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CT64 CABLE TESTER

Universal cable testing equipment.



OPERATOR'S MANUAL & PROGRAMMING GUIDE

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SECTION 1 - INTRODUCTION

1.1 - Introduction

Congratulations on your purchase of the CT64 Cable Tester. This sophisticated piece of test equipment will enable you to test cables and wiring looms in a fraction of the time that it would take to test manually.

The CT64 will test most cables against user-programmed definitions in a fraction of a second, and will clearly identify any faults found. Short circuits and open circuits are easily detected and shown on the LCD screen with the names of the contacts involved, this makes rectification of the fault quick and easy.

The CT64 can easily be configured for testing new cables by the end-user. Details are provided in this manual for creating cable adaptors, and writing cable definitions using the easy-to-use application software.

In the box, you will have received:

- CT64 Cable Tester
- 9V DC Power supply
- Serial Lead (9W plug to 9W socket)
- Commoning lead (eyelet to eyelet)
- CD-ROM containing software
- Parts checklist

Depending on your order, you may also have received one or more cable adaptors.

If any of these items are missing, consult your distributor immediately.

1.2 - Disclaimer

SMR Electronics Limited accepts no responsibility for damage caused directly or indirectly to any cabling or equipment connected to the CT64 Cable Tester, whether used correctly or not.

No liability will be accepted by SMR Electronics Limited for failure of equipment (whether belonging to customer or not) caused by incorrect test results provided by the CT64 Cable Tester due to unforeseen malfunction.

The CT64 Cable Tester must not be used as the only means of testing cables or harnesses where personal injury or death may be expected to result directly or indirectly from the failure of the cable or harness.

1.3 - Safety In Operation

This section highlights safety issues only, and is not intended as a substitute for reading the relevant sections in the manual.

The CT64 Cable Tester is intended for indoor use only. It must not be used in damp, or excessively dusty environments otherwise internal damage and malfunction may occur.

The CT64 Cable Tester is a low-voltage appliance, and must only be used with the supplied 9V DC adaptor. If the adaptor is not suitable for the wall socket or voltage in your country then please consult your supplier.

The DIN41612 connector (cable test adaptor connector) must only be connected to an appropriate adaptor, and the adaptor connected to a cable to test. **You must ensure that the cable to be tested is never connected to the CT64 Cable Tester while simultaneously connected to any other equipment.**

Do not apply external voltages to the DIN41612 connector, otherwise the CT64 Cable Tester may be damaged. Do not connect the DIN41612 connector to external circuitry, otherwise damage may occur to this circuitry.

The serial ports on the CT64 Cable Tester conform to the RS232 specification, and use three-wire communications (pins 2,3 & 5). They must only be connected to an equivalent serial port (COM port) on a host computer, or to other CT64 Cable Testers. All connections must only be made using the included serial lead (one supplied with each CT64).

1.4 Warranty

The CT64 Cable Tester and supplied accessories are guaranteed against manufacturing defects for a period of one year from the date of purchase. This does not include physical damage caused by abuse or misuse of the product.

In the event of failure, please contact your distributor or SMR Electronics Limited for authorisation of return. We will repair or replace (at our discretion) the faulty equipment and return it to you. Replacement units may be refurbished.

See the PRODUCT SUPPORT section for contact details.

Certain consumable items (batteries, printer ribbons etc.) are not included in the warranty.

This warranty will only extend to the equipment supplied by SMR Electronics Limited at the time of purchase. No third party equipment will be covered.

The warranty is not transferable.

This warranty does not affect your statutory rights.

SECTION 2 – OPERATOR'S MANUAL

See section 3 (Programming Guide) for details on programming the CT64.

2.1 – Set up & Controls

To set the CT64 Cable Tester up for normal use, you will require the following:

- CT64 Cable Tester, pre-loaded with the appropriate cable definition.
- 9V DC plug-top power supply (included with CT64).
- Cable adaptor, suitable for the cables to be tested.

NOTE: A computer is not required for normal testing.

Connect the cable adaptor to the CT64. Connect the power supply to the CT64, and to the mains supply. The CT64 will power-up and beep.



1. Power input, for 9V DC plug-top power supply.
2. Master serial port, for connecting to other CT64s (linked mode).

3. Slave serial port, for connecting from other CT64s (linked mode).
4. Commoning point (linked mode).
5. Status LEDs, indicating progress through test.
6. Liquid Crystal Display (LCD)
7. Select buttons, for selecting a cable type to test.
8. Test button.
9. Cable adaptor connector (DIN41612).
10. LCD contrast adjust (on underside of unit).

2.2 – Testing A Cable

To test a cable, first use the up / down 'SELECT' buttons until the required cable is displayed on the LCD. Normal convention is for the first line to show the name of the cable, and the second line to show the cable adaptor that will be required, although this will be dependant on how the CT64 has been programmed.

The choice of cable will be stored in non-volatile memory after the test has been run for the first time. The CT64 will default to this cable the next time it is turned on.

Next, connect the cable which is to be tested to the adaptor (which should already be connected to the CT64). **You must ensure that the cable to be tested is never connected to the CT64 Cable Tester while simultaneously connected to any other equipment.**

Press the 'TEST' button to run the test. The amber LED will illuminate, and the CT64 will begin to run the test. After a short time, one of the following will happen:

TEST PASS

The amber LED will extinguish, and the green LED will light. The CT64 will show the 'PASS' message, and play the 'PASS' tone (both of which are configured by the programmer of the cable definition file, so may vary). This ends the test.

TEST FAIL

The red LED will light (the amber LED will stay lit, as the test is not yet complete at this stage). The CT64 will beep and display the nature of the fault, which will be one of two types:

- a IS SHORTED TO b – two contacts are linked together that shouldn't be.
- a NOT CONNECTED TO b – two contacts should be linked, but aren't.

Where 'a' and 'b' refer to the contacts in a connector. These will have been given appropriate names by the programmer of the cable definition file to simplify location of the fault.

At this stage, the test can either be continued or aborted.

To continue the test and check for further faults, press the 'TEST' button again. However, it should be remembered that depending on the way the cable definition file is written, further faults may actually be the same one detected again. For example, 'PIN A IS SHORTED TO PIN B' is obviously the same fault as 'PIN B IS SHORTED TO PIN A'. The 'TEST' button can be pressed repeatedly until the end of the test is reached.

To abort the test after a fault is detected, press either of the 'SELECT' buttons. This will end the test immediately and show the 'FAIL' message and play the 'FAIL' tone.

