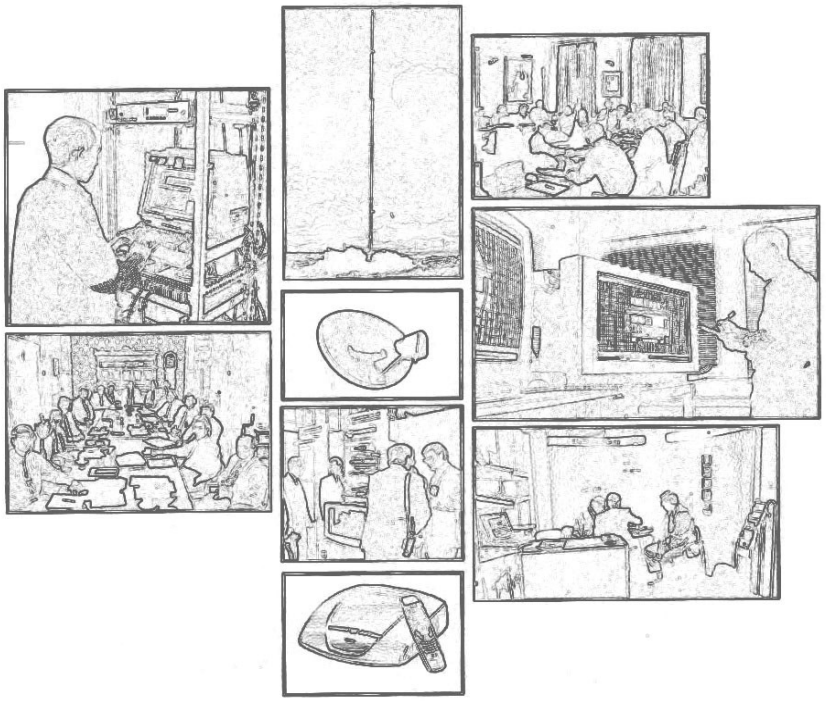
Contract Title:
Digital Television Project:
Provision of Technical Assistance

Contracting Authority:
Department of Trade and Industry

Preliminary Investigation of a SCART Lead Benchmarking Scheme



FEBRUARY 2005

DIGITAL TELEVISION PROJECT
PROVISION OF TECHNICAL ASSISTANCE

Preliminary Investigation of a SCART Lead Benchmarking Scheme

Issue 1.0, 7th February, 2005

Authors: Paul Gardiner, Peter Barnett

Document Status

The preparation of this report has been facilitated by DTG Management Services Ltd, a wholly owned subsidiary company of the Digital TV Group. The report has been compiled by an acknowledged industry expert with the aim of providing answers to specific questions posed by the UK Department of Trade and Industry. While every effort has been made to ensure accuracy and to provide a consensus view when required, it should not be assumed that all member organisations of the Digital TV Group support all aspects of the report. The views expressed in the report are those of the authors and not the collective views of DTG Council.

Prepared for:

Ian Dixon
Department of Trade & Industry

Facilitated by:
DTG Management Services Ltd
7 Old Lodge Place
Twickenham
TW1 1RQ

Tel: +44 20 8891 1830
Fax: +44 20 8891 1999

CONTENTS

EXECUTIVE SUMMARY

This study has identified the characteristics of a ‘Digital Friendly SCART’ lead that would make it easier to install consumer equipment for digital switchover.

The ‘Digital Friendly SCART’ lead is a fully wired SCART lead with a more secure plug that is less prone to inadvertently becoming detached.

We believe that the benefits of an improved ‘Digital Friendly SCART’ would include:

- Reduced consumer confusion
- Increased consumer confidence
- Reduced time for installation
- Fewer service calls

The detailed criteria described in this report could form the basis of future SCART lead benchmarking scheme, or they may simply be used as a good practice guide for manufacturers and suppliers.

Further industry feedback is invited on the detailed conclusions and recommendations of this report.

1 Introduction and Context of the Study

1.1 Scope of the investigation

The Digital Television Action Plan identified a number of technical issues for digital switchover that require further investigation, analysis, study or consultation. On several occasions, the Technical Equipment Group (TEG) within the Action Plan project structure has debated the issues associated with SCART leads. Such issues were highlighted in two DTG Management Services reports for the DTI: in 2003 in a report on Recorder Technology[1], and in 2004 a report on In-home Distribution[2].

The issues are various, but notably include the connectivity of the wiring within the SCART lead, and also the robustness of the connection itself. The work described in this report outlines technical requirements that might be used to form a SCART lead benchmarking scheme. With digital switchover in mind, this would serve to raise the average standard of equipment connection and performance, and improve reliability.

The objectives of the study are:

- To determine the technical criteria against which SCART leads/connectors could be measured
- To determine how such technical criteria could be tested
- To provide an outline design for a possible SCART benchmarking scheme

The overall aim is to reduce difficulties that might otherwise be encountered by viewers as millions of SCART leads are installed or reconfigured during the course of digital switchover.

1.2 Approach

Interviews have taken place with several technical experts, from BSkyB, SCART manufacturers, and receiver manufacturers.

It is not the aim of this study to propose re-writing the existing standards. Rather, we offer pragmatic guidance to procurers and suppliers of SCART products, in a form that could potentially be used in a benchmarking scheme.

The objective is to encourage manufacturers to make reliable and robust SCART leads more readily available, to the benefit of everyone involved in digital switchover.

[1] Recorder Technology, report by the Digital TV Group for the Digital Action Plan (August 2003) www.digitaltelevision.gov.uk

[2] Review of In-Home Networks, report by the Digital TV Group for the Digital Action Plan (April 2004) www.digitaltelevision.gov.uk

1.3 What is the problem?

SCART leads have long had a reputation for being bulky, awkward, and troublesome – and a source of confusion for consumers.

