applications where space is limited and there is a need for high-frequency operation or fast switching. A typical example of this type of application is the TV tuner shown in Fig.1.

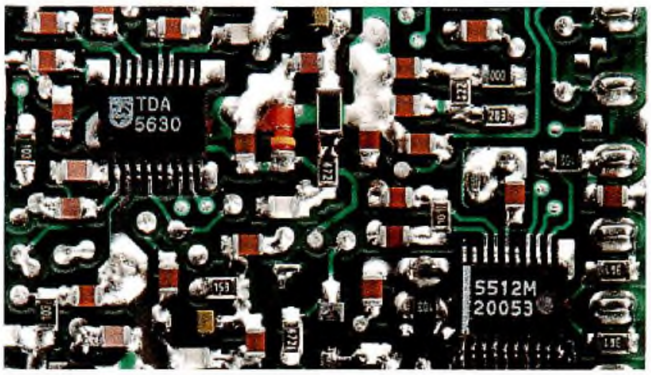


Fig.1 SSO-packaged ICs are ideal for high-frequency applications in small areas such as this TV tuner

Mechanical details

The SSO-20 plastic package shown in Fig.2 is similar in appearance to its SO (large) counterpart. However, whereas the SO package has a 7.5 mm wide body and short, stiff gull-wing leads on a 1.27 mm lead pitch, the SSO-20 package has a 4.4 mm wide body and a 0.65 mm lead pitch.

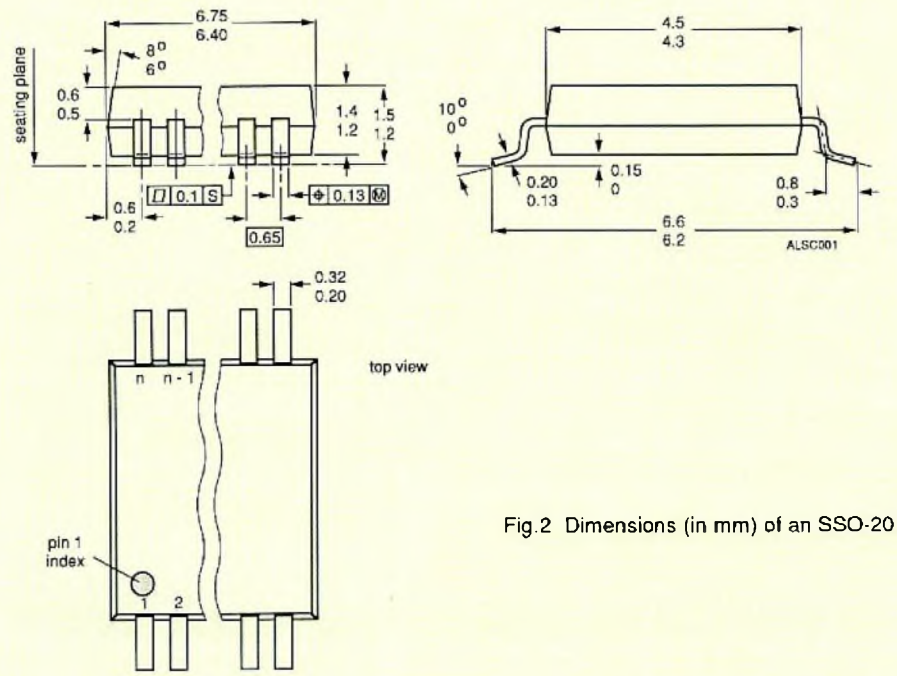


Fig.2 Dimensions (in mm) of an SSO-20 package

THE SOLDERING ENVIRONMENT

It is recommended that all the equipment for soldering ICs in SSO packages is located in a controlled environment maintained at a temperature of 22 ± 2°C, and a relative humidity (RH) of 55 +5/−10%.

DOUBLE WAVE SOLDERING

Because of the closely-spaced leads of the SSO package, and the attendant danger of solder bridging, this soldering method is not recommended. If it must be used however, the following conditions must be observed:

- the PCB footprint must incorporate dummy solder lands or solder thieves on the downstream end
- the longitudinal axis of the IC must be parallel to the direction of solder flow.

A suitable PCB footprint for double wave soldering ICs in SSO-20 packages is given in Fig.3.