END OF TEST

At the end of the test, the amber LED will extinguish, and either the green LED will be lit (test passed), or the red LED will be lit (test failed), along with the pass or fail message on the LCD.

In addition, after the first test has been run, the total number of tests passed (indicated by a tick), and tests failed (indicated by a cross) will be shown at the bottom of the screen. These counts are reset if a the cable selection is changed, or if the power is disconnected.

The cable can now be disconnected from the adaptor and dealt with accordingly. The CT64 is ready to perform the next test.

If no keys are pressed, after ten seconds, the LED will extinguish, and the CT64 will go back to displaying the name of the cable. The pass & fail counts will remain at the bottom of the screen.

CONTINUOUS TEST

Sometimes it may be desirable to repeatedly run a test on the same cable. This frees the operator to pull or twist the cable or connectors in an attempt to force an intermittent fault to show up. This is often known as a 'wiggle test' for obvious reasons!

To start a continuous test, press and hold the 'TEST' button until the test has completed for the first time. The button may then be released, and testing will continue repeatedly until one of the following occurs:

- Any fault is detected – this will stop the continuous test.
- The 'TEST' button is pressed again to abort the continuous test.

The pass count at the bottom of the screen will be incremented while the continuous test is running.

2.3 – Learning A New Cable

The CT64 Cable Tester has the ability to learn a cable, and create its own new cable definition. This feature may be used when a 'known-good' cable is available, and a number of other cables need to be checked against it.

To use the learn mode, first use the up / down select buttons until 'LEARN NEW CABLE' is displayed on the screen. This is not a cable definition which has been loaded into the CT64, but a function to generate a new cable definition.

Next, ensure that a suitable cable adaptor is connected to the CT64, and connect the 'known-good' cable to the adaptor.

Press the 'TEST' button. This will learn the cable, and create a cable definition for it. The CT64 will then automatically select this new cable and run a verification test on it. The new cable definition will be named as LEARN nnnn, where 'nnnn' is the next available number, and starts from 0001.

LIMITATIONS

- Name of cable definition does not obviously identify cable, being simply 'LEARN 0001'
- Contact names are not known, and are assigned as PIN 01 to PIN 64 by default.
- User-defined pass and fail messages and tones cannot be created.
- Test is slower than if it was specifically written, due to the learn function assuming that all 64 contacts are used in the cable (where in reality there may be far less).
- Linked-mode (for cables with more that 64 contacts) cannot be used with the learn function.

To get around many of these limitations, it is possible to transfer the newly learnt cable definition to a host PC, edit the file, and transfer it back to the CT64. Please see section 3 (programming guide) for more information.

2.4 – Linked Mode Operation

Linked mode enables the 64-contact limitation to be expanded to allow testing of cables with up to 512 contacts. This is accomplished by linking two of more CT64s together, up to a maximum of 8 units (64 x 8 = 512 contacts).

To set up for linked mode testing, the following equipment will be required:

- CT64 Cable Tester containing appropriate cable definition (master unit)
- One or more further CT64s (as required) which do not need to be loaded with the cable definition file for the cable being tested (slave units).
- Power supplies for all CT64s
- Serial lead for each slave unit, one less than the total number of CT64s.
- Commoning lead for each slave unit, one less than the total number of CT64s.
- Multiple – CT64 cable adaptor(s) for cable to be tested.

Connect a serial lead from the MASTER serial port on the first (master) CT64 to the SLAVE serial port on the second (slave) CT64.

Repeat this operation until all CT64s have been linked together. The MASTER serial port on the last CT64 will not be connected to anything.

Attach commoning leads to the stud on the back of the CT64s until they are all linked together. This is important to ensure that the serial lead is not used as the ground return which may cause erratic operation.



Connect the cable adaptor(s) to all CT64s in the correct sequence. This is important as the pin numbering for the slave units will be offset from the usual 1-64 as the chain of units is progressed:

1. Master unit ..... Pins 1 - 64
2. First slave unit ..... Pins 65 - 128
3. Second slave unit (if used) ..... Pins 129 - 192
4. Third slave unit (if used) ..... Pins 193 - 256
5. Fourth slave unit (if used) ..... Pins 257 - 320
6. Fifth slave unit (if used) ..... Pins 321 - 384
7. Sixth slave unit (if used) ..... Pins 385 - 448
8. Last slave unit (if used) ..... Pins 449 - 512

Connect power to all units. All operation is conducted using the master unit, and no interaction with the slave unit(s) is required.

Select the appropriate cable to test on the master unit. The lower half of the screen will indicate the number of additional CT64s required for the test.

Run the test as normal (please refer to section 2.2). Due to the additional number of contacts, and the time taken for the communications between the CT64s, the test will take longer than tests conducted without using linked mode.

2.5 – Printing

NOTE: At this time, the report printer is not available from SMR Electronics Limited.

The report printer (optional extra) may be used to print failure reports for cables tested. When enabled, a report is printed showing all the faults in a cable under test, and the CT64 goes directly to the PASS or FAIL screen without stepping through the faults one by one. No report is printed if a cable passes the test.

To print reports, the following equipment will be required:

- CT64 (or multiple CT64s if using linked mode) set up ready for testing.
- CT64 Report printer
- CT64 Printer lead (supplied with printer)
- Printer power supply / battery charger (supplied with printer)

The printer must be connected to the SLAVE serial port of the CT64 (or the SLAVE serial port of the master CT64 when using linked mode).

Ensure the printer is loaded with paper, and press the '1' button to turn it on. For information regarding changing the paper or ribbon in the printer, please refer to the manual supplied with the printer.

The printer should already be correctly configured correctly. If you experience problems, please refer to the end of this section for the default printer settings.

To enable printing on the CT64, you will need to enter the printer set up menu by pressing both SELECT buttons simultaneously. Now press either SELECT button to enable the printing of failure reports. Press 'TEST' to exit the printer set up menu.

The state of this setting is stored in non-volatile memory, and is remembered even if the power is turned off. It will be necessary to disable the printing of failure reports if the printer is not to be used anymore.

Next, run the test as normal (please refer to section 2.2). If a fault is detected, a report will be printed showing all faults. This will be in the following format:

```
SMR ELECTRONICS LTD
CT64 CABLE TESTER

FAILURE REPORT:

CABLE NAME:    <name of cable>
CABLE ADAPTOR: <name of adaptor>

PIN 1            PIN 2            SHORTED
PIN 3            PIN 4            OPEN

END OF REPORT
```

'CABLE NAME' and 'CABLE ADAPTOR' are the description of the cable shown on the first two lines of the LCD when the cable is selected.

