DATE	TITLE	PAGE

revision 3
Prog version AT404C

INSTRUCTION MANUAL

AVSI2 SERIAL COMPUTER INTERFACE

RV-Elektroniikka Oy
Veromiehentie 14
SF-Ø151Ø VANTAA, FINLAND

phone 358-Ø-822Ø87
telex 191ØØ449 vdx sf
fax 358-Ø-822184

TABLE OF CONTENTS

1. COMMAND SUMMARY

P CR	RESET TO DEFAULT SETTINGS
P CR	RESET TO DEFAULT SETTINGS
EØ CR	ECHO OFF Commands are not echoed
E1 CR	ECHO ON Commands are echoed
CØ CR	MANUAL CONTROL MODE Manual switches override
C1 CR	COMPUTER CONTROL MODE Computer overrides
R CR	GIVE CURRENT RANGE
R<1...7> CR	SELECT RANGE
X CR	GIVE CURRENT EXCITATION
X<1...6> CR	SELECT EXCITATION
D CR	TRANSMIT RESULT OF ONE A/D CONVERSION

MULTIPLEXER COMMANDS

M CR	GIVE CURRENT INPUT CHANNEL
MØ CR	DISABLE MULTIPLEXER
M<1...15> CR	SELECT INPUT CHANNEL

INDIRECT READOUT COMMANDS

O8 CR	SELECT TEMPERATURE READOUT MODE
OØ CR	SELECT RESISTANCE READOUT MODE
O CR	GIVE CURRENT READOUT MODE
Snnnnn CR	DISPLAY TEMPERATURE nnnnn

2. INTRODUCTION

The AVSI2 Serial Computer Interface for the AVS-46 Resistance Bridge is an intelligent RS232 compatible communications unit. In addition to the standard RS232 mode, it offers optoisolated current loop operating mode with complete isolation between resistance bridge and computer. It is possible to use the interface to control the most important, though not all, functions of the bridge, and to read the A/D conversion results, currently selected range, excitation and input channel. The indirect readout feature facilitates the use of the AVSI2 for displaying temperature or other numeric data transmitted by the computer.

The AVSI2 is available installed in new bridges, but it can be also field-installed in a few minutes.

For clarity, we list below the operations that are possible with the AVSI2, and operations that are not possible:

YOU CAN

*Get the DVM reading to your computer
*Display this reading as such, or linearize the data with your computer and send the temperature to AVS-46 to be displayed.
*Select resistance range
*Select excitation range
*Select multiplexer input channel
*Operate the bridge as manual or autoranging instrument and read current range, excitation and input channel to computer
*Obtain complete isolation between AVS-46 and computer, if the interface is used in optoisolated current loop mode.

YOU CANNOT

*Change position of following manual switches: CAL/MEAS, FAST/SLOW, DELTA-R/R, REF BUTTON, AUTO/MANUAL RANGE, AUTO/MANUAL EXCITATION, x1/x10 MODE
*Set the deviation reference from computer

3. FIELD INSTALLATION

Later installation of the AVSI2 interface is easy and does not require special tools. Before installation, check the baud rate (see Baud Rate Setting). Proceed as follows:

1) Disconnect power cord for your safety.

2) Open the top cover plate of the AVS-46 by removing the four cross-head screws at the corners. Use a small screwdriver or knife to lift the plate until you can grip it with fingers. The cover will come out without force if it is in right position.

3) Remove the small plate covering the RS232 connector slot.

4) A 3x30mm screw, nut, two spacers and two plastic insulators follow the AVSI2. Insert them as shown in the drawing below.

5) Put the AVSI2 into its place. Insert the two M3x8 screws fixing the unit to the rear panel (B). Insert the second insulator as shown (C), and tighten nut (D) carefully without excessive force.

6) Insert the wide ribbon cable. Note position of the marked strip.

7) Remove U407 (type CD4511) from its socket. Insert the narrow ribbon cable from socket J701 to the socket of U407 (this cable is for indirect readout). Note position of the coloured side of the cable.

If the bridge is now turned on, it should operate just as before without any difference. Prepare a suitable cable and test the installation (these instructions are for the IBM PC):