A typical SCART lead has a length of 1 m - 1.5 m, but it's possible to buy them in a considerably wider range of lengths – generally from 0.75 m to 5 m (even longer leads are available, but are rarely required).

Prices vary considerably, starting at under £2 to as much as £69.99.

However, not all SCART leads provide the same functionality – some are partly wired, while in others the cable is of poor quality, offering little or no screening between conductors. *The cost of a SCART lead is not necessarily an indicator of its functionality or quality*.

Interviews with industry representatives have highlighted the key issues with SCART leads and connectors. In particular, BSkyB have experienced the impact that SCART difficulties can have on the customer call centre, and several years ago carried out extensive research into the design of a more secure SCART lead. Subsequently, only this type has been supplied with their satellite receivers. This dramatically reduced the number of problems reported.

Shortcomings fall into three broad categories:

- Physical/mechanical problems associated with the SCART plug, connectors, and lead
- Problems with SCART lead wiring
- The functionality of the device(s) to which the SCART lead is connected.

1.3.1 Mechanical connection problems leading to full or partial loss of sound and/or vision

All items of equipment that are SCART enabled have a female socket, while the SCART lead is fitted with a male plug.

- **There is no standardised locking mechanism to ensure that the SCART plug remains firmly connected to the socket**

The SCART specifications simply give a minimum required extraction force. Once inserted into the socket, there is no mechanism to securely lock the SCART plug into position, and to ensure that the socket properly retains all 21 pins.

- **SCART cables can be bulky and stiff**

SCART cables vary considerable in their construction. A fully wired lead, with all 21 contacts connected, results in a thick and fairly stiff round cable (or in a wide flat ribbon cable) that can be difficult to manoeuvre.

Even a small movement of a stiff cable can exert a considerable turning moment on the plug.

- **Just a few degrees of movement of the SCART plug with respect to the socket can be enough to cause loss of one or more signals**

One of the most common problems is the partial disconnection of the plug from the socket. This can easily result from forces inadvertently exerted on the connector when equipment is moved, even from small disturbances when cleaning or dusting around the equipment.

On casual visual inspection, all may even appear to be well, and the consumer will be unaware of the cause of the problem.

Most susceptible to loss of contact are the two pins at the end of the SCART plug closest to the point of cable entry into the plug – see Fig. 1 below. These two contacts (1, 2) carry the right-channel audio ‘out’ and ‘in’ respectively, so partial loss of audio is often the first symptom experienced by the customer.

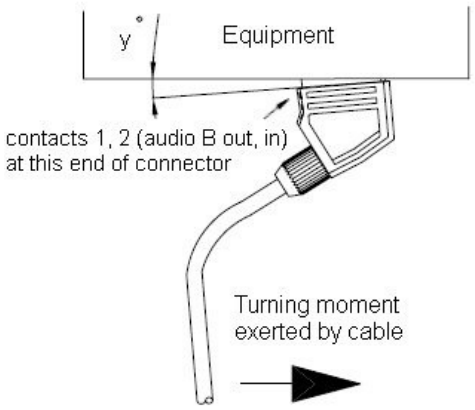


Fig. 1 - A small rotation of the connector can lead to disconnection of signals

The angle of tilt to cause electrical disconnection varies according to the play in the plug (and socket). In some cases, the tilt (angle ‘y’ in Fig. 1) need be as little as 2°, although with more robust leads the connection integrity is maintained better than 3°.

Depending on which contacts are lost first, and how the SCART cable is being used, audio may for example be lost either on VCR playback, or only when making new VCR recordings. The end result is likely to be a confused customer.

- **There is no standard orientation for the fixed SCART socket**

The SCART plug is fairly large, and the plug can be quite difficult to insert. It will fit only when inserted the right way round.

The orientation of the socket varies between items of equipment, as illustrated in Fig. 2. On the television it is generally vertical, such that the cable from the plug is angled downwards. On set top boxes, DVD players and recording devices, it is usually horizontal, but in one of two possible ways – the cable emerging from a standard SCART plug is angled either to the left, or to the right.

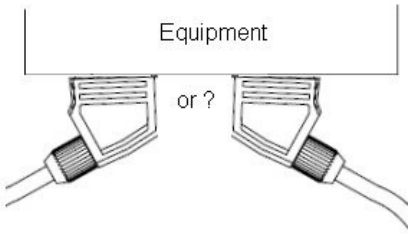


Fig. 2 - There is no right or wrong orientation for a SCART socket

This is merely somewhat inconvenient, and with millions of items of existing equipment in use, it would now seem too late to suggest that only a single orientation be used for horizontal mounting.

If a consumer changes from one set to box to another, or replaces a VCR or DVD player, the SCART plug may need to be rotated through 180 degrees. This can be difficult when the cable is thick and stiff, and the resulting forces on the SCART connector can lead to partial disconnection if it is not securely attached.

- **Poorly constructed SCART plugs are prone to damage**

Physical stress applied to a poorly designed SCART plug can even result in wires becoming detached within its housing, or in physical deformation of parts of the connector assembly - rendering it partially or fully inoperable.

1.3.2 Wiring

- **Not all SCART leads are fully wired**

SCART is a general system for interconnecting a range of consumer equipment in a variety of configurations. Not all of these necessarily require all the available connections to be made.

This has led to the availability (encouraged by the specifications, see Section 2.1 below) of leads that implement various subsets of connections.

- **It’s almost impossible to identify the type of SCART lead**

When purchasing a SCART lead, the consumer is faced with sometimes confusing choices.