Contact names are provided by cable definition file, and will clearly indicate the location of the fault. In this example PIN 1 – 4 have been used for simplicity.

The two faults in this example are the only two types which can occur:

- SHORTED – PIN 1 should not be connected to PIN 2, so the fact that it is constitutes a fault.
- OPEN – PIN 3 should be connected to PIN 4, but a fault is generated because it is open circuit.

All faults found in the cable will be listed in a single report. This would typically be torn off the printer, and sent with the faulty cable to the repair or rework department to aid in rectification of the fault.

PRINTER DEFAULT SETTINGS

To access or edit settings, please refer to the manual supplied with the printer.

```
Data bits :-    8
Parity    :-    None
Baud-rate :-    1200
Country   :-    U.K.
Print mode:-    Text
Auto-off  :-    5 Min.
Emulation :-    FKI
DTR       :-    Normal
```

```
Interface :-    Serial
Mechanism :-    M183
```

SECTION 3 – PROGRAMMING GUIDE

3.1 – Host Software Installation

To create and edit cable definition files, it is necessary to install the application software on a host PC. The minimum requirement for this computer is as follows:

- IBM PC or 100% compatible computer.
- Pentium 200MHz or better processor.
- 32MB RAM minimum.
- Microsoft Windows 98 or later.
- SVGA (800x600) 16-bit or higher screen resolution.
- CD-ROM drive.
- Serial port (COM port) with 9-way connector (USB COM ports are NOT recommended).

Please ensure that all other applications are closed before beginning the installation.

Insert the CT64 application disc in your CD-ROM drive. If installation does not begin automatically, click on the 'Start' button, and then click 'Run'. Type 'D:\setup.exe' and press return (where 'D' is the letter corresponding to your CD-ROM drive).

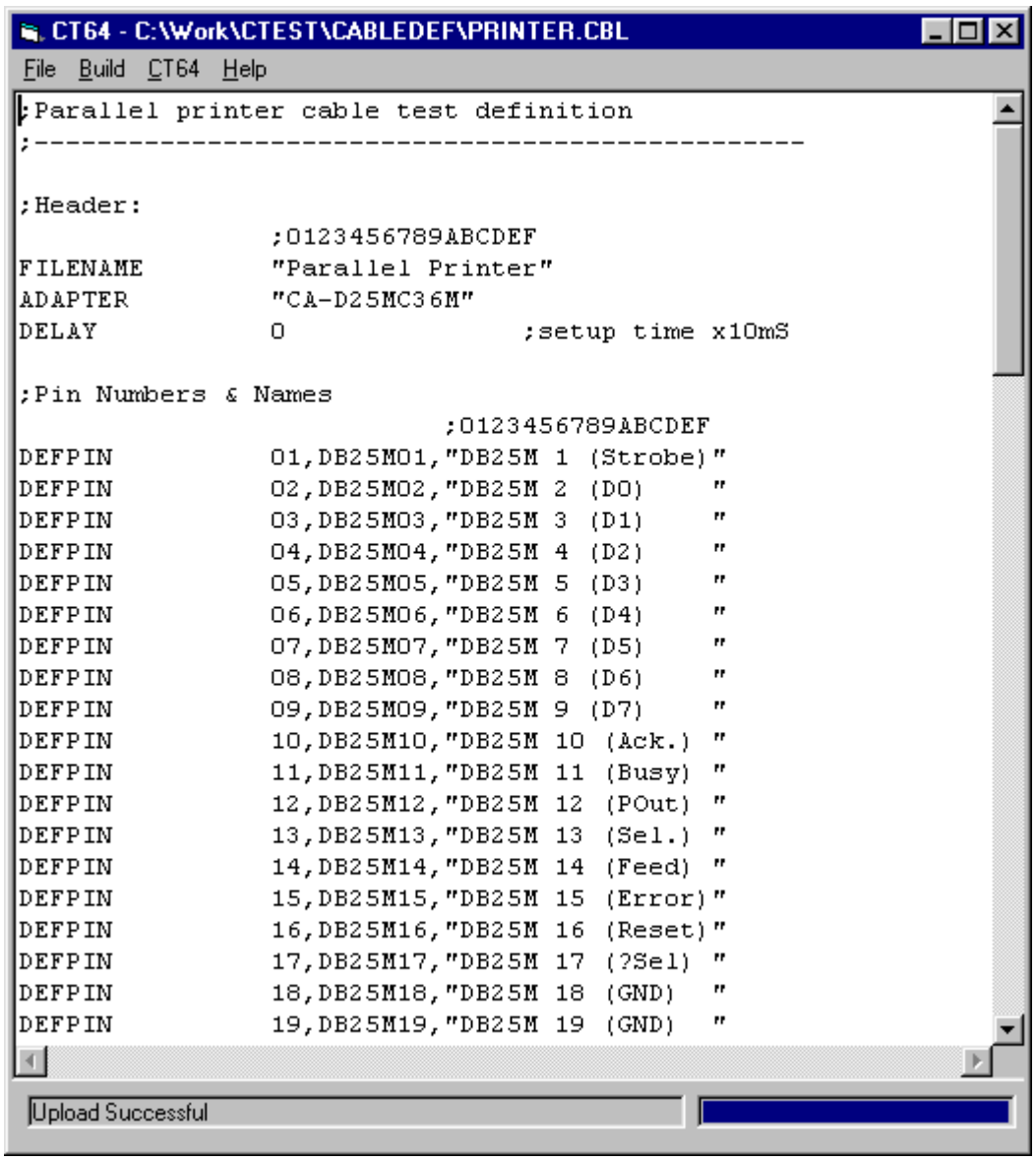
Follow the on-screen instructions, and installation will complete automatically.

To run the application, click on the 'Start' button, 'Programs', 'SMR Electronics', and then 'CT64 Host Application'. For information on creating a desktop shortcut, please refer to your Microsoft Windows manual.

3.2 – Using The Host Software

Upon launching the application, you will be presented with a blank window. This can be thought of as a simple text editor, similar to Microsoft Notepad.

Please refer to section 3.5 (Step-by-Step example) for a tutorial on using the host software.



FILE MENU:

- Open – Load an existing cable definition (.CBL).
- Save – Save the current cable definition.
- Save As – Save the current cable definition under a new name.
- Close – Close the current cable definition, and clear the screen.
- Exit – Quit the application.