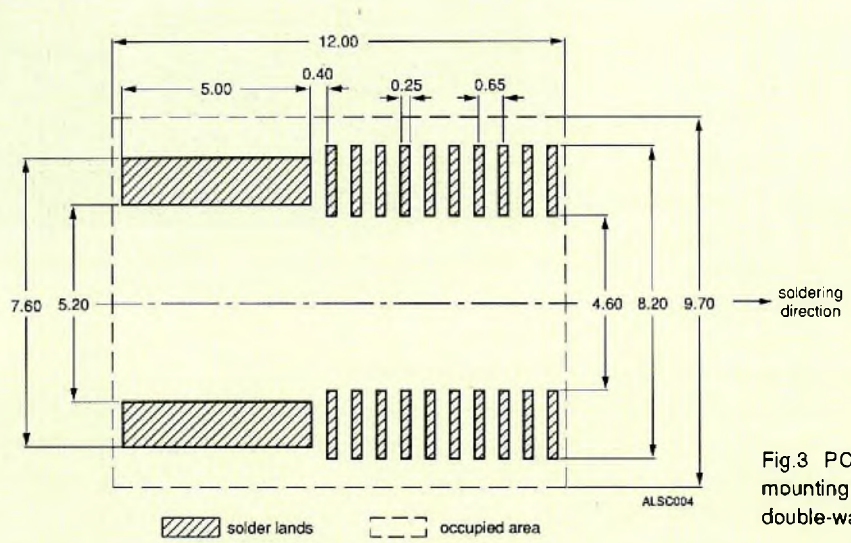


Fig.3 PCB footprint dimensions (in mm) for mounting an SSO-20 package on a PCB for double-wave soldering

Adhesive bonding before soldering

To prevent movement of SSO-packaged ICs during double wave soldering, it is necessary to bond them to the PCB with a high green strength adhesive (thermosetting epoxy resin such as Heraeus PD 860002 SP) and cure it. The preferred method of applying the adhesive is by syringe because this allows application of a precisely measured amount to each position.

The amount of Heraeus PD 860002 SP adhesive required per dot for bonding ICs in SSO packages to a PCB is:

- diameter: 1.6 mm ± 0.1 mm
- height: 625 μm
- volume: 0.7 mm^3 ± 0.05 mm^3.

Curing time can be as short as 3 minutes at 110 °C as shown in Fig.4.

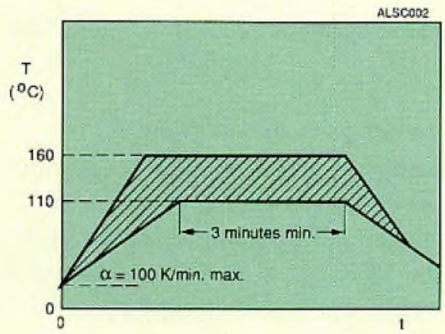


Fig.4 Permitted time/temperature profile area for curing adhesive prior to double wave soldering

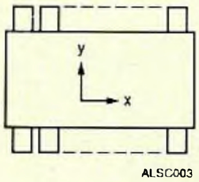


Fig.5 Alignment of SSO-packaged ICs on the PCB

Positioning the IC on the PCB

ICs in SSO packages can be positioned on a PCB either manually or by a placement machine. However, dimensional tolerances of the IC package and PCB, combined with inaccuracy of the placement machine, or manual placement errors, can lead to component misalignment. The component must be placed with an accuracy of 100 μm (translation, rotation) both in the x and y directions (Fig.5). This placement accuracy is based on calculations taking into account considerations such as:

- minimum overlap of leads and lands
- minimum distance between lead and adjacent land

Soldering method and parameters

After applying adhesive, placing the ICs and curing the adhesive, the areas to be soldered are coated with a thin layer of rosin mildly activated flux applied by spraying or as a foam. The PCB is then pre-heated to 85° C (temperature of the solder side of the board) and the solder applied by moving the inclined board across two successive waves of solder. To prevent the board warping during soldering, the clamping force exerted on its longer sides by the transport system must not exceed 0.5 N/cm.

Table 1 gives the general process parameters for double wave soldering SSO-packaged ICs. Two suitable rosin mildly activated fluxes are mentioned; one foam and one spray. They are Philips products; colophony fluxes in isopropanol with DEA halogen and dicarboxylic acid activation, solids content 17.2%. However, other types of fluxes can of course be used.