While the packaging will usually (but not always!) describe the purpose of the lead, one lead looks much the same as another - and the consumer may be unaware which wires are connected and which are not.

For example, a SCART lead originally purchased to connect a VCR to a television may not work correctly if used instead to connect a digital set top box – it might not contain conductors for the RGB signals. You simply can't tell just by looking at it.

- **SCART lead conductors may not be properly screened**

The specifications require the use of screened cable for certain signals. Not all cordsets do so, while others use screened conductors with poor shielding. Under some circumstances this can lead to visible patterning on the picture, or audible interference on the sound.

1.3.3 Equipment issues

Set top boxes and televisions are often fitted with two or more SCART sockets.

- **There may be different functionality between primary and secondary SCART sockets**

The fixed SCART sockets fitted to equipment are usually intended for connection to specific devices – for example, to a VCR, or a TV. The signals available on one socket, such as RGB intended for the display, may not be present on the other. On the TV itself, it may be that only one SCART socket is able to accept RGB signals.

Even if clear instructions are given in the user manual, consumers can still find the interconnection requirements confusing. Furthermore, not all devices include clear labels showing the intended use for the SCART socket. Even if they do, once installed they can be difficult to read

- **Device protocols have to be correct for the system to function correctly**

The SCART system includes a number of switching and control connections. These perform functions such as function switching, aspect ratio, and blanking.

These issues are complex, particularly when several items of equipment are interconnected, and are outside the scope of this report. More details are given in the DTG Connectivity Guidelines for Installers and Manufacturers[3].

A more comprehensive but complex intercommunication protocol, AV.link[4], is available on equipment from several manufacturers. This uses low bit rate data carried on SCART contact 10 (see Ref. 3). It enables one device in a system to control others, while selecting the appropriate signals paths between them without further user intervention. An example of this is a VCR recording the output of a set top box, then playing back in optimum quality.

2 The SCART Legacy

SCART (from *Syndicat des Constructeurs d'Appareils Radiorécepteurs et Téléviseurs*) is a 21-contact interconnection system used for linking together baseband (video and audio) signals between audiovisual equipment and television sets. It was originally developed as a French standard in the late 1970s to enable television receivers to be used with external decoders for Antiope teletext.

SCART makes it easy to connect VCRs, DVD players, set-top boxes (Pay TV, analogue or digital cable, terrestrial digital TV), home computers, gaming systems and other equipment to television sets.

The term 'SCART' does not appear in the European Standard (EN 50049-1). Rather, it is referred to as the **Peritelevision** connector. It is also known as **Péritel** (especially in France, where the term 'SCART' is not normally used), and **Euroconnector**.

SCART sockets have been widely fitted to televisions with large screens since the early 1990s, and indeed this became a requirement of EU Directives (see Appendix 3).

There are two principal specifications:

BS EN 50049-1 (see Ref. 1) defines the interconnection characteristics of 'peritelevision' devices (for example, VCR, DVD, set top box, games console), both between themselves and with television receivers.

IEC 60807-9 (see Ref. 2) describes the male and female connectors and their construction, and also lists test requirements.

BS EN 50157-1 (see Ref. 3) outlines the general requirements of AV.link and provides useful additional information on SCART requirements in the AV.link environment.

---

[3] Connectivity Guidelines for Installers and Manufacturers, published by the DTG (July 2001) www.dtg.org

[4] Used by a number of manufacturers under their own brand names (e.g. SmartLink, Q-Link, and EasyLink etc. Also known as P50, and sometimes referred to as nextTViewLink when describing VCR timer programming features.

The peritelevision connector consists of two elements: 1) a female socket on the equipment, permanently wired to the relevant circuits contained within the device; 2) a male plug located at the end of the cordset.

BS EN 50049-1 defines the types and related groups of signals: composite video, audio, primary colour and control. Levels and impedances together with tolerances are specified. It also covers the mechanical characteristics of the connectors, and the wiring of interconnection cordsets.

The interconnections are at baseband for video and audio, with low data rate digital control data signals.

Connections between the socket and plug use two rows of 10 contacts plus a metal shield contact.

The male connector consists of 20 spade-shaped contacts in an insulated block, surrounded by an almost rectangular metal shield in the form of a skirt that protrudes from a tapered (usually plastic) housing. The metal shield acts as a screen, and also as the 21st contact with the socket.

The manner in which the signals on the connector are processed within products incorporating SCART sockets is outside the scope of the standard.

The following sections give a commentary on the main features of the specifications, and offer recommendations for characteristics of an improved, secure SCART lead that could be included in a possible future benchmarking scheme.

2.1 Types of SCART lead

The connector fitted to equipment is always a female socket. Connections are therefore made using cordsets fitted at each end with a male SCART plug.

Five different types of lead are identified in the standard (referred to as ‘cordsets’) according to intended use, although other variants are also permitted:

Cordset type U (Universal). Identified by a black marking. This incorporates all the interconnections covered by the standard (i.e. all 21 contacts are connected).

Cordset type V (Video only). Identified by a white marking.

Cordset type C (Audio and composite video but not RGB). Identified by a grey marking.

Cordset type A (Audio only). Identified by a yellow marking.

Cordset type B (Data bus only). Identified by a green marking. This provides interconnection of contacts 10, 12, and 21 only.

In practice, colour coding is rarely used. Other types of cordset exist that comprise a SCART plug at one end, and a variety of other types of audio/video plugs at the other end (e.g. phono, S-video connectors, etc.).