BUILD MENU:

- Build File – The current cable definition file will be compiled, ready to send to the CT64 Cable Tester.
- Generate Listing Files – When checked, this will cause a listing file (.LST) to be generated and saved in the same folder as the master .CBL file. The listing file provides detailed information of how the test will be conducted, and can be loaded into Microsoft Notepad, or any word processor.
- Generate S-Records – When checked, this will cause a Motorola S-Record (.MX) to be generated and saved in the same folder as the master .CBL file. The S-Record is the compiled data file that is sent to the CT64.

CT64 MENU:

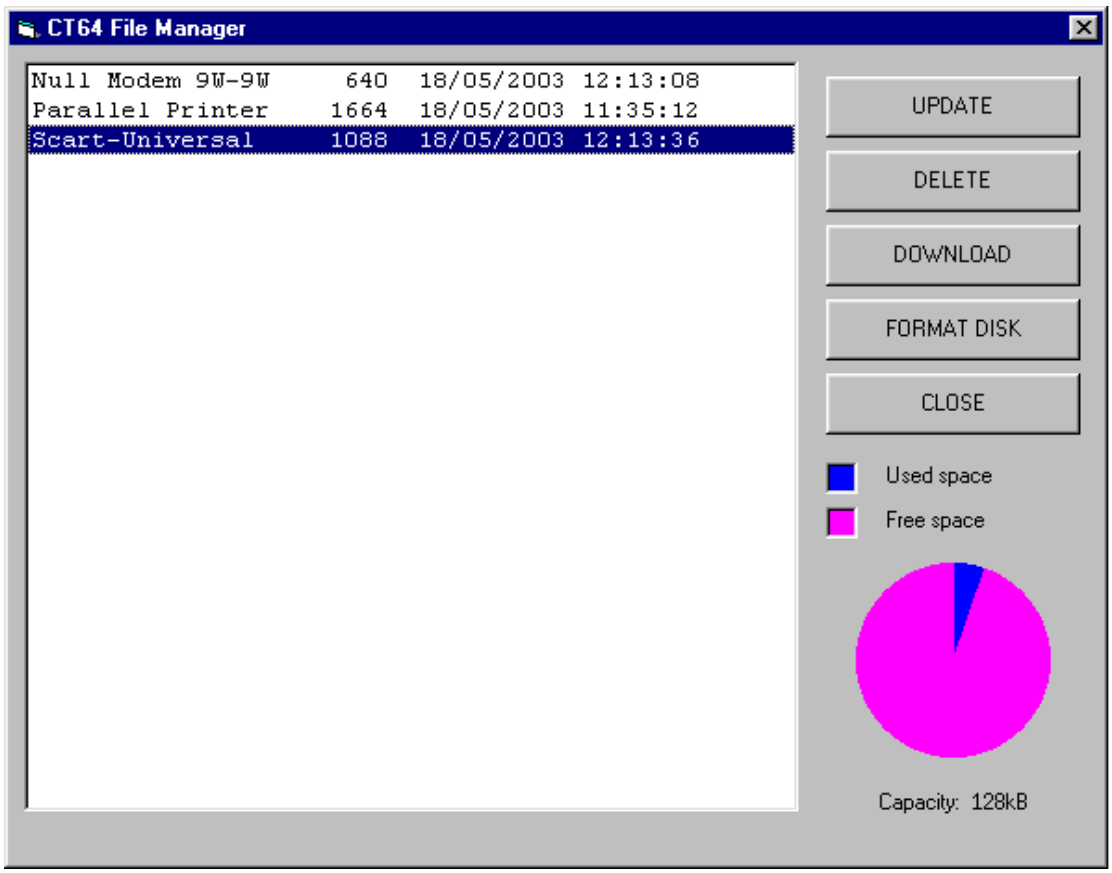
- Upload File – Transfer the current cable definition to the CT64. The definition will be compiled if not already done so using 'Build File'.
- File Manager – Opens the file manager (see below).
- COM Port – Allows selection of the COM port for communication with the CT64.

HELP MENU:

- About – Provides details about the application.

FILE MANAGER

Selected from the CT64 menu, this is used to view and maintain the cable definition files on the CT64 Cable Tester.



When opened, the File Manager will display a list of the cable definitions on the CT64. The buttons perform the following functions:

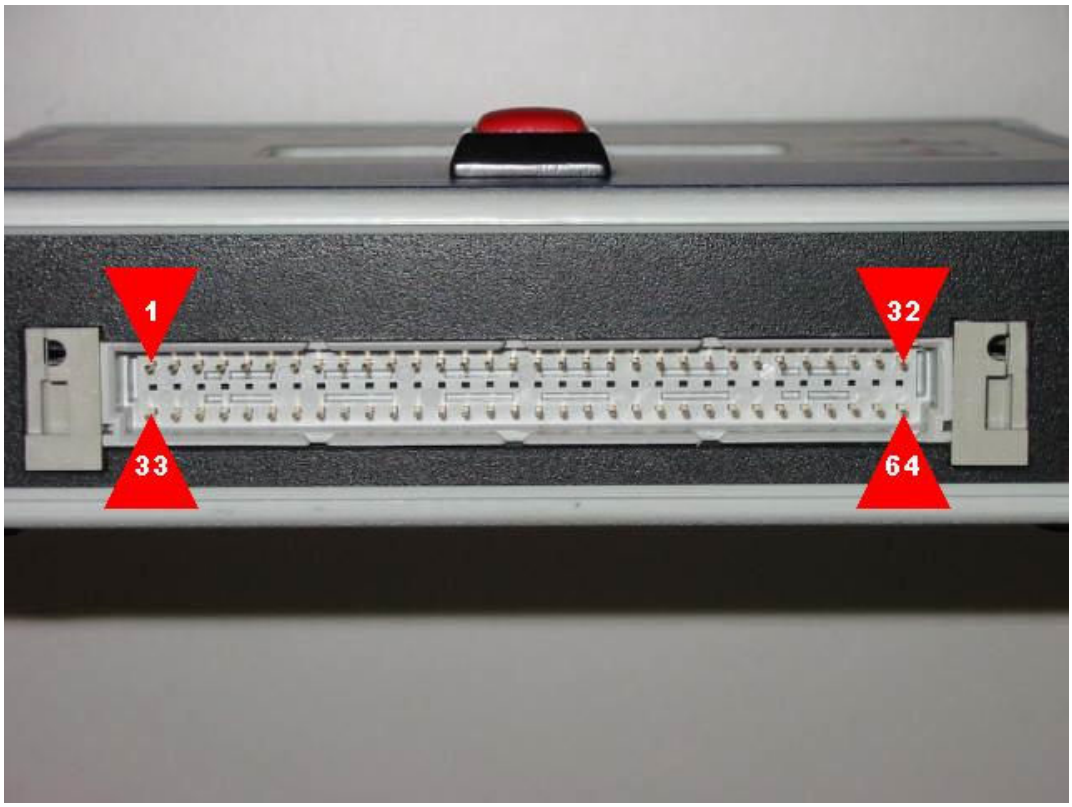
- Update – Refresh the list of files. This would need to be done if a new cable definition was uploaded from the Application while the File Manager screen was open.
- Delete – Permanently delete the selected file from the CT64.
- Download – Transfer the selected file from the CT64 to the Host Application. This is particularly useful for editing or saving files created using the Learn mode. When used to download files originally uploaded by the application, it should be noted that any comments will have been lost.
- Format Disk – Erase ALL files from the CT64 Cable Tester's internal memory disk, and re-generate the file system. This is required if the amount of memory is changed, or the disk becomes corrupt.
- Close – Close the File Manager screen (but not the Application).