TABLE 1
General process parameters for wave soldering SSO-packaged ICs onto a 1.6 mm thick PCB

Parameter	Data	
	foam Philips 622	spray Philips 628
thickness of cured flux layer on PCB just before soldering	4 μm	2 μm
pre-heating		
temperature of the solder side of the PCB just before soldering	115 ±10 °C	
Δ temp./Δ time (ΔT/Δt)	≤ 3 K/s	
inclination of PCB during soldering	7 ±0.5°	
warpage of PCB during soldering (both waves)	0 mm + 0/– 0.3 mm	
solder temperature	250 ±3 °C	
double wave configuration:		
contact time with 1st (turbulent) wave	0.5 s + 0.5/– 0 s	
contact time with 2nd (smooth) wave	2 s ± 0.2 s	
immersion depth of PCB:		
into 1st wave	1.6 mm + 0.5/– 0 mm	
into 2nd wave	0.8 mm + 0.5/– 0 mm	
flow direction of 2nd wave relative to PCB	relatively stationary	
type of solder	Sn 60/Pb 40	

In a double-wave soldering machine (Fig.6), the PCB first contacts a turbulent wave of solder which has a high vertical velocity and constant height. This ensures good solder contact with the edges of the IC and prevents joints from being missed. The second, smooth laminar wave of solder completes formation of the solder fillet and reduces bridging. A little activated oil in the second wave of solder helps to prevent formation of oxide skins on the surface of the solder, thereby reducing bridging as the PCB leaves the wave.

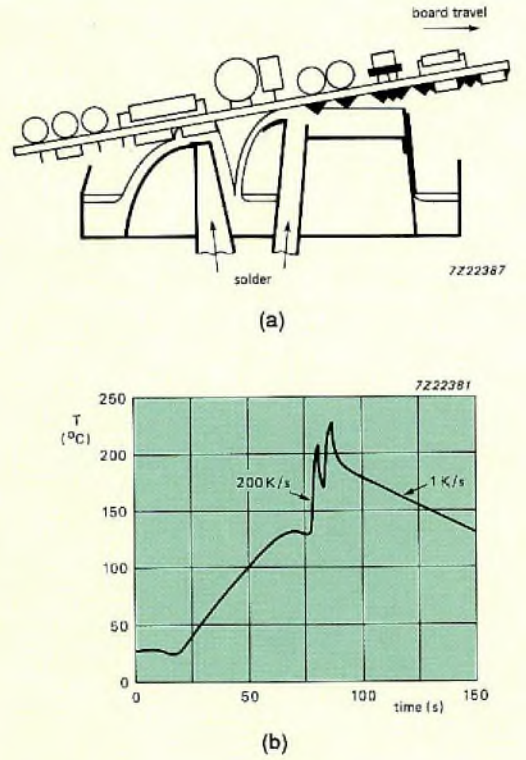


Fig.6 Double-wave soldering (a) principle of the method (b) measured temperature profile of the leads at the immersion point

REFLOW SOLDERING WITH INFRARED HEATING

Reflow soldering uses a paste consisting of a mixture of flux and solder which can be applied by screen printing or stencilling. When heated, after component placement, the mixture reflows to form the soldered joints.

Applying solder paste to the PCB

The first stage of reflow soldering of SSO-packaged ICs with IR heating is application of 0.5 to 0.7 mg/mm^2 of solder paste to the solder lands on the PCB by screen printing or stencilling. The solder paste consists of small particles of solder and a flux with binder, solvents and additives to control the rheological properties. Suitable types of Philips solder paste are SP029, SP032 or SP031 with smaller particles, or SP026 with larger (approx. 75 μm) particles.

Applying solder paste by screen printing

A fine-mesh screen coated with emulsion, except for the areas where paste is required, is placed over the PCB. A squeegee is then passed across the screen to force solder paste through the areas in the emulsion where paste is required and onto the PCB.

The parameters of a suitable screen for applying solder paste to an SSO IC footprint on a PCB for reflow soldering are:

- type: metal gauze Bopp wire
- thickness: 100 μm, 80 mesh
- thickness of emulsion: 180 μm
- total thickness: 280 μm
- solder land openings: 1 × 0.3 mm^2, open area 72%

Applying solder paste by stencilling

This is similar to screen printing, except that a metal stencil is used instead of a fine-mesh screen.