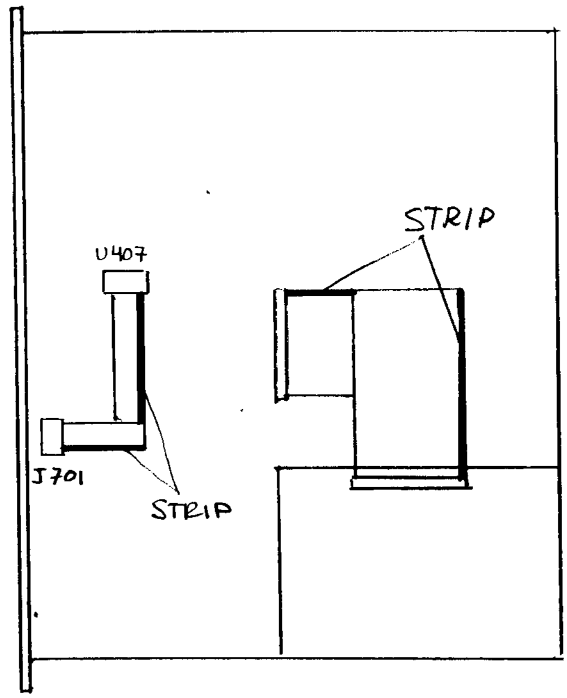
Connect the cable to COM1 or COM2 serial port. Load program AVSI2.EXE from the diskette. Give command <C1> which sets the AVSI2 into computer mode, and changes range to 200 Ω and excitation to 1 mV. You can now change range, excitation and multiplexer channel (if you have a multiplexer installed). Check also indirect readout mode. If AVSI2.EXE does not work, try the following: Initialize COM1 using the DOS command <MODE COM1:4800,n,8,1>. Then send commands to the AVSI2 as follows:

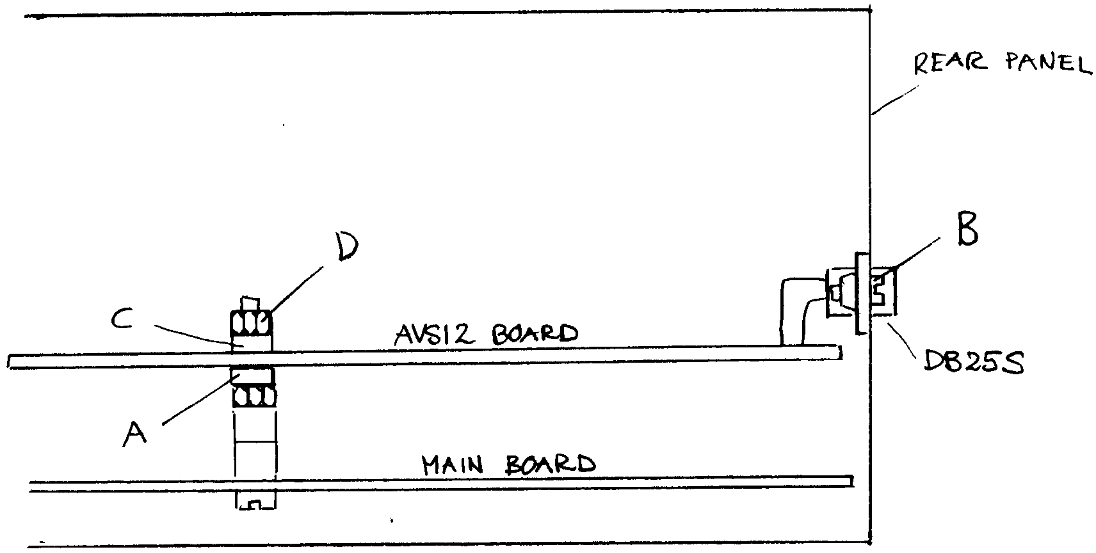
```
copy con COM1:
C1
Ctrl-Z <enter>
```

Note that you can use this method only for sending commands to AVSI2. Do not try to read data from COM1 with the DOS "COPY" command, as you would probably have to reboot you computer which waits for a character. For reading data from the AVSI2 you need a procedure that first verifies the existence of a character or string to be read.

DATE	TITLE	PAGE
6.5.87	AVSI2 INSTRUCTIONS	6

FIG 3-1: AVSI2 INSTALLATION





4. MAKING THE RS232 CABLE FOR THE IBM PC

Following cable has been found suitable for use with the IBM PC, PC/XT and compatibles. We recommend that when you connect the AVSI2 interface to your PC for the first time, you try the demo programs using this cable.

```
AVSI2 CONNECTOR                  PC CONNECTOR

PIN 2-------------------------PIN 3  (RXD input)
PIN 3-------------------------PIN 2  (TXD output)
PIN 7-------------------------PIN 7  (GROUND)

PIN 4 ┐                     ┌ PIN 4  (RTS output)
PIN 5 ┘                     └ PIN 5  (CTS input)

                            ┌ PIN 6  (DSR input)
                            └ PIN 20 (DTR output)
```

Following cable should be used with the 9-pole connector used in AT-type computers.

```
AVSI2                            PC/AT CONNECTOR

PIN 2-------------------------PIN 2 (RXD input)
PIN 3-------------------------PIN 3 (TXD output)
PIN 7-------------------------PIN 5 (GROUND)

PIN 4 ┐                     ┌ PIN 7 (RTS output)
PIN 5 ┘                     └ PIN 8 (CTS input)

                            ┌ PIN 4 (DTR output)
                            └ PIN 6 (DSR input)
```

5. OPERATING MODES

5.1. RS232 MODE

RS232 mode is selected when strap J4 is connected between pins 1 and 2. Refer to component layout drawing.