2.1.1 Nature of the conductors

- **The conductors conveying video and audio signals should be of the individually screened type**

The conductors conveying video signals or equivalent, namely those connected between the pairs of contacts (19, 17), (20, 18), (11, 9), (7, 5), (16, 14) are specified as coaxial type 75 Ω characteristic impedance.

It has nevertheless been observed that some SCART cables do not use screened conductors for the video signals. This can result in visible patterning on the screen, particularly if composite video happens to be present on both the 'Video input' and 'Video output' conductors.

For example, the TV set SCART socket may provide composite video as received from the TV tuner, whilst the TV is displaying composite video input from an external device such as a VCR connected to it – in which case both signals may be present on the same SCART lead.

The conductors conveying audio signals are specified simply as screened cable type for audio frequencies (contacts 3, 1, 6, 2, 4). The impedance is not specified, but this is not an issue where typically short SCART leads are connected to equipment with high impedance audio inputs.

However, there is an ambiguity here in terms of screening requirements, and many SCART leads bundle all four audio signals (as two stereo pairs) within a single return screen, connected to contact 4.

As for composite video, there may be circumstances in which audio is present on both stereo pairs, in which case audible crosstalk may result. For example, it may be possible to hear TV sound in the background (from the SCART output from the television) set while playing back a recording on a VCR.

The AV.link specification refers to screened cable for each *pair* of contacts carrying audio.

The conductors conveying digital data (contacts 10, 12, 21) are also of the 'screened audio' type[5].

The connection corresponding to contact 8 is by means of a single insulated wire.

[5] It should be noted that the AV.link specification (see Ref. 3) has a different requirement for the conductor connected to contact 12, specified as of the 75 ohm coaxial type. No signals are currently carried on this conductor, and contact 12 remains reserved for future use.

- **There is no enforcement of the requirements given in the specifications**

While the standard does provide basic information on the types of conductor to be used, this provides no guarantee that all SCART leads conform to these requirements. It is left to individual manufacturers to choose what to implement.

- **Visual examination of a SCART lead is unlikely to be sufficient to determine which connections are available**

The cordset colour-coding scheme is rarely used. The consumer must rely on the packaging to describe the intended application.

Even if connectors are visible on the plug, this does not guarantee that the correct type of cable – or indeed any type of cable at all – has been connected.

There is no requirement for all 21 connections to be made – the standard allows for a variety of cordsets according to the application and commercial requirements. Table 2 of EN 50049-1 offers a complex list of essential and optional connections for various applications. The list dates from the days of analogue television, and does not include digital adapters.

- **A 'Digital Friendly SCART' lead should be fully wired**

In proposing a possible benchmarking scheme, it would seem sensible to concentrate on the providing the type of SCART lead that could be used in the greatest number of situations. Without doubt, this is the *fully wired* type. Among other reasons, this ensures that high quality RGB signals can be fed to the display, together with signals to select the correct aspect ratio. Also, use of AV.link requires a fully wired lead.

A possible counter-argument might be that there are cost savings in using SCART leads with only the minimum number of wired connections according to the application. For example, a manufacturer supplying a SCART lead with a particular device (e.g. VCR) is likely to seek the most cost effective product available at the time that is suitable for the purpose in hand.

However, it has become clear during the course of discussions with industry representatives that *the nature and number of the conductors have little, if any, impact on the cost*.

Rather, it is the volume of supply of the product that has the greatest effect on cost. Marketing factors often dominate in determining the price paid by the end consumer.

It is a matter for further debate as to whether a benchmarking scheme might encompass leads with a SCART plug at one end and other types of

connectors at the other end. However, these form a minority of SCART leads, and are used in specialist situations (such as connecting a domestic camcorder to a TV or VCR).

We favour the simplicity of a single type of benchmarked SCART lead, fully wired with a SCART plug at each end.

2.1.2 Testing

The quality of screened cable to be used is not currently specified. It should be noted that *all input and output signals may be present simultaneously*. Care must therefore be taken to avoid crosstalk between the various signals.

- **Crosstalk from other signals present within the lead should not be visible on pictures**

A commonly reported problem is spurious patterning visible on the picture.

A suitable measure of inter-channel crosstalk is outlined in the former ITC Handbook of Technical Standards (see Ref. 7).

- **For the purpose of achieving satisfactory screening in a SCART lead, it is proposed that the video crosstalk measured using the above technique should be no greater than -45 dB[6].**

A composite video blanking and sync waveform is applied to each video path under test, ensuring that it is correctly terminated. Each of the other video inputs would in turn be fed with 100% Colour Bars. The signal-to-crosstalk ratio is defined as the ratio, in decibels, of the normal peak-to-peak amplitude of the picture signal to the peak-to-peak amplitude of the crosstalk waveform. Noticeable audio crosstalk is less common but can occur where screened audio cable is not used. Arguably, the requirement for individually screened cables for conductors carrying audio signals should provide sufficient safeguard.

The case for additional requirements for conductors conveying video signals is not straightforward. Factors such as insertion loss (particularly at high frequencies) and return loss will affect the overall system quality. This will be influenced by the degree of screening around each SCART plug assembly as well as by the type of cable in the lead – and also as by the wiring of the sockets on equipment to which the SCART lead is connected.

In seeking to address the *principal* shortcomings of current SCART leads insofar as they impact on installation difficulties and service calls, it seems unlikely that further requirements and tests on the conductors of ‘Digital Friendly SCART’ leads will be of wide benefit. Discerning consumers will be

[6] A measure of crosstalk formerly applied by the IBA/ITC in assessing the performance of vision circuits, see Ref. 7.

prepared to seek out products, including SCART leads, of superior performance.