In addition, a simple pie-chart is provided to indicate the approximate amount of disk space used.

3.3 – Adaptors

Before writing a cable definition file, it is important to understand how the adaptor is used to interface the CT64 Cable Tester to the cable under test.

The Cable Adaptor connector (DIN41612) has 64 pins, these are all identical in function, and are numerically identified as follows:



Each contact of the cable to be tested will be connected to one of these pins, and it is essential to know the sequence. Normal procedure is to start at pin 1 of the DIN41612 connector, and wire 1-to-1 to the first of the test connectors. The shield is also connected, so if the first connector was to be a 25 way D-type socket, pins 1-26 would be used (with pin 26 being connected to the shield). The second test connector would then be wired in the same fashion. If this was to be a 36 way centronics socket (36 pins, plus shield, equals 37 pins used), then it would connect to pins 27 to 63 of the DIN41612 connector.

It is advisable to document the connection details, and several examples are provided in the ADAPTORS folder of the CD-ROM. The naming convention for the adaptor (and for the associated documentation file) is "CA-" followed by abbreviated names

of the MATING connectors (NOT the actual connectors used). The adaptor described above would be "CA-D25MC36M" (Cable Adaptor for D-type 25 way Male and Centronics 36 way Male), and would be used for testing printer leads.

3.4 – Writing A Cable Definition

The structure of a Cable Definition file consists of four sections. These are designated by the commands which they contain, but additionally, the following can be used anywhere in the file:

- Comment – Any occurrence of a semicolon ';' will designate that the rest of the line is a comment, and will be ignored by the compiler.
- White space – Blank lines may be included anywhere in the text to improve readability. Additionally, at least one space must be included after a command to separate it from its arguments.

HEADER:

This comes first in the file (after any comments regarding the author, cable description etc). The header will contain the following commands:

- `FILENAME  "Name of file"`
- `ADAPTOR  "Name of adaptor"`
- `DELAY  0`

'Filename' describes the cable, and will be the name shown on the top line of the CT64 screen when selecting the cable. It will also be the name used by the File Manager. The maximum length is 16 characters, and longer text will be truncated.

'Adaptor' specifies the name of the adaptor required for the cable, it will be displayed on the second line of the CT64 screen. The maximum length is 16 characters, and longer text will be truncated.

'Delay' defines how long each pin should be driven before all pins are sampled during the test. It is set in multiples of 10mS (approx), and for most applications can be set to zero or omitted.

CONTACT DEFINITIONS:

This section describes the way the adaptor connects to the cable under test. It does not contain any information regarding how the test should be performed. There is only one command type used in this section:

- `DEFPIN n,mnemonic,"Contact Name"`

One 'DefPin' (Define Pin) command is required for each contact used within the adaptor. It details what the specified pin on the Cable Adaptor (DIN41612) connector is used for.

'n' specifies the number of the pin on the Cable Adaptor (DIN41612) connector. It will typically start from 1, and may go as high as 64 (or 512 if linked mode is to be used).

'mnemonic' describes a short name that will be used to refer to the pin in the next section (connection details).

"Contact Name" is the text that will be used on the CT64 screen to refer to faults relating to the specified contact. The maximum length is 16 characters, and longer text will be truncated.

CONNECTION DETAILS

When a cable is tested, there are three possible relationships between a pair of pins:

- Must be connected together (otherwise there's an 'open circuit' fault).
- Must not be connected together (otherwise there's a 'short circuit' fault).
- May be connected together (does not constitute a fault either way).

There are two commands used in this section which cater for all possibilities:

- `MUSTCONN a,b,c,n`
- `MAYCONN a,b,c,n`

Where 'a', 'b', 'c' etc. are mnemonics referring to any number of contacts to be included in the test.

Contacts grouped in a 'MustConn' (Must Connect) command must be connected together, otherwise an 'open circuit' fault will occur.

Contacts grouped in a 'MayConn' (May Connect) command may, or may not be connected together, a fault will not occur either way.

Contacts not specifies either as 'MustConn' or 'MayConn' are automatically categorized as being 'Must Not Connect', and will cause a failure if they are connected.

TEST COMPLETION

This section describes what to do at the end of a test, whether passed or failed. To ensure that an operator does not miss one failure in a large batch of otherwise ok cables, it is possible to add customised 'PASS' and 'FAIL' messages and tones which can be more attention-grabbing.

All commands in this section are optional, and may be omitted. The default text is simply 'PASS' and 'FAIL', and the default tone is C2 at 800mS for a pass, and G1 at 1200mS for a fail.

- `PASSTEXT  "pass message"`
- `FAILTEXT  "fail message"`
- `TEMPO     n`
- `PASSTONE  a,b,c,n`
- `FAILTONE  a,b,c,n`

'PassText' and 'FailText' define the message shown on the CT64 screen when a cable passes or fails a test. The maximum length is 16 characters, and longer text will be truncated.

'Tempo' defines the speed to play the following tone or tune, and is typically 40-200.

'PassTone' and 'FailTone' are used to define the tone (or sequence of tones, making up a tune) that will be played on pass or fail. If either command is repeated on different lines, all the tones will be joined together to make one long tune.

The format for a tone (a,b,c,etc.) is speed, followed by frequency, and delimited using commas or spaces.