The DB25S connector pin assignments are as follows:

PIN NO	SIGNAL	DIRECTION	DESCRIPTION
2	TXD	OUTPUT FROM AVSI2	TRANSMITS DATA to an RS232 compatible device
3	RXD	INPUT TO AVSI2	RECEIVES DATA from an RS232 compatible device
4	RTS	OUTPUT FROM AVSI2	REQUEST TO SEND. High state indicates that AVSI2 is ready to accept data
5	CTS	INPUT TO AVSI2	CLEAR TO SEND. High state enables AVSI2 to send data
7	GROUND		

NOTE 1) If RTS and CTS signals are not used, they should be connected together.

NOTE 2) It is recommended that the communications is based only on TXD and RXD signals, because then you can change over to current loop operation without program modifications.

5.2. OPTOISOLATED CURRENT LOOP MODE

For current loop mode the strap J4 is placed between 2 and 3. Refer to AVSI2 board component layout figure.

The DB25S connector pin assignments for this mode are:

PIN NO	SIGNAL	DIRECTION	DESCRIPTION
9	RD+	INPUT	RECEIVE DATA, positive
10	RD-	INPUT	RECEIVE DATA, negative
18	SD+	OUTPUT	TRANSMIT DATA, positive
19	SD-	OUTPUT	TRANSMIT DATA, negative

The AVSI2 serial interface is capable of providing complete galvanic isolation when operating in the standard 20 mA current loop mode. Both current loops are passive, and protected against voltages of wrong polarity. The receiving optocoupler has a 120 Ohm current-limiting resistor which is suitable for voltage range below 12 Volts. Current flowing into transmitter output must be externally limited. Refer also to AVSI2 circuit schematic. See section 16 for a simple RS232-to-current loop adapter.

5.3. BAUD RATE

The AVSI2 interface unit supports following baud rates:

RATE	J3 STRAP POSITION
300	1
600	2
1200	3
2400	4
4800	5

Refer to AVSI2 component layout figure for location of strap J3.

6. INSTRUCTION SYNTAX

All commands to the AVS-46 consist of one UPPER-CASE LETTER followed by an optional numeric parameter. The command is executed when the AVSI2 receives a CR character (decimal ASCII code 13).

Upon receipt of a valid instruction and CR, the AVSI2 interface responds by sending

* requested data followed by CR
* only a CR character if no data is requested

If the command is illegal or unknown, the response is a question mark (decimal ASCII 63) followed by CR.

The CR response is useful especially in current loop mode, where handshaking cannot be implemented using RTS and CTS signals. Proper operation of a computer's asynchronous interface may require that this CR response character is read away from the communications buffer immediately after sending a command to the AVSI2. Refer also to program examples (Section 12).

The reset command P sets echo flag E to zero, and the AVSI2 does not repeat the commands it has received. You can set the ECHO ON by command E1 CR (cancel this by EØ CR). Now the AVSI2 echoes all commands and characters it has received. The echoed characters are not followed by CR.

WARNING: Be very careful not to set the ECHO ON unless your computer program is able to read characters from the communications buffer even though there is no terminating character (CR). For example, BASIC command

LINE INPUT #filenum, stringvariable$

may cause your program to await the CR character forever and you would have to reboot your computer.

Examples on useful communications routines are given in Section 14.

7. RESET STATE AFTER POWER-ON

When the AVS-46 is switched on, the AVSI2 assumes a state for normal manual operation of the AVS-46, specifically:

* Range and excitation are controlled only by the front panel toggle switches
* Multiplexer is disabled (channel indicator digit is blanked).
* Display is in resistance readout mode.

In the initial state range should be 2 kΩ and excitation 3ØØØ microvolts. The default settings (see descriptions in later paragraphs) are:

X = 6 (excitation)
R = 4 (range)
E = Ø (echo flag)
C = Ø (computer control flag)
M = Ø (multiplexer)

If you now switch the AVSI2 into computer controlled mode using command

C1 CR

range will change to 200 Ω (R = 3) and excitation to 1000 microvolts (X = 5). This change also indicates to you that the AVSI2 receives valid instructions from computer.

8. READING THE RESISTANCE DATA

8.1. COMMANDS

The result of a single A/D conversion is read using command

D CR (read data command)

The AVSI2 responds by sending a string of characters, starting from polarity (+ or -), followed by the conversion result from MSD (most significant digit) to LSD (least significant digit), and the string ends with a CR character.

The A/D converter of the AVS-46 makes about 2.5 conversions/sec. The conversion result ranges from -19999 to +19999, and data is transferred using decimal numbers 0...9.

Note that if you do not use hardware handshaking (RTS,CTS), you computer must be fast enough to read the characters as they come from the AVSI2. In the current loop mode only software handshaking is possible, and you must use a lower baud rate if you have problems with timing.