A stainless steel or bronze stencil for applying solder paste to the PCB should be 200 μm thick with a step-etched pattern 125 μm thick formed by chemical etching. To ensure that the edges of the openings in the stencil are always positioned within the solder lands, the dimensions of the openings should be about 10% smaller than those of the solder lands. For solder lands of 1.1 × 0.35 mm^2 as shown in Fig.7, the size of the openings in the stencil should be 1.0 mm × 0.3 mm + 0/− 0.05 mm.

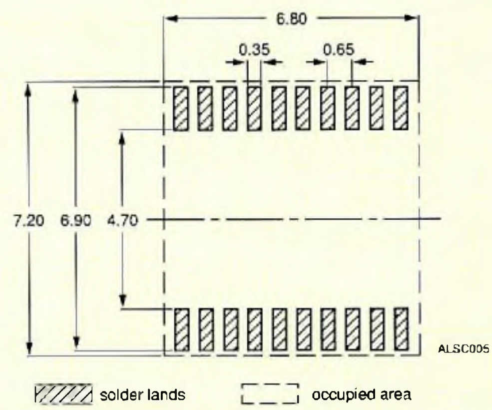


Fig.7 PCB footprint dimensions (in mm) for mounting an SSO-20 package on a PCB for reflow soldering

Positioning the IC on the PCB

ICs in SSO packages can be positioned on a PCB either manually or by a placement machine. However, dimensional tolerances of the IC package and PCB, combined with inaccuracy of the placement machine, or manual placement errors, can lead to component misalignment. The component must be placed with an accuracy of 100 µm (translation, rotation) both in the x and y directions (Fig.5). This placement accuracy is based on calculations taking into account considerations such as:

- minimum overlap of leads and lands
- minimum distance between lead and adjacent land

Solder reflow method and parameters

In the final stage of the reflow soldering process, the PCB is heated to above the melting point of the solder alloy by an infrared source. This causes the solder to reflow and form the soldered joints.

Figure 8 shows the principle of this soldering method. IR ovens usually contain more than one type of heating element, operating in the mid- to far-infrared regions, positioned above and below a moving belt. The main limitation of IR heating is the different rates of IR transmission, absorption and reflection. For example, IC leads are excellent IR reflectors, whereas the black plastic package of the IC is an excellent IR absorber. This leads to an uneven temperature profile across the board which can only be reduced by extending the exposure time. IR reflow soldering is mainly used in conjunction with glass-epoxy PCBs.

The time/temperature curve for reflow soldering with IR heating is given in Fig.8. If the PCB also contains other components with a larger thermal mass than the SSO-packaged ICs, lengthening of period t_e is unavoidable. However, t_e must never exceed five minutes.

REFLOW SOLDERING WITH LOCAL HEATING BY AN ENERGY BEAM

With this method, the solder is caused to reflow by applying localized heat to the leads of the IC by scanning them with an energy beam.

Applying solder/solder paste to the PCB

Solder can be applied to the lands on the PCB with solder paste or, preferably, by wave soldering as previously described.

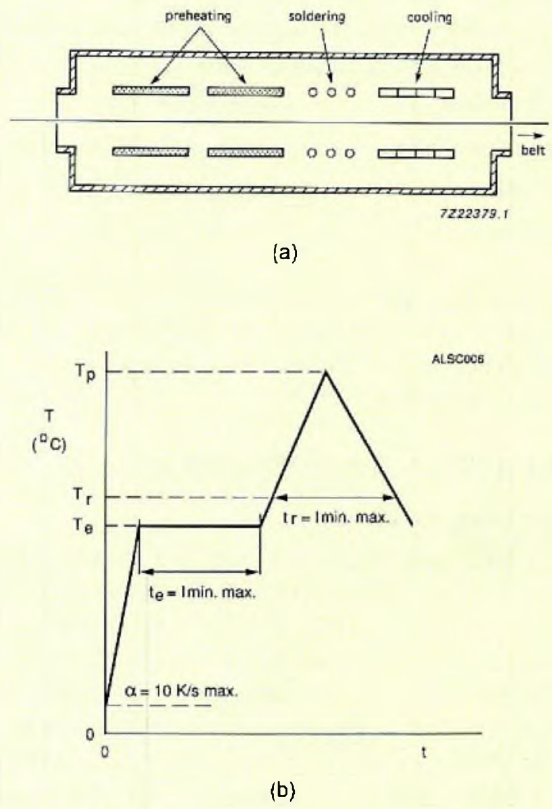


Fig.8 IR reflow soldering (a) principle of the method (b) time/temperature profile; T_p = 215 to 280°C, T_r = 180°C, T_e = 160°C max.