Speed may be one of the following: 1, 2, 4, 8, 16, 32, 64, etc. and specifies the fraction of a full tone length (1, ½, ¼, etc). The speed may be followed by a dot '.', which will extend the length by 50%.

Frequency is in the format of musical note, followed by octave. One octave consists of the notes: c, c#, d, d#, e, f, f#, g, g#, a, a#, b. The CT64 supports notes from a#0 (lowest) to a#4 (highest).

For example, '2a#0' will play a half-length lowest tone, '4.c3' will play a 3/8 length middle C.

This format is directly compatible with the Nokia Composer format for which mobile phone 'ringtones' are available, and may be 'copy & pasted' into the application window.

3.5 – Step-by-Step Example

This section provides a complete guide to designing a cable adaptor, and writing a cable definition file. The cable that has been selected for this example is a SCART lead, commonly used for interconnections in consumer AV applications.

DESIGNING THE ADAPTOR

The SCART plug is a 21-pin connector (20 pins plus shield ground). The adaptor will require two mating SCART line sockets, totalling 42 pins used. The first SCART socket will connect to pins 1-21 of the CT64 cable adaptor (DIN41612) connector and be designated 'A'. The second SCART socket connects to pins 22-42 and is designated 'B'. The adaptor will be named 'CA-2SCM'.

This adaptor is described in the file ADAPTORS\CA-2SCM.txt on the CD-ROM.

WRITING THE CABLE DEFINITION

First, we need to write the header. This is simply:

```
;Header:
                ;0123456789ABCDEF
FILENAME        "Scart-Composite"
ADAPTOR         "CA-2SCM"
```

The purpose of the comment containing '0123456789ABCDEF' is to check that the length of the text does not exceed the 16 character limit.

Note that this definition file is for testing type 'C' (composite video & audio) cables, but it will be written so that type 'U' (universal) cables will also pass.

Next, the contacts must be defined. This information comes from the way the adaptor is designed:

```
;Contacts:
```

```
                          ;0123456789ABCDEF
DEFPIN          01,SCA01,"SC-A 1 AUD.OUT B"
DEFPIN           02,SCA02,"SC-A 2 AUD.IN B "
DEFPIN           03,SCA03,"SC-A 3 AUD.OUT A"
DEFPIN           04,SCA04,"SC-A 4 AUDIO GND"
DEFPIN           05,SCA05,"SC-A 5 BLUE GND "
DEFPIN           06,SCA06,"SC-A 6 AUD.IN A "
DEFPIN           07,SCA07,"SC-A 7 BLUE     "
DEFPIN           08,SCA08,"SC-A 8 FUNC.SW. "
DEFPIN           09,SCA09,"SC-A 9 GREEN GND"
DEFPIN           10,SCA10,"SC-A 10 COM.LN.2"
DEFPIN           11,SCA11,"SC-A 11 GREEN   "
DEFPIN           12,SCA12,"SC-A 12 COM.LN.1"
DEFPIN           13,SCA13,"SC-A 13 RED GND "
DEFPIN           14,SCA14,"SC-A 14 COM.GND "
DEFPIN           15,SCA15,"SC-A 15 RED     "
DEFPIN           16,SCA16,"SC-A 16 BLANKING"
DEFPIN           17,SCA17,"SC-A 17 VID.GND "
DEFPIN           18,SCA18,"SC-A 18 BLK.GND "
DEFPIN           19,SCA19,"SC-A 19 VID.OUT "
DEFPIN           20,SCA20,"SC-A 20 VID.IN  "
DEFPIN           21,SCA21,"SC-A 21 SHIELD  "

DEFPIN           22,SCB01,"SC-B 1 AUD.OUT B"
DEFPIN           23,SCB02,"SC-B 2 AUD.IN B "
DEFPIN           24,SCB03,"SC-B 3 AUD.OUT A"
DEFPIN           25,SCB04,"SC-B 4 AUDIO GND"
DEFPIN           26,SCB05,"SC-B 5 BLUE GND "
DEFPIN           27,SCB06,"SC-B 6 AUD.IN A "
DEFPIN           28,SCB07,"SC-B 7 BLUE     "
DEFPIN           29,SCB08,"SC-B 8 FUNC.SW. "
DEFPIN           30,SCB09,"SC-B 9 GREEN GND"
DEFPIN           31,SCB10,"SC-B 10 COM.LN.2"
DEFPIN           32,SCB11,"SC-B 11 GREEN   "
DEFPIN           33,SCB12,"SC-B 12 COM.LN.1"
DEFPIN           34,SCB13,"SC-B 13 RED GND "
DEFPIN           35,SCB14,"SC-B 14 COM.GND "
DEFPIN           36,SCB15,"SC-B 15 RED     "
DEFPIN           37,SCB16,"SC-B 16 BLANKING"
DEFPIN           38,SCB17,"SC-B 17 VID.GND "
DEFPIN           39,SCB18,"SC-B 18 BLK.GND "
DEFPIN           40,SCB19,"SC-B 19 VID.OUT "
DEFPIN           41,SCB20,"SC-B 20 VID.IN  "
```

```
DEFPIN          42,SCB21,"SC-B 21 SHIELD  "
```

The text line shows as much useful information as possible to help identify the location of the fault: Name of connector (SC-A or SC-B), pin number, and signal name.

The next stage is to define how the cable should be wired. As mentioned earlier, this definition will be for testing type 'C' cables, and the wiring is as follows:

```
;Pin connection details:

MUSTCONN        SCA01,SCB02     ;Audio A>B right
MUSTCONN        SCA02,SCB01     ;Audio B>A right
MUSTCONN        SCA03,SCB06     ;Audio A>B left
MUSTCONN        SCA06,SCB03     ;Audio B>A left
MUSTCONN        SCA04,SCB04     ;Audio ground
MUSTCONN        SCA08,SCB08     ;Function switching
MUSTCONN        SCA10,SCB10     ;Comms line 2
MUSTCONN        SCA12,SCB12     ;Comms line 1
MUSTCONN        SCA14,SCB14     ;Comms ground
MUSTCONN        SCA17,SCB17     ;Video ground
MUSTCONN        SCA19,SCB20     ;Video A>B
MUSTCONN        SCA20,SCB19     ;Video B>A
MUSTCONN        SCA21,SCB21     ;Shield
```

This would pass type 'C' cables, but fail any other configuration. To expand the test so that type 'U' cables would also pass the test, the following would be added:

```
MAYCONN         SCA05,SCB05     ;Blue ground
MAYCONN         SCA07,SCB07     ;Blue
MAYCONN         SCA09,SCB09     ;Green ground
MAYCONN         SCA11,SCB11     ;Green
MAYCONN         SCA13,SCB13     ;Red ground
MAYCONN         SCA15,SCB15     ;Red
MAYCONN         SCA16,SCB16     ;Blanking
MAYCONN         SCA18,SCB18     ;Blanking ground
```

This cable definition can be found in CABLEDEF\SCART_C.CBL on the CD-ROM.