8.2. DECIMAL POINT

The data from the A/D converter is a decimal number expressed in Ohms regardless of range setting. If range 4 (2 kΩ) or lower is selected, the resistance data will include decimal point, but readings taken on the three highest ranges are integers.

Note that decimal point position in magnified deviation mode corresponds to that of the original range. It is therefore necessary to divide the readings by 10.

8.3. OVERLOAD CONDITION

If the response to D CR command is +9999900, this indicates overload condition, and can be used to alert the operator or to start an autoranging program sequence.

If you use the AVS-46 in autoranging mode (AVSI2 in C0-state), your data acquisition program should check all readings for 9999900, so that only valid data is recorded. You should also include a delay loop in the program so that once the overload condition has been detected, recording of data is inhibited for at least 10 seconds.

8.4 NOTES ON THE MAGNIFIED DEVIATION DISPLAY MODE

The MAGNIFIED DEVIATION MODE of the AVS-46 may be used for measuring very low resistances, and it is especially useful when the lead resistances are high. The AVSI2 interface does not know whether the bridge is in normal or x10- display mode, and therefore your computer program should include a manually selectable scaling parameter, which divides the resistance data by 10 in the x10- display mode.

The magnification for the x10- mode is obtained from a DC amplifier outside the extremely stable AC loop of the bridge. Therefore the offset drift in x10- mode cannot be ignored. If you have the multiplexer installed and can afford one of the input channels, we recommend that this channel is used as a short-circuit reference, and the offset is measured and stored into computer memory from time to time. This offset can be deducted from all bridge readings regardless of range or excitation. Take offset reading at highest excitation to avoid errors from noise.

9. RANGE

9.1. COMPUTER CONTROL

Computer control of range and excitation is enabled by command

    C1 CR   (computer control mode)

Now the range can be selected using command

    R<1...7> CR   (select range command)

The AVSI2 responds with a CR character. Current range can be asked by command

    R CR   (read range command)

The response is an integer from 1 to 6 followed by CR.

If you try to use the manual range switch in C1 mode, AVSI2 returns immediately the range previously defined by R<1..7> command. Autorange switch must be in manual position, otherwise a race condition will arise between AVS-46 autoranging circuitry and the interface.

9.2. MANUAL CONTROL

Manual control of range and excitation is enabled by command

C0 CR (manual control mode)

The front panel toggle switch can now be used to change range. "Select range" command from computer is ignored in C0 mode. "Read range" command R CR returns current range setting.

9.3. AUTORANGE

The autoranging feature of the AVS-46 is useful only in C0 mode. Beware that when the autoranging action takes place, some readings transmitted to computer may be invalid (9999900) and your program should be able to ignore these.

Note also that a 1 or 5 seconds delay, depending on a jumper setting, is reserved for the bridge to stabilize between successive autoranging operations. In scanning applications with the multiplexer, better results are obtained in computer control mode, if the last range setting for each sensor is stored in computer memory, and the selection of multiplexer channel is accompanied by selecting this range.

10. EXCITATION

10.1. COMPUTER CONTROL

When the AVSI2 is in C1 mode, the excitation can be selected using command

X<1...6> CR (select excitation command)

AVSI2 response is a CR character. Current excitation may be asked by

X CR (read excitation command)

and the response is now an integer 1...6 followed by CR.

10.2. MANUAL CONTROL

Manual control of excitation is possible only in C0 mode, when also range is selected manually. Current excitation can be asked using X CR command.

10.3. AUTOMATIC CHANGE

One of the AVS-46 features is the possibility to change excitation automatically whenever the autoranging circuitry selects a new resistance range. Autoexcitation can therefore be used only when the bridge is in autorange mode (and interface in C0 mode).

11. MULTIPLEXER

The AVS-46 may be equipped with one or two seven-channel input multiplexers. In the reset state after power-on, the multiplexers are disabled and the channel display LEDs are blanked.

Multiplexer inputs are selected using command

M<1...15> CR (select input command)

The selected input channel number is seen at AVS-46 display so that channels 1...7 of multiplexer A are shown by upper LED, and channels 9...15 of multiplexer B are shown by the lower LED. Channel 8 does not exist.

The currently selected input channel can be asked by command

M CR (read input channel command)

Multiplexers are disabled by command

M<0> CR or M<8> CR

12. INDIRECT READOUT

12.1 COMMANDS

The AVSI2 changes over into indirect readout mode on command

O8 CR   NOTE: letter O

This mode is indicated by blanking the decimal point of the AVS-46 display. Now the interface is ready to receive data from the computer, to be displayed. Indirect readout can be used in both CØ and C1 modes.

Data to be displayed by AVS-46 is transmitted from computer using command

SNNNNN CR   (display data command)

where the string NNNNN consists of one to five digits, each ranging from Ø to 9. Examples:

* SØ and SØØØØ are displayed as ØØØØØ
* S1 and SØØØ1 ØØØØ1
* S1ØØØ Ø1ØØØ
* S99999 99999 (upper limit)

The displayed temperature must be in form of a <u>positive integer</u> (decimal point is blanked in this mode). In cryogenic applications below 1ØØK, the display units may be millikelvins and at higher temperatures the unit can be 1Ø mK.