2.2 SCART plug construction and mechanical issues

Various problems have been reported arising from the construction of SCART plugs, the main ones being:

- Metal shield becomes distorted, or comes off
- Plastic hood becomes damaged or detached
- Wires become detached from pins
- SCART plug becomes detached from socket

Some earlier plugs have been known to be particularly lacking in physical robustness. There is no recognised locking mechanism, although a future locking mechanism is alluded to, but not described, in the AV.link specification.

2.2.1 Construction

The standards provide only minimal guidance on the overall physical construction of a SCART plug.

The near-rectangular metal shield of the plug (that also serves as contact 21, ground) is normally shaped from a single piece of metal.

- **Instead of the two ends abutting together in a straight line, shaping of the metal shield to form a simple interlocking mechanism reduces the likelihood of deformation.**

The join is usually in the middle of the shortest end of the plug, between pins 1 and 2, see Fig. 3. Traditionally, the two ends meet in a straight-line. If so, there may be little to prevent lateral movement of the screen when force is exerted on it, and it is possible for one end of the screen to become displaced. This movement can then make it difficult to re-insert the plug.

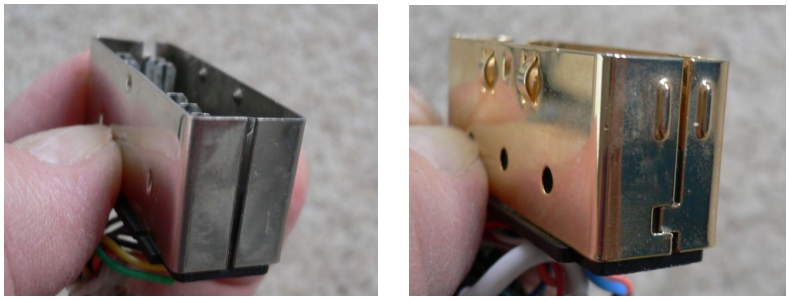


Fig. 3 – the metal shield of a standard SCART plug (left) and an example of shaping to improve robustness (right)

The metal shield makes snug contact with the surrounding insulating block that contains the male contacts. However, in some connectors, there can be displacement between the shield and the insulating block.

- **There should be interlocking indentations between the insulating block and the metal shield to ensure that the metal shield is held firmly in position**

Surrounding the shield is typically a one-piece plastic hood, as illustrated in Fig. 4. The specification indicates that the cable exit is angled[7]. The detailed construction of the hood is not specified.

Fig. 4 - A typical SCART plug

- **The metal screen and the hood should be designed to lock securely together. This can be achieved by means of simple notches and indentations.**

This prevents the hood from easily becoming detached from the metal screen, and possibly leading to damage to the inner cable assembly.

- **The locking ring around the cable at its entry point should grip the cable firmly**

The hood generally incorporates a screwthread and locking ring. This should grip the cable firmly. This avoids the situation where tugging on the cable can lead to stress on the male contact pins inside the insulating block assembly.

- **Use lead-free solder or crimp the conductors to attach them to the SCART plug connectors**

Wires from the cable have been known to detach from the metal spade connectors to which they are affixed. This is much less likely to happen if the cable is securely attached to the hood. Fortunately, the recent widespread introduction of silver lead-free solder[8] and the use of modern crimping techniques (that are also generally more cost effective) makes this much less of a problem than it used to be.

[7] Notwithstanding the template given in IEC 60807-9, a number of SCART leads from reputable sources use a different arrangement ribbon cable exiting at right angles to the plug.

[8] EU Directives 2002/96/EC on Waste Electrical and Electronic Equipment (the WEEE Directive) and 2002/95/EC on the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (the RoHS Directive) are due to come into effect by 1 July 2006.

The SCART plug shield includes three small latches on the inner side of the metal. These can be seen in Fig. 5 located between contacts 10 and 12 on one side, and between contacts 7 and 9, and 13 and 25 on the other side. Precise dimensions are not specified.

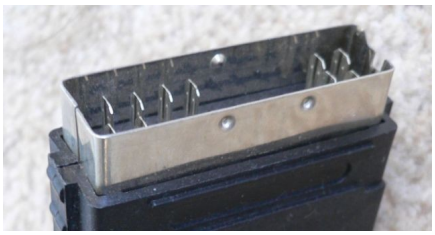


Fig. 5 - Detail of SCART plug shield showing the three latching indentations

These latches are intended to grip into the plastic insulating block of the female connector. Unfortunately, as the protrusions in the metal shield are generally small and rigid, they tend to have the effect of gouging a channel into the female connector.

After a small number of insertions and extractions, or if the cable is tugged sharply, the retention ability may be greatly reduced. This depends partly on how easily damaged is the plastic used in construction of the socket.

With millions of sockets fixed to existing equipment, the only scope for improvement of retention capability is in modifications to the plug.

- **The metal shield of the SCART plug should incorporate a latching mechanism to improve its retention capability when inserted into existing sockets**

A simple additional series of shaped metal notches (firm but incorporating some springiness) can grip the socket much more securely.

It is not the purpose of this report to seek to specify a single such mechanism, but examples of existing secure SCART plugs are shown in Fig. 6.

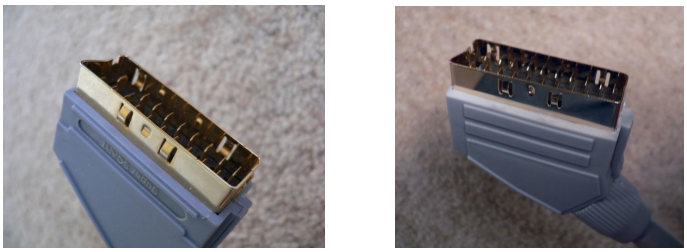


Fig. 6 - Examples of improved locking mechanisms in the shield of a secure SCART

Some SCART plugs use contact blades (pins) with small indentations to act as ‘stiffeners’ to further improve retention.