SECTION 4 – ADVANCED TOPICS

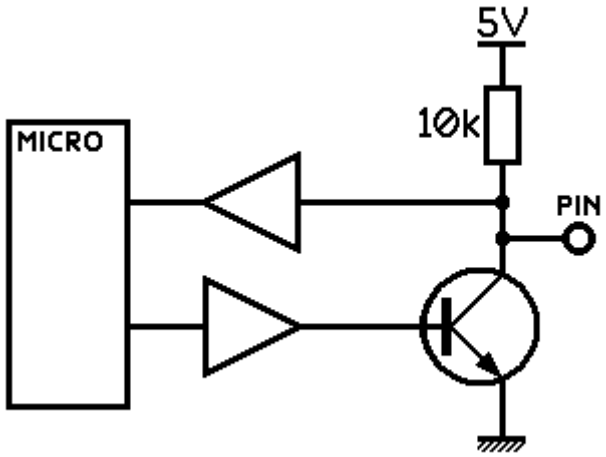
For normal use of the CT64 Cable Tester, the information in this section will not be required. The technical information provided here may be of use to programmers, or those wishing to use the CT64 for other uses.

4.1 – Theory of operation

The basic principle of conducting a test is to 'drive' a single contact in a cable, and then read back the state of all of the contacts to see which ones are connected to the driven one.

The pin being driven will obviously read back as connected, and this feature is used as part of the power-on self test (POST) to ensure that the CT64 is functioning normally.

All 64 pins on the CT64 are individually writable and readable by the internal microcontroller. A simplified circuit diagram of a single pin (repeated 64 times in the CT64) is as follows:



To 'drive' a pin, the microprocessor switches the transistor on, forcing the pin to 0V. All of the pins naturally idle at 5V due to the 10k pull-up resistor, but any pin connected to the driven one will read at 0V. Only one transistor is ever turned on at a time.

For each pin that is driven, all of the pins are read back and checked against an internal table created from the cable definition file.

The list file (.LST) which can be generated from the Host Application clearly shows the sequence in which the pins will be driven, and which pins should read back as connected.

4.2 – File Structure

The file to be sent to the CT64 can be output from the Host Application in Motorola S-Record format. It is possible to manually create this type of file if required using any suitable assembler (such as a 68000 assembler). This may be desirable if creating unusual definition files, or if using a computer unable to run the Host Application (such as an Amiga or Apple Mac).

The file structure is as follows:

```
CT64 File Structure V1.0 - 03/02/2003

Data guaranteed to be in first block (for filesystem
reference):

ADDRESS         CONTENT

$000 b          ASCII filename (16 bytes fixed)
$010 b          ASCII adaptor type (16 bytes fixed)
$020 b          Date, BCD
$021 b          Month, BCD
$022 b          Century, BCD
$023 b          Year, BCD
$024 b          Hour, BCD
$025 b          Minute, BCD
$026 b          Second, BCD
$027 b          Filetype (spare), always zero

$028 w          Total number of contacts (M) (need not be
                sequential)
$02A w          Setup time (x8.889 mS)
$02C b          spare
$02D b          Number of extra CT64s required (in
                addition to master one), 0-7
$02E w          spare

Further data is cable test data and may continue into
subsequent blocks:
```

```
$030 w          CONTACT 0: pin number (1-512)
$032 b          CONTACT 0: ASCII name (16 bytes fixed)

$042 w          CONTACT 1: pin number (1-512)
$044 b          CONTACT 1: ASCII name (16 bytes fixed)

$030+N*$12 w    CONTACT N: pin number (1-512)
$032+N*$12 b    CONTACT N: ASCII name (16 bytes fixed)

        where N is 0 to M-1.

$030+(M*$12) w  Start of test parameters for first
                contact (SUBTEST):

+$0 w           CONTACT NUMBER for test (X)
 $2 w           List of CONTACTs that X MUST connect to
                (AN)
 $2+AN*2 w      NULL (0)
 $4+AN*2 w      List of CONTACTs that X MAY connect to
                (BN)
 $4+AN*2+BN*2 w NULL (0)

        remaining contacts not listed as MUST connect or
        MAY connect are assumed to be MUST NOT connect.

REPEAT ABOVE (SUBTEST) BLOCK AS MANY TIMES AS REQUIRED.

+$0 w           NULL (0) Indicates end of test.

TEST PASSED DATA:

+$000 b         ASCII PASS string (16 bytes fixed)

 $010 w         Pass music, First note (period x17.36uS)
                (lower byte only)
 $012 w         Pass music, First note (duration x2.22mS)
   :
 $?   w         Pass music, Last note (period)
 $?+2 w         Pass music, Last note (duration)

 $?+4 w         NULL (0)

TEST FAILED DATA:
```

```
Same format as TEST PASSED data.
```

To communicate with the CT64 Cable Tester without using the Host Application, set up & configure a terminal program to use 9600bps, 8N1, no handshaking.