Previous data is displayed until updated by a new S command.

Voltage readout mode is restored using letter+number command

OØ CR   (voltage readout command)

Any previously stored temperature data will be lost, the AVS-46 indicates measured resistance. Decimal point is enabled.

It is also possible to ask for present display mode by command

O CR

Response from the AVSI2 is Ø CR in resistance mode and 8 CR in indirect display mode.

12.2. APPLICATIONS

The indirect readout provides some extra convenience in applications where the AVS-46 is interfaced with a computer, especially if the latter and its screen are located outside the cryostat room.

The most evident way to use the indirect readout mode is to display a digital average of many readings, as calculated by the computer. This will provide a more stable display at the lowest sensor power levels.

If the computer calculates temperature from the sensor resistance, indirect readout may be used to display the temperature in units of millikelvins or tens of millikelvins. Whereas the standard AVS-46 readout extends to 19999, full five digits up to 99999 are available for the indirect mode. Thus, temperature display goes up to 999K with a resolution of 10 mK and up to 99K with 1 mK resolution.

In a multiplexed-input application, where several sensors are scanned, you may want to display just one sensor instead of the individual readings that change continuously. Indirect readout makes this possible, as the readout mode does not affect the operation of the A/D converter.

It is also possible to use the indirect readout to show the channel number and temperature. This is made by constructing the S-command string as follows:

S + (channel number digit) + (hex digit greater than 9) + (three digits of data).

Of course, this leaves you only three digits for the temperature, which is enough for 1 mK resolution below 1 K and 0.1 mK resolution below 0.1 K.

The 4 1/2 digit display range can be extended to 30000 or 40000 with the aid of the indirect readout.

Select deviation display mode and null the resistance display in CAL mode by the REFERENCE potentiometer. Then use the computer to add 10000 to all subsequent readings, and send them back to the AVS-46.

You can also dial the potentiometer to 19990 with the aid of the SET display, and then add 19990 to all readings (range is extended to 39990). This latter method is not quite as accurate as the former one.

13. PROGRAMMING

13.1 GENERAL PRINCIPLES

Asynchronous communications can sometimes be tricky, and therefore we present here some principles and hints that has been found useful.

If your computer is not very slow, we do not recommend hardware handshaking, as this cannot be used in current loop mode where you have only two signal wires available. The AVSI2 interface is very fast. It can read all valid commands at its highest baud rate (4800) without problems. Therefore, it is possible to send commands to AVSI2 as a complete string like "S12345<enter>". For this purpose, there is BASIC command PRINT#, and TURBO PASCAL command WRITELN(AUX,string), for example.

AVSI2 responds to all commands. Any string ending with a <CR> character is interpreted as a command. If this command is not valid, response will be a question mark (?) followed by <CR>, and if the command was valid, AVSI2 will take the requested action or send the requested data, and terminate the response with a <CR>. AVSI2 will never transmit characters without a preceding command from computer.

Reading data, transmitted by the AVSI2, from the computer's serial port is not as easy as giving commands to the AVSI2. First of all, you must make sure there is a character or string you can read. If you fail to do this, you will either get an error message, or your computer will wait for the character. But the character cannot be received, as the AVSI2 does not send anything without a preceding command. You cannot send the command because your computer is waiting, and there is nothing else to do than to reboot the computer.

The most reliable communications routines are based on transmission and reading of single characters only. In the next section we describe a BASIC subroutine that has proven reliable. This routine is used in demo programs AVSI2.EXE and NTEST.EXE.

13.2. A SUBROUTINE FLOW DIAGRAM

Refer to diagram on the next page. Before going into the subroutine, TXD$ is set equal to the command string to be transmitted (the complete string instead of separate characters is transmitted using one command, because it is simpler and works well this way). First the routine checks that the communications buffer is empty, and if not, it reads as many characters as there are in the buffer (line 720). Then we can transmit TXD$ to AVSI2.

It will take some time until the AVSI2 response is completed, but we cannot know how long. Therefore a cycle counter is initialized (line 740). Next we test whether a character has been received or if the buffer is still empty. If empty, the cycle counter is incremented and we test the buffer again. After a reasonable number of trials, a time-out error message is set, and we return to main program.