2.2.2 Insertion and withdrawal

Maximum insertion and withdrawal forces are specified in IEC 60807-9.

The ‘full connector’ test makes use of a ‘connector gauge’ – a reference device with 21 steel blades to simulate a set of SCART plug pins.

The full connector insertion and withdrawal test therefore in effect measures the ease of insertion of the plug, and the retention capability of the socket, when populated with a *full set of reference connector pins*.

The maximum insertion and withdrawal forces for the full connector are mentioned in two places in the standard, but with differing figures for maximum insertion force. It seems possible that one of these is a typographical error, even though the same figures appear in both the French and English language versions of the standard.

A retention force test is also specified for individual contacts. This checks the ability of an individual socket contact to support a reference pin.

A mechanical endurance test for a SCART plug and socket is also specified, and greatly exceeds the number of such insertion/withdrawal operations likely to be experienced over the lifetime of any individual SCART cable.

The testing described by the IEC is not mandatory, and it is unclear how many manufacturers actually use these particular tests.

The fact remains that practical experience shows that many current SCART leads are fairly easily dislodged. In particular, as described in Section 1.3.1, the shape of the standard plug, in which the cable emerges at angle, makes it prone to a leverage effect generated by even small movements of a stiff SCART cable. The tests referred to in the specifications do not check for this effect.

How much more secure should a Secure SCART be? When the AV.link locking mechanism is active, it is interesting to note that the AV.link specification leaves a new minimum requirement for extraction force to be finalised.

BSkyB carried out thorough investigations several years ago, resulting in modifications to the metal surround of the SCART plug supplied with BSkyB satellite receivers. The simple pass/fail test devised was whether the lead could support a BSkyB satellite set-top box.

The weight of set top boxes and other attached devices varies considerably: from about 0.5 kg to several kg for larger devices such as some VCRs and DVD recorders. The SCART lead is of course commonly attached to a much heavier television or display device.

2.2.3 A new retention test

Rather than specify particular retention mechanisms or locking devices, a simple test of retention effectiveness is proposed.

Individual manufactures would be free to decide how to implement the detailed design of a more secure SCART connector.

This proposed test is of the retention capability of the SCART socket/plug pair, making use of the leverage effect of the cable on the plug that is widely recognised a major source of difficulties.

The proposed test is illustrated in Fig. 7 and is described in more detail in Appendix 5.

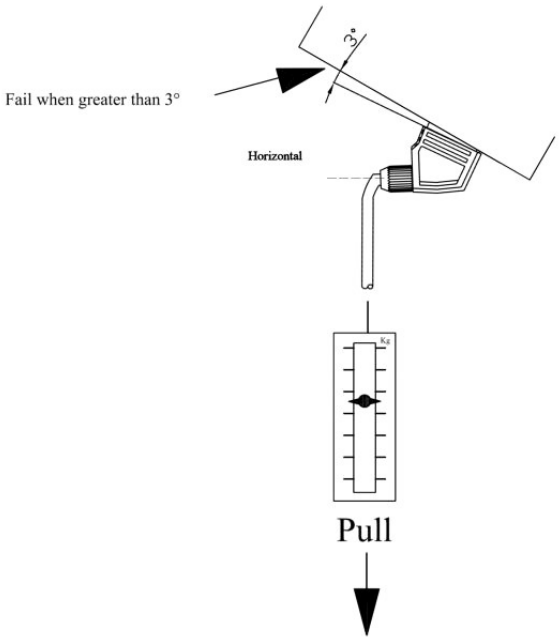


Fig. 7 - Outline of proposed new retention test

In conjunction with this test, the electrical integrity of all 21 connections must be maintained when the SCART plug is displaced by an angle of up to 3° from the socket.

- **It is essential to identify a generally acceptable SCART reference socket to use with a retention test, and the DTG should consult its members on how best to resolve this issue**.

The absence of a fully specified reference SCART socket (or ‘gauge’) is a major obstacle. Any form of retention testing of a SCART plug against a variety of real-world sockets is known to give results that *vary considerably*.

This aspect needs wider discussion. In reality, we have to accept the installed base of sockets attached to TVs and existing boxes of various types, which are known to vary in their retention capabilities.

3 Next steps to a ‘Digital Friendly SCART’ lead

This study has identified the characteristics of a ‘Digital Friendly SCART’ lead, including a physically more secure SCART plug. This should make it easier to install consumer equipment for digital switchover, and to reduce the likelihood of subsequent problems.

A pragmatic approach needs to be taken to identify a reference SCART socket in order for tests on SCART leads to be repeatable and meaningful.

While they have served well to reduce customer difficulties and service calls, secure SCART plugs could strictly speaking be said to depart slightly from the letter of current international specifications on their construction. It may be desirable to at least draw this to the attention of the appropriate standards bodies. However, there may be little general enthusiasm to engage in what could possibly turn out to be a lengthy process of revising these standards.

A related issue is that a more secure SCART plug might exceed the maximum insertion and extraction forces currently specified in testing the socket. While there has been no reported case of damage to equipment with a fixed SCART socket, caution in this respect is appropriate in developing a benchmarking scheme.