To ensure good quality joints, the IC leads should first be treated with a rosin mildly activated flux which must not be allowed to completely dry before soldering. The average thickness of the layer of solder on the lands should be about 10 µm.

Positioning the IC on the PCB

ICs in SSO packages can be positioned on a PCB either manually or by a placement machine. However, dimensional tolerances of the IC package and PCB, combined with inaccuracy of the placement machine, or manual placement errors, can lead to component misalignment. The component must be placed with an accuracy of 100 µm (translation, rotation) both in the x and y directions (Fig.5). This placement accuracy is based on calculations taking into account considerations such as:

- minimum overlap of leads and lands
- minimum distance between lead and adjacent land

A touch-down force of 30 N distributed over the total surface area of the IC is sufficient to ensure that all its leads contact the solder lands.

Energy beam parameters for solder reflow

The following choice of energy beam parameters will result in good quality soldered joints:

- power source: continuous
- power per beam: 15 W on PCB (2 beams)
- scanning rate: 20 mm/s
- spot size on PCB: 1.1 mm × 1.4 mm

Care should be taken when using solder paste; if heating is too rapid, solder paste cannot be used because there will be a violent loss of solvent and insufficient time for adequate solder flow.

REPLACING A SOLDERED IC

De-soldering the IC

ICs in SSO packages can be removed from a PCB by heating the leads on both sides of the package with a hot air gun with a small orifice nozzle giving an air temperature of 320 °C and an airflow rate of 1 litre/min.

The jet of hot air is continually moved along all the leads of the IC to avoid overheating the board. The IC can then be removed easily with a pair of tweezers. However, care must be taken not to damage any other components on the board.

Although the hot air gun can also be used to de-solder most other types of components, a different nozzle will be required if the components are large.

Applying solder paste to the PCB

Prior to replacing the IC, a dispenser is used to place a small dot (0.3 mg) of Philips SP032 solder paste (special modified dispenser solder paste) on each solder land.

Positioning the new IC

The new IC is positioned on the PCB manually. It must be placed with an accuracy of 100 µm (translation, rotation) both in the x and y directions (Fig.5). This placement accuracy is based on calculations taking into account considerations such as:

- minimum overlap of leads and lands
- minimum distance between lead and adjacent land

A touch-down force of 30 N distributed over the total surface area of the IC is sufficient to ensure that all its leads contact the solder lands.

Parameters for soldering the new IC with hot air

To ensure good quality soldered joints the PCB should be pre-heated for 40 seconds to a temperature of 130°C (temperature of the solder side of the board). The jet of air from the hot air gun is then moved along all the leads of the IC to raise their temperature to 250°C and reflow the solder paste without overheating the board. Soldering takes about 10 seconds for an SSO-20 package. Temperature profiles for the PCB and the leads of the IC during pre-heating and soldering are given in Fig.9.

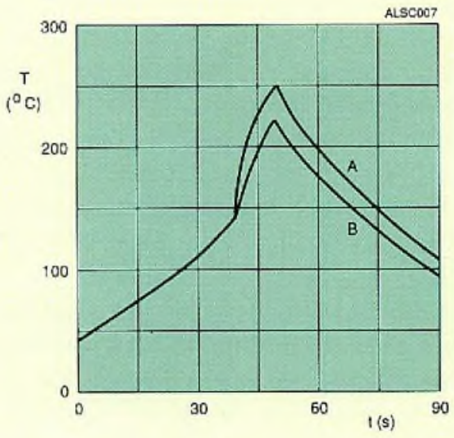


Fig.9 Preferred time/temperature profiles for using hot air soldering to replace an SSO-packaged IC.
A: temperature of the leads on both sides of the IC
B: temperature of the PCB

Abstracts

A new generation of World System Teletext ICs
This article gives an overview of the basic teletext system configurations using WST ICs. The systems use one of our new range of Integrated VIP and Text (IVP) ICs SAA5244/5246/5247. The SAA5246 (IVT1.0) needs an external 8K × 8 bit SRAM for storing four pages (extension packet mode) or eight pages (normal mode). With an SAA5244 (IVT1.1), a single-page RAM is built into the chip so that no external RAM is necessary. The SAA5247 (IVT1.1BMC) with Background Memory Control (BMC) has an on-chip single-page RAM and facilities for storing up to 512 pages in external DRAM which is rapidly scanned on each page request, thereby giving near instant page access. The article also surveys World System Teletext developments and concludes with an overview of teletext software packages.