Press <return> to get a prompt if necessary, and type help <return>:

```
CT64>help

 COMMAND SUMMARY
 ~~~~~~~~~~~~~~~
 DELETE filename  - Delete specified file
 DIR              - Show directory of disk
 FORMAT           - Format disk - all files will be lost
 HELP             - Display this page
 LOAD filename    - Output specified file to host
 SAVE             - Input file from host and save to disk
```

The commands are fairly self-explanatory, and generally correspond to the Host Application commands detailed in section 3.2.

4.3 – Specifications

- Dimensions (HxWxD): 1¾" x 6" x 7" (exc. cables)
- Weight: 16 oz.
- Power consumption: 350mA max
- Power supply: 9V (7-15V unreg.) 500mA
- Test current (single pin): 500µA
- Test current (maximum 512 pins): 256mA
- Test voltage: 5V DC
- Microprocessor: 8-bit, 14.7456MHz
- Display: 16 x 4 character alphanumeric LCD
- Communications: RS232C 9600bps (printer at 1200bps)
- Cable Test connector: DIN41612
- User non-volatile memory (disk): 64kB standard, 128kB option

5.1 - Appendix A - Error Messages

HOST APPLICATION ERRORS (BULID ERRORS):

- **11 - Build Error, Wrong number of arguments**
  The wrong number of arguments have been supplied for the specified command. Please refer to section 3.4 (Writing A Cable Definition) for correct command syntax.
- **15 - Build Error, Undefined pin name**
  Pin name specified by a MUSTCONN or MAYCONN command has not been previously defined by a DEFPIN command.
- **63 - Build Error, DEFPIN number must be 1-512**
  Valid pin numbers range from 1-512 only.
- **64 - Build Error, Pin already defined**
  DEFPIN command has been used to define the same pin twice.
- **100 - Build Error, Tone unknown or out of range**
  Tones used in PASSTONE & FAILTONE commands must range from a#0 (lowest) to a#4 (highest).
- **101 - Build Error, Duration must be 3-100000mS**
  Calculated duration (from note length & tempo) must be 3mS minimum to 100 seconds maximum.

CT64 ERRORS (FILE SYSTEM ERRORS):

- **30 - FILE NOT FOUND**
  Specified file (for delete or download) is not found on disk.
- **40 - DISK IS FULL**
  No more space available for files (when learning or uploading). Delete unused files or format the disk.
- **70 - BAD WRITE VERIFY**
  An error occurred while writing or deleting a file. Check the write-protect status (internal jumper), or format the disk.
- **80 - READ CSUM FAILED**
  A checksum error occurred when reading a file. Delete the file (or format the disk) and upload again.
- **90 - ACCESS VIOLATION**
  An attempt was made to read a non-existent disk block. Possible causes include; Memory capacity changed without re-formatting; Hardware failure of non-volatile memory chip(s). Formatting the disk may cure the problem.

5.2 - Appendix B - Troubleshooting

SYMPTOM	PROBLEM	SOLUTION
CT64 is not operating, and screen is blank.	Power not getting to CT64.	Check / replace power supply.
CT64 beeps on key presses, but screen is blank or black.	LCD contrast set too low or too high.	Adjust contrast with screwdriver on back of unit.
CT64 is not operating, two thick horizontal lines on screen.	Hardware fault.	If problem persists, contact service.
Frequent file system errors occurring.	Non-volatile memory chip(s) nearing end of life.	Replace NV chip(s) and format disk, or contact service.
Known-good cable fails test when using linked mode.	No common ground connection between CT64s	Connect all CT64 commoning points together.
Communications failure during tests when using linked mode.	Serial lead not connected from master to slave between CT64s. OR No ground between CT64s.	Connect serial lead(s) correctly. OR Connect all commoning points together.
Cannot communicate between CT64 & Host Application.	Serial lead not connected correctly. OR Wrong COM port selected on PC.	Connect serial lead to correct COM port on PC, and slave serial port on CT64. OR Select correct COM port on PC.
'Printer not ready' message whenever cable is tested.	Printer is not connected correctly, not switched on, or out of paper.	Check printer (connects to slave serial), or disable printer if no longer required.

5.3 - Appendix C - Definition Of Terms

ADAPTOR — A cable assembly consisting of one or more *DIN41612* connectors, connected to appropriate plugs or sockets for connection to the lead under test.

APPLICATION — The user-interface software supplied with the *CT64* for installation onto the *HOST PC*.

CABLE ADAPTOR — See *ADAPTOR*.

CABLE DEFINITION — A file defining the connection configuration of a cable. This may be a text file on the host PC (suffixed with .CBL), or a binary file internal to the CT64.

COM PORT — See *SERIAL PORT*.

CONDUCTOR — A wire within a cable, designated as connecting from a *CONTACT* to one or more other *CONTACT*s.

CONTACT — A pin or receptacle in a connector which may or may not have a wire connected.

CT64 — The SMR Electronics Limited Cable Tester, for testing cables with up to 64 contacts.

DEFINITION — See *CABLE DEFINITION*.

DIN41612 — The type of connector used on the *CT64* for connection to the *ADAPTOR*.

FAULT — A wiring discrepancy that occurs in a cable and is detected by the *CT64*. It will be either a *SHORT CIRCUIT* or an *OPEN CIRCUIT*.

HOST PC — A Windows PC running the *CT64 APPLICATION*, used for creating *CABLE DEFINITIONS*.

LISTING FILE	Text file (suffixed .LST) which can be optionally generated from the *APPLICATION,* detailing the exact step-by-step tests performed.
NON-VOLATILE MEMORY	Memory which retains its contents when power is disconnected. Used in the *CT64* as a 'memory disk' for storing *CABLE DEFINITIONS.*
OPEN (CIRCUIT)	A broken connection is a *CONDUCTOR* causing it to become two *CONDUCTORS.* Typically caused by a broken wire or solder joint. One of the two types of *FAULT* that can occur in a cable.
PLUG-TOP POWER SUPPLY	A self-contained, isolated power supply, built into an oversized domestic mains plug. The one supplied with the *CT64* is NOT interchangeable with power supplies provided for other products.
SERIAL PORT	Either of the two communication connectors on the back of the *CT64*, used for communication with the *HOST PC* or other *CT64*s. Also, the similar connector on the *HOST PC*.
SHORT (CIRCUIT)	A unintentional join between two (or more) *CONDUCTORS* causing them to appear as a single *CONDUCTOR.* Typically caused by damaged insulation or excess solder. One of the two types of *FAULT* that can occur in a cable.
S-RECORD	(Motorola S-Record) Text file (suffixed .MX) which can be optionally generated from the *APPLICATION.* It is the raw data making up a cable definition (excluding comments) that is sent to the *CT64.*

PRODUCT SUPPORT

The CT64 Cable Tester is designed an manufactured by:

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Answerphone outside office hours.

For general product support queries, please call the number above, or e-mail with details of the problem you are having to:

ct64support@smr-electronics.co.uk

Please do not return products without first obtaining a Return Material Authorisation (RMA). This can be obtained by telephone on the number above, or by e-mail to:

rma@smr-electronics.co.uk

For software or documentation updates, or for details of other products and services, please visit the website at:

www.smr-electronics.co.uk

SMR Electronics Limited provide a service for manufacturing CT64 adaptors to customer's specification. These adaptors are built to a high quality, and use a fully enclosed backshell on the DIN41612 connector.

For a quotation, please call, or forward your specification to:

ct64adaptor@smr-electronics.co.uk

Or send by fax to the number above.

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