The benefits of an improved ‘Digital Friendly SCART’ would nevertheless seem to be substantial:

- Reduced consumer confusion
- Increased consumer confidence
- Reduced time for installation
- Fewer service calls

The essential features of a single type of ‘Digital Friendly SCART’ lead, with a SCART plug at each end, are summarised as follows:

- **A ‘Digital Friendly SCART’ lead should be fully wired.**

- **The conductors conveying video and audio signals should be of the individually screened type (see requirements proposed in Appendix 4).**

- **The SCART plug should be securely retained by the socket, meeting a proposed simple test of retention effectiveness (see Appendix 5).**

- **It is necessary to identify a generally acceptable SCART reference socket to use with a retention test, and the DTG should consult its members on how best to resolve this issue**.

- **For the purpose of achieving satisfactory screening in a SCART lead, video crosstalk should be no greater than -45 dB (see Ref. 7).**

Crosstalk from other signals present within the lead should not be visible on pictures.

The following guidelines apply to the construction of the SCART plug, in order to achieve a more robust assembly:

- **The two ends of the metal shield of the plug should form an interlocking mechanism to reduce the likelihood of deformation.**

- **There should be interlocking indentations between the insulating block and the metal shield to ensure that the metal shield is held firmly in position.**

- **The metal screen and the hood should be designed to lock securely together. This can be achieved by means of simple notches and indentations.**

- **Use lead-free solder or crimp the conductors to attach them to the SCART plug connectors.**

- **The locking ring around the cable at its entry point should grip the cable firmly.**

- **The metal shield of the SCART plug should incorporate a latching mechanism to improve its retention capability when inserted into existing sockets.**

We recommend that there should be wider industry consultation on these conclusions and recommendations before proceeding with development of a SCART lead benchmarking scheme.

APPENDICES

APPENDIX 1

REFERENCES

Standards

1. BS EN 50049-1:1997, *Domestic and similar electronic equipment interconnection requirements: Peritelevision connector (incorporating Amendment A1:1998)*

2. IEC 60807-9:1993, *Rectangular connectors for frequencies below 3 MHz Part 9: Detail specification for a range of Peritelevision connectors*

3. BS EN 50157-1, *Domestic and similar electronic equipment interconnection requirements: AV.link - Part 1: General*
   (see also *Part 2-1*, *Part 2-2*, *Part 2-3*: BS EN 50157-2-1, BS EN 50157-2-2, BS EN 50157-2-3)

Other references

4. Recorder Technology, report by the Digital TV Group for the Digital Action Plan (August 2003) www.digitaltelevision.gov.uk

5. Review of In-Home Networks, report by the Digital TV Group for the Digital Action Plan (April 2004) www.digitaltelevision.gov.uk

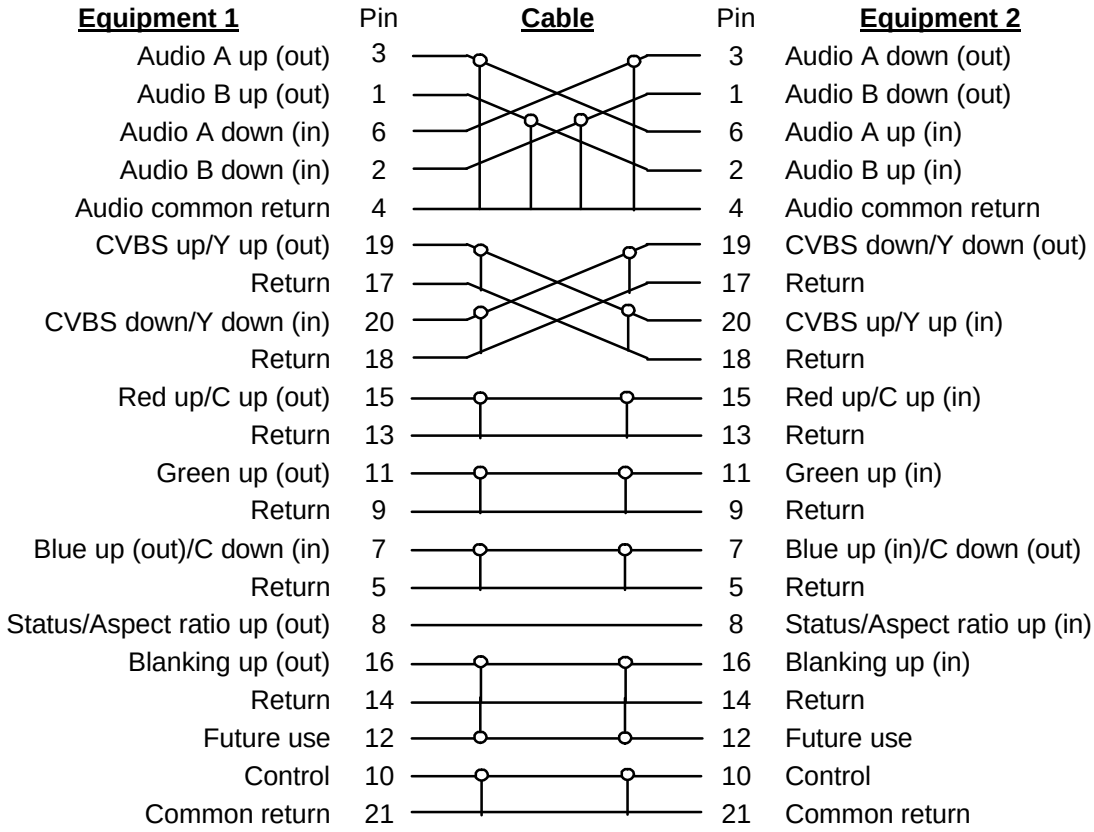
6. Connectivity Guidelines for Installers and Manufacturers, published by the DTG (July 2001) www.dtg.org.uk.