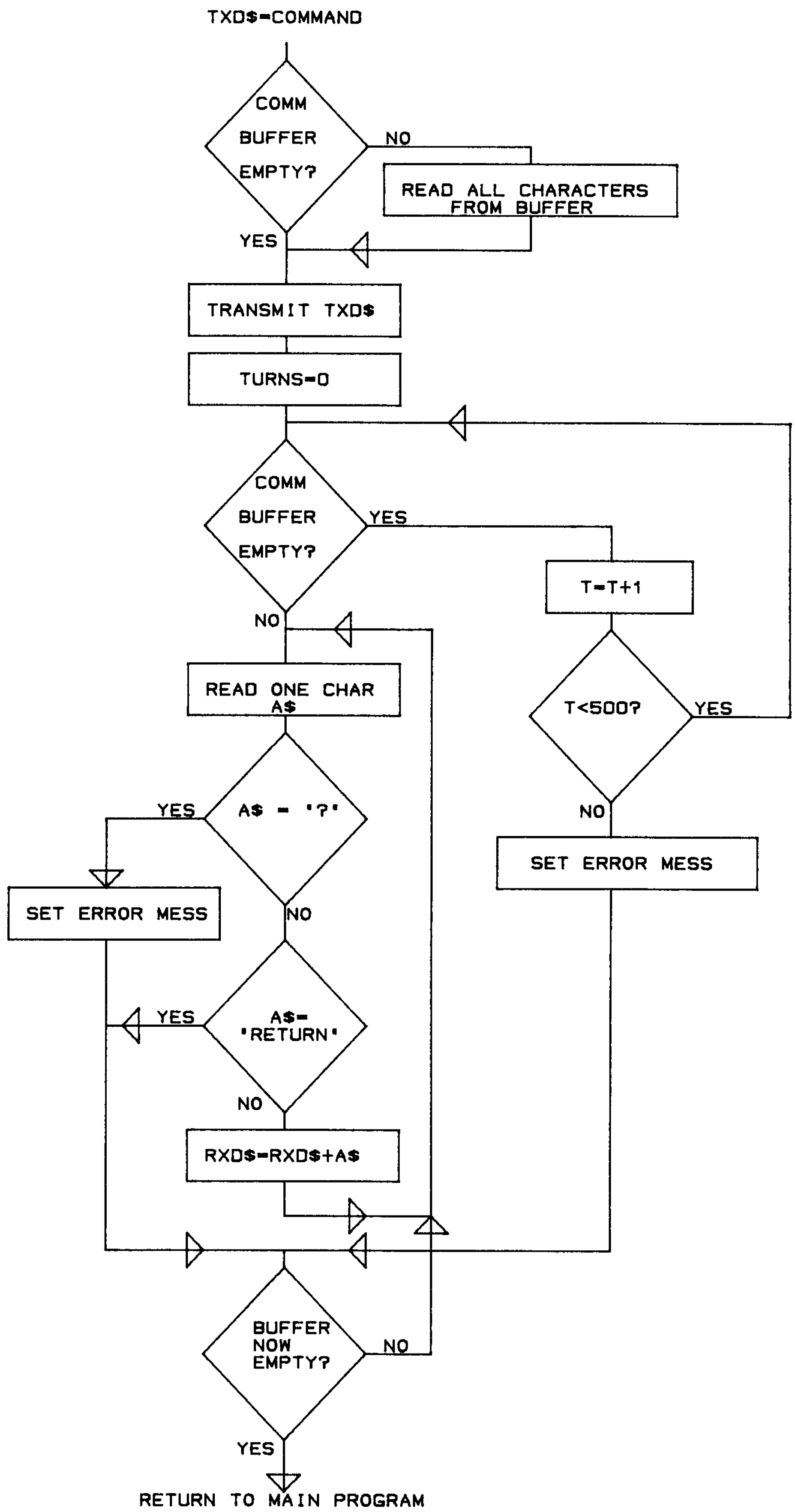
If you have an IBM PC/AT or equivalent fast computer, you must increase the delay counter test value from 5ØØ to 5ØØØØ.

If there is a character in the buffer, it is read (79Ø). If this character is a question mark, an error message string is set, and we branch to the end of the subprogram. Branching to end occurs also if we read a carriage-return character (82Ø), otherwise the last character is added to build up the response string RXD$ (83Ø). Reading procedure is repeated until a CR character is encountered, and RXD$ is complete. The final test of line 84Ø is actually not necessary because we test the buffer in the beginning, but it is good to make this test at least once.

This kind of subroutine is quite immune to error conditions, and enables you to stop the program with Ctrl-Break without booting the computer.

Keep the reading loop (here lines 79Ø-83Ø) fast, so that the computer can always read previous character before the next comes. Otherwise you will need hardware handshaking. Do not insert more tests than is strictly necessary in this loop. If your computer is not fast enough, try a lower baud rate.