NICAM-728 two-channel digital TV sound
This article describes the NICAM-728 TV sound broadcast format and protocol and shows how just two Philips ICs are used to decode it in a TV set. One of the ICs is the well-proven Nicam demodulator that was used in the earlier three-chip approach to decoding. The other IC is a second-generation Terrestrial Digital Sound Decoder that includes an IEC/EBU 958 digital audio interface and replaces the decoder and separate dual DAC IC used in the three-chip approach. The article concludes with an Appendix describing the protocol for the IEC/EBU 958 interface.

XX1610 – the super 2nd generation image intensifier tube
New developments in image intensifier manufacture give the XX1610 far superior night vision performance than other 2nd generation tubes. In particular, sensitivity is nearly twice that of a conventional type. Although 3rd generation tubes using a GaAs photocathode have even greater sensitivity, the difference in night vision performance between the XX1610 and a 3rd generation tube is marginal. This is because factors other than sensitivity must also be considered when making a true comparison of night vision performance. This article explains the significance of noise on night vision performance, and shows that the XX1610 display is far less noisy than that of a 3rd generation tube, making it a very competitive tube for many low light applications.

Guidelines for soldering surface mount ICs in SSO packages
ICs in SSO packages are the most recent extension to Philips' range of miniature electronic components for surface-mount assembly. This article gives recommendations on how to solder these packages, and describes specific methods such as double-wave soldering, and solder paste methods with energy beam heating. It also gives instructions for replacing an IC using a hot air gun.

Eine neue Generation von Videotext-ICs (World System Teletext)
Dieser Beitrag enthält eine Übersicht über die Basiskonfigurationen von Bildschirmtextsystemen, die auf der Basis von WST-ICs arbeiten (WST = World System Teletext). Diese Systeme enthalten jeweils einen unserer neuen Familie von Integrierten Videoeingangsprozessor- und Text-ICs (IVT) SAA5244/5246/5247. Die Schaltung SAA5246 (IVT1.0) benötigt ein externes SRAM mit 8K × 8 Bit zur Speicherung von vier Seiten (Betrieb mit Pseudoreihen (extension Packets) bzw. acht Seiten (Normalbetrieb). SAA5244 (IVT1.1) verfügt über ein internes Seitenspecher-RAM mit einer Speicherkapazität für eine Seite, so daß kein externer RAM-Speicher erforderlich ist. Die Schaltung SAA5247 (IVT1.1BMC) mit Background Memory Controller (BMC) verfügt ebenfalls über einen On-Chip-Einseiten-RAM, bietet jedoch zusätzliche Möglichkeiten zur Speicherung von bis zu 512 Seiten in einem externen Zyklusspeicher-DRAM, das bei jeder Anwahl einer Seite kurz abgefragt wird, wodurch man einen nahezu verzögerungsfreien Seitenzugriff erhält. Darüber hinaus vermittelt der vorliegende Beitrag einen Überblick über die Entwicklungen auf dem Gebiet des World System Teletext und schließt dan mit einer Übersicht der Bildschirmtext-Softwarepakete.

Digitale Zweikanal-Fernsehton-Übertragung mit NICAM-728
Dieser Artikel beschreibt das NICAM-728 Fernsehton-Übertragungsformat und -protokoll und zeigt, wie sich in einem Fernsehgerät Signale, die nach diesem Format übertragen werden, mit Hilfe von zwei Philips ICs decodieren lassen. Einer der beiden ICs ist der bewährte Nicam-Demodulator, der in der früheren Drei-Chip-Schaltungsversion zur Decodierung eingesetzt wurde. Bei dem anderen IC handelt es sich um einen digitalen Tonsignal-Decoder der zweiten Generation für terrestrische Signalübertragung, der eine digitale Audio-Schnittstelle vom Typ IEC/EBU-958 enthält. Dieser zweite IC ersetzt den Decoder-IC und den IC des Zweifach-Digital/Analog-Umsetzers der früheren Drei-Chip-Version. Der Artikel schließt mit einem Anhang, in dem das Protokoll für die IEC/EBU-958-Schnittstelle beschrieben wird.