7. Handbook of Technical Standards for Television Programme Production, Issue 2.0 ITC (December 1996) http://www.ebu.ch/en/technical/publications/userguides/television_handbook.php

APPENDIX 2

INTERCONNECTION OF LEADS WITH SCART PLUGS AT EACH END

The diagram below shows the interconnecting SCART cable between two products and the signal connections on the products' SCART connectors.



(Source: DTG Connectivity Guidelines, see Ref. 6)

APPENDIX 3

SCART AND EUROPEAN DIRECTIVES

The Advanced Television Services Regulations 2003 (SI No.1901 and 2750) implement:

- Article 4(2) of Directive 2002/19/EC of the European Parliament and of the Council on access to, and interconnection of, electronic communications networks and associated facilities (O.J. No. L 108, 24.4.2002, p.7, “the Access Directive”), and

- Article 24 of and Annex VI to Directive 2002/22/EC of the European Parliament and of the Council on universal service and users’ rights relating to electronic communications networks and services (O.J. No. L 108, 24.4.2002, p.51, “the Universal Service Directive”).

The following are key extracts:

Regulation 6 *– All television sets with an analogue tuner and an integral viewing screen of visible diagonal greater than 42cm shall be fitted with at least one open interface socket, as standardised by a recognised European Standards Organisation e.g. as given in the CENELEC EN 50049-1:1997 standard (also known as Peritelevision or SCART) permitting simple connection of peripherals including additional decoders and digital receivers.*

Regulation 7 *– All television sets with an integrated decoder of digital television signals and an integral viewing screen of visible diagonal greater than 30 cm shall possess at least one open interface socket (conforming to an industry wide specification) e.g. the DVB common interface connector permitting both the simple connection of peripherals and able to pass all the elements of a digital television signal, including information relating to interactive and conditionally accessed services.*

Regulations 6 and 7 apply only to televisions placed on the market after the 25th July 2003. If the equipment was placed on the market before that date, it must comply with the requirements set out in the 1996 regulations.

The current regulations replace the earlier standards provided for in the Advanced Television Services Regulations 1996, which implemented Directive 95/47/EC of the European Parliament and of the Council on the use of standards for the transmission of television signals (O.J. No. L281, 23.11.95, p. 51).

APPENDIX 4

PROPOSED NEW REQUIREMENTS FOR CONDUCTORS

Round cable cordsets

Coaxial cable type, 75 ohm characteristic impedance: six individual cables (signal, return):

19, 17 20, 18 15, 13 11, 9 7, 5 16, 14

Screened cable type for audio frequencies: four individually screened cables with screens connected to contact 4

3, 4 1, 4 6, 4 2, 4

Screened cable type for audio frequencies, screens connected to contact 21:

10, 21 12, 21

Single insulated wire:

8

Contact 21 is connected to the plug shield and, in the case of round leads, to an overall common screen.

In all cases, a conductor must be connected from connection 21 at one end of the lead to connection 21 at the other end.

Ribbon leads

Ribbon leads comprising individually screened cables have been noted to follow conventions that differ slightly from the specification. This makes it easier during manufacture to connect the inner and outer conductors of each of the adjacent screened cables to conveniently located pins on the connector. Differences have been observed as follows (signal, return):

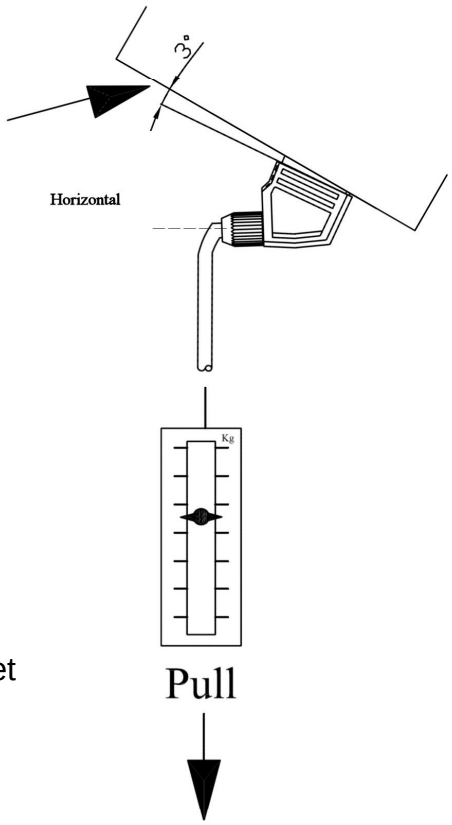
20, 17 16, 18 12, 14 8, 10

For other connections, the same rules should apply as for round leads.

APPENDIX 5

PROPOSED SECURE SCART RETENTION TEST

This is designed as a Pass / Fail test to determine whether a connected SCART lead is sufficiently secure.



Insert the SCART lead into a SCART socket.

Attach a pull gauge to the cable 25 cm from the entrance to the plug.

Position the assembly so that the cable exits the SCART Plug horizontally below the socket. (In the case of a flat ribbon lead, the socket is positioned as it would have been for a standard SCART plug.)

Apply downwards force of 5 N to the cable. Pass if the plug is still attached to the socket, but fail if the angle between the plug and socket is greater than 3°.

Repeat the above on three SCART samples.

Choose one of the samples and insert and extract 20 times and then repeat the test.

Note:

- The Hood must remain in place
- There must be no visible damage to the plug or to the socket
- The electrical integrity of all 21 connections must be maintained when the SCART plug is displaced by an angle of up to 3°

APPENDIX 6

ACKNOWLEDGEMENTS

The authors wish to thank the following individuals and companies for their kind cooperation and assistance:

Gary Flynn, GFI Cables Ltd
David Holliday, BSkyB
Jeremy Kennedy, Solutions Group plc
Nick Shepherd, Philips
David Woolgar, Philips