READ-WRITE SUBROUTINE



14. PROGRAM EXAMPLES

```
10    ' PROGRAM TO TEST AVSI2 INTERFACE
20    ' RV-ELEKTRONIIKKA OY, 8.5.1987
30    '
40    '
50    CLS:KEY OFF
60    PRINT:PRINT:PRINT
70    PRINT"                **************AVSI2*********************"
80    PRINT:PRINT:PRINT
90    PRINT"                This program can be used to test the operation"
100    PRINT"                of the AVSI2 computer interface. You can give"
110    PRINT"                all commands from keyboard and read resistance"
120   PRINT"                and status data."
130   PRINT
140   PRINT"                You can use either COM1: or COM2:. Allowed baud"
150   PRINT"                rates are 300, 600, 1200, 2400 and 4800. Refer"
160   PRINT"                to AVSI2 instruction manual for checking the"
170   PRINT"                current baud rate setting of the interface."
180   PRINT
190   PRINT"                Ctrl-Break terminates the program."
200   PRINT
210   PRINT"                Press any key to continue...."
220   '
230   '
240   S$=INKEY$
250   IF S$="" THEN 240
260   CLS:LOCATE 5,15
270   INPUT"Output port (1 for COM1:, 2 for COM2:) ";PORTNUMBER
280   IF (PORTNUMBER=1 OR PORTNUMBER=2) THEN 310
290   CLS:LOCATE 4,15
300   PRINT"INVALID PORT NUMBER": GOTO 270
310   IF PORTNUMBER=1 THEN PORT$="COM1:" ELSE PORT$="COM2:"
320   '
330   '
340   LOCATE 8,15
350   INPUT"BAUD RATE (<RETURN> FOR 2400) ";BAUDRATE$
360   TEST$="300 600 1200 2400 4800"
370   IF BAUDRATE$="" THEN BAUDRATE$="2400"
380   IF LEN(BAUDRATE$)<3 THEN 410
390   F=INSTR(1,TEST$,BAUDRATE$)
400   IF F<>0 THEN 430
410   CLS:LOCATE 7,15
420   PRINT"INVALID BAUDRATE":GOTO 350
430   '
440   '
450   OPEN PORT$+BAUDRATE$+",N,8,1"AS#1
460   TXD$="P":GOSUB 690
470   IF ERRMSG$<>"" THEN PRINT ERRMSG$:GOTO 460
480   '
490   '
```

```
500   CLS:LOCATE 25,15
510   PRINT"PRESS 'H' FOR HELP"
520   LOCATE 5,15
530   PRINT"AVSI2 IS READY. USE ONLY CAPITAL LETTERS."
540   LOCATE 6,15
550   PRINT"COMMANDS MUST BE FOLLOWED BY <RETURN>"
560   '
570   TXD$=""
580   S$=INKEY$
590   IF S$="H" OR S$="h" THEN GOSUB 880:'  PRINT HELP PAGE
600   IF S$="" THEN 580
610   IF ASC(S$)=13 THEN 630
620   TXD$=TXD$+S$:GOTO 580
630   GOSUB 690
640   PRINT RXD$
650   IF ERRMSG$<>"" THEN PRINT ERRMSG$
660   GOTO 570
670   '
680   '
690 'SUBROUTINE TO WRITE DATA TO AVSI2 AND TO READ THE RESPONSE
700 ' INPUT TO ROUTINE IS TXD$ AND OUTPUT FROM IS RXD$
710 '
720 IF LOC(1)>0 THEN A$=INPUT$(LOC(1),1)
730 '
740 PRINT #1, TXD$:TURNS=0:RXD$="":ERRMSG$=""
750 IF LOC(1)=0 THEN TURNS=TURNS+1 ELSE GOTO 790
760 IF TURNS<500 THEN 750
770 ERRMSG$="TIMEOUT ERROR IN RECEIVING":GOTO 840
780 '
790 A$=INPUT$(1,1)
800 IF A$="?" THEN ERRMSG$="UNKNOWN COMMAND "+TXD$:GOTO 840
810 '
820 IF ASC(A$)=13 THEN 840
830 RXD$=RXD$+A$:GOTO 790
840 IF LOC(1)>0 THEN 790
850 RETURN
860 '
870 '
880 '     *******HELP MESSAGES*********
890 PRINT"            COMMAND SUMMARY ":PRINT
900 PRINT"AVS-46 COMMANDS:"
910 PRINT"P reset       E0 echo off     E1 echo on      C0 manual control"
920 PRINT"C1 computer control           R Read range    R<1..7> set range"
930 PRINT"X read excitation             X<1..6> set excitation
940 PRINT"D read A/D conversion result
950 PRINT:PRINT"MULTIPLEXER COMMANDS:"
960 PRINT"M read input channel   M<1..15> select input channel   M0 disable multipl
970 PRINT:PRINT"TEMPERATURE READOUT COMMANDS:"
980 PRINT"O8 enable temperature readout mode    O0 restore resistance readout"
990 PRINT"O read current mode                   Snnnnn display temperature nnnnn"
1000 PRINT:PRINT"CCO-510 AND CCO-520 RELATED COMMANDS:"
1010 PRINT"P reset to manual state        O5 open error input     O0 short error inp
1020 PRINT"A6 CR G<0...B> select proportional gain"
1030 PRINT"A4 CR G<0...7> select integrator time constant"
1040 PRINT"A5 CR G<0...7> select derivator time constant"
```

```
1050 PRINT"A3 CR G<0...FFFF> set control point in units of 100 uV"
1060 PRINT:PRINT"PRESS ANY KEY TO CONTINUE...."
1070 TEST$=INKEY$:IF TEST$="" OR TEST$="H" OR TEST$="h" THEN 1070
1080 CLS:LOCATE 25,15:PRINT"PRESS 'H' FOR HELP"
1090 RETURN  570
```

LINEARISATION ALGORITHM FOR PT-100 SENSORS

Following short algorithms can be used to convert PT-100 resistance readings into temperature, and the desired final temperature into resistance (for defining control set point).

Input parameters for the first algorithm are TSTART, which is any Celsius temperature, and R, which is the resistance reading in Ohms. Calculation is made by iteration from the DIN 43760 equations, which are different for positive and negative (Celsius) temperatures.

Iteration converges quite rapidly. If you do not scan many sensors, you can retain the TSTART value from one subroutine call to the next and reduce the number of iteration cycles (row 2940) to make program faster. In scanning applications it is probably wiser to use a fixed start value and a sufficient number of cycles.

Before returning, Celsius degrees are converted into Kelvins, but you can skip lines 2980 and 3040.

The input parameter for the second algorithm is B$, which represents a Kelvin temperature to be converted into resistance. It is first converted into Celsius degrees (line 3100). Positive and negative temperatures have different formulas. Iteration is not needed, as the DIN equation can be used directly.

Output parameter is set point SP in terms of volts.

```
2900 REM SUBROUTINE TO CALCULATE TEMPERATURE FROM RESISTANCE DATA
2910 REM ITERATION IS BASED ON DIN 43760 EQUATION.
2920    T=TSTART
2930    IF R<100 THEN GOTO 3000
2940    FOR I=1 TO 20
2950    T=(R-100+5.80195E-05*T*T)/.390802
2960    NEXT
2970    TSTART=T
2980    T=T+273.15
2990    GOTO 3050
3000    FOR I=1 TO 20
3010    T=(R-100+5.80195E-05*T*T+4.2735E-10*(T-100)*T*T*T)/.390802
3020    NEXT
3030    TSTART=T
3040    T=T+273.15
3050 RETURN


3080 REM SUBROUTINE TO CALCULATE SET POINT RESISTANCE FROM SET POINT
3090 REM TEMPERATURE.
```

```
3100 T=VAL(B$)-273.15
3110 IF T<0 THEN 3140
3120 SP=(1+3.90802E-03*T-5.80195E-07*T*T):REM SP IN VOLTS
3130 GOTO 3150
3140 SP=(1+3.90802E-03*T-5.80195E-07*T*T-4.2735E-12*(T-100)*T*T*T):REM SP IN VOLTS
3150 RETURN
```

15. AVSI2/AVS-46 INTERFACE CONNECTOR

PIN No	SIGNAL DESCRIPTION
1	5V TTL power output from AVS-46
2	TTL GND ground
3	TTL GND ground
4	REM MUX DOWN o/c output from AVSI
5	REM MUX UP o/c output from AVSI
6	not used
7	OVERRANGE output from AVS-46
8	not used
9	RANGE DATA 2 output from AVS-46
10	RANGE DATA 1 output from AVS-46
11	RANGE DATA 0 output from AVS-46
12	EXC DATA 2 output from AVS-46
13	EXC DATA 1 output from AVS-46
14	EXC DATA 0 output from AVS-46
15	AUTORANGE DOWN o/c output from AVSI
16	AUTORANGE UP o/c output from AVSI
17	AUTOEXC DOWN o/c output from AVSI
18	AUTOEXC UP o/c output from AVSI
19	not used
20	not used
21	MUX DATA 3
22	MUX DATA 2
23	MUX DATA 1
24	MUX DATA 0
25	+5V TTL power output from AVS-46
26	POLARITY output from AVS-46
27	STROBE output from AVS-46
28	BUSY output from AVS-46
29	not used
30	not used
31	SR DATA serial output "DATA" from AVSI
32	SR STROBE serial output "STROBE" from AVSI
33	SR CLOCK serial output "CLOCK" from AVSI
34	DISPLAY DATA 3 output from AVS-46
35	DISPLAY DATA 2 output from AVS-46
36	DISPLAY DATA 1 output from AVS-46
37	DISPLAY DATA 0 output from AVS-46 (LSB)
38	DECIMAL POINT DISABLE output from AVSI (low when disabled)
39	+15V power output from AVS-46
40	-15V power output from AVS-46

16. A SIMPLE RS232 TO CURRENT LOOP ADAPTER

Figure 16-1 shows a simple adapter circuit which enables you to make use of the optoisolated current loop mode even though your computer does not have a current loop serial port.

In case of ground loop problems, spend one or two hours for building this adapter. Then your computer will be isolated from the AVS-46, and proper grounding of the measurement circuit becomes much easier.