XX1610 – Die Super-Bildverstärkerröhre der zweiten Generation
Dank neuer Entwicklungen zur Herstellung von Bildverstärkerröhren ist die Röhre XX1610 mit ihren Leistungen als Restlichtverstärker anderen Röhren der zweiten Generation weit überlegen. Gegenüber herkömmlichen Typen wurde insbesondere die Empfindlichkeit nahezu verdoppelt. Obwohl sich Röhren der dritten Generation, die mit einer GaAs-Fotokatode ausgestattet sind, durch eine noch größere Empfindlichkeit auszeichnen, läßt sich der Leistungsunterschied bei der Anwendung in Nachtsichtgeräten zwischen der Röhre XX1610 und einer Röhre der dritten Generation vernachlässigen. Bei genauem Vergleich der Leistungsfähigkeit von Restlichtverstärkern müssen neben der Empfindlichkeit auch andere Parameter berücksichtigt werden. In diesem Beitrag wird der Einfluß von Rauschstörungen auf die Leistungsfähigkeit von Nachtsichtgeräten erläutert und gezeigt, daß die Bildverstärkerröhre XX1610 im Vergleich zu Röhren der dritten Generation eine weitaus Rauschärmere Wiedergabe ermöglicht, wodurch sie eine sehr konkurrenzfähige Alternative für eine Vielzahl von Restlichtanwendungen darstellt.

Richtlinien für das Löten von SMD-ICs mit SSO-Gehäusen
ICs mit SSO-Gehäusen sind die jüngsten Mitglieder in derPhilips-Familie miniaturisierter elektronischer Bauelemente für Oberflächenmontage. Dieser Beitrag gibt Empfehlungen zum Löten dieser Gehäuse und beschreibt typische lötverfahren wie Doppelwellenlöten und Reflow-Verfahren mittels Infrarotstrahlung. Außerdem werden Hinweise gegeben zum Austauschen von ICs mit Hilfe einer Heißluftpistole.

Une nouvelle génération de CI Télétexte Système Mondial (WST)
Cet article donne une vue d'ensemble des configurations de système Télétexte de base utilisant des circuits intégrés WST. De tels systèmes tirent parti de l'un de nos CI de la nouvelle gamme de produits intégrés VIP et Text (IVP): SAA5244/5246/5247. Le type SAA5246 (IVT1.0) nécessite une SRAM externe de 8K × 8 bits pour la mise en mémoire de quatre pages (mode d'ensemble d'extension) ou huit pages (mode normal). Avec le type SAA5244 (IVT1.1), une RAM à page unique est incorporée à la puce, de sorte qu'aucune RAM externe n'est nécessaire. Le type SAA5247 (IVT1.1BMC), avec pilotage de mémoire non prioritaire (BMC), est équipé d'une RAM à page unique incorporée à la puce, ainsi que des dispositifs permettant de conserver en mémoire jusqu'à 512 pages en DRAM externe, laquelle est rapidement explorée à chaque demande de page, ce qui procure un accès pratiquement instantané aux pages. L'article passe également en revue les développements du World System Teletext et il se termine en donnant un aperçu des ensembles de logiciel Télétexte.

Son numérique TV à deux canaux NICAM-728
Cet article décrit le format et le protocole de diffusion pour son TV NICAM-728 et montre que deux CI Philips seulement suffisent à le décoder dans un téléviseur. L'un des CI est le démodulateur Nicam qui a déjà fait ses preuves et qui a été utilisé dans la première phase de décodage à trois puces. L'autre CI est le Terrestrial Digital Sound Decoder (Décodeur Terrestre pour Son Numérique) de la deuxième génération comprenant une interface audio numérique IEC/EBU 958 et remplaçant le décodeur et le CI pour CNA double et séparé, utilisé dans l'approche à trois puces. Cet article se termine par une Annexe décrivant le protocole pour l'interface IEC/EBU 958.

XX1610 – le super tube amplificateur de luminance de la deuxième génération
Des développements récents intervenus dans la fabrication des amplificateurs de luminance confèrent au XX1610 des performances de vision nocturne largement supérieures à celles des autres tubes de la deuxième génération. Plus particulièrement, leur sensibilité est près du double de celle des type conventionnels. Sans doute les tubes de la troisième génération utilisant une photocathode GaAs possèdent-ils une sensibilité plus grande encore, mais la différence de performances en vision nocturne, entre les XX1610 et les tubes de la troisième génération, est marginale. Ceci est dû à des facteurs autres que la sensibilité avec lesquels il faut compter lorsque l'on veut établir une véritable comparaison au plan des performances de vision nocturne. L'article explique l'importance du bruit sur de telles performances, et montre que l'affichage produit par les tubes XX1610 présente beaucoup moins de bruit par rapport aux tubes de la troisième génération, ce qui en fait une proposition très concurrentielle dans de nombreuses applications sous faible lumière ambiante.

Directives pour le soudage des CI à montage en surface dans des ensembles SSO
Les circuits intégrés dans les ensembles SSO constituent la plus récente extension de la gamme Philips de composants électroniques miniatures pour le montage en surface. Cet article donne des recommandations quant à la manière de souder ces ensembles et décrit des méthodes spécifiques, comme par exemple le brasage tendre à la vague double et l'application de pâtes à souder en conjonction avec le chauffage par faisceau d'énergie. Il fournit aussi des instructions pour le remplacement d'un CI à l'aide d'un pistolet à air chaud.

Una nueva generación de circuitos integrados para el sistema mundial de teletexto (WST)
Este artículo describe las configuraciones básicas del sistema de teletexto utilizando circuitos integrados WST. Los sistemas utilizan uno de nuestros nuevos circuitos integrados VIP y texto integrados (IVP) de la gama SAA5244/5246/5247. El SAA5246 (IVT1.0) necesita una memoria SRAM de 8Kx8 bit para almacenar cuatro páginas (modo de extensión de paquete) u ocho páginas (modo normal). Con el SAA5244 (IVT1.1) se incorpora en el circuito integrado una memoria para una sola página, de modo que no se necesite memoria RAM externa. El SAA5247 (IVT1.1BMC) con control de memoria de fondo (BMC), lleva integrada una memoria RAM de una sola página en el circuito y puede almacenar hasta 512 páginas en una memoria externa DRAM que es rápidamente examinada en cada requerimiento de página, posibilitando así el acceso casi inmediato a una página. En este artículo también se trata sobre la evolución de los sistemas de teletexto en el mundo y finaliza con una lista de paquetes de software para teletexto.

Sonido digital en TV con dos canales NICAM-728.
En este artículo se describen el formato y protocolo para la transmisión de sonido en TV NICAM-728 y muestra como solo dos CI Philips se usan para decodificar la señal en un receptor de TV. Uno de esos CI es el bien probado demodulador Nicam que se usó en el primitivo circuito demodulador con tres chips. El otro CI es la segunda generación de un Decodificador de Sonido Digital Terrestre, que incluye un interfase digital audio IEC/EBU 958 y sustituye al decodificador y al CI doble separado DAC utilizados en el circuito con tres chips. El artículo termina con un Apéndice describiendo el protocolo para el interfase IEC/EBU 958.

XX1610 – la segunda generación del tubo de rayos catódicos super-intensificador de imagen
Las innovaciones en la fabricación de intensificadores de imagen confieren al XX1610 unas características de visión nocturna muy superiores a las de otros tubos de rayos catódicos de segunda generación. En particular la sensibilidad casi duplica a la del tipo convencional. Aunque los tubos de tercera generación que usan fotocátodos de arseniuro de galio (GaAs) tienen una sensibilidad mayor, la diferencia en visión nocturna entre el XX1610 y la tercera generación es mínima. Esto es debido a que, al comparar realmente las características de visión nocturna, se han de tener en cuenta otros factores diferentes a la sensibilidad. En este artículo se explica la influencia del ruido en la visión nocturna, mostrándose cómo la pantalla del XX1610 es mucho menos sensible al ruido que la de un tubo de tercera generación, lo cual hace de este tubo una opción muy competitiva para numerosas aplicaciones con baja intensidad de luz.

Indicaciones para soldar circuitos integrados de montaje superficial con encapsulados SSO
Los circuitos integrados con encapsulado SSO son la ampliación más reciente de la gama Philips de componentes electrónicos en miniatura para montaje superficial. En este artículo se recomienda cómo soldar estos encapsulados, se describen métodos específicos como la soldadura de doble onda y métodos con pasta para soldar por calentamiento de rayo energético. También explica cómo sustituir un circuito integrado utilizando una pistola de aire caliente.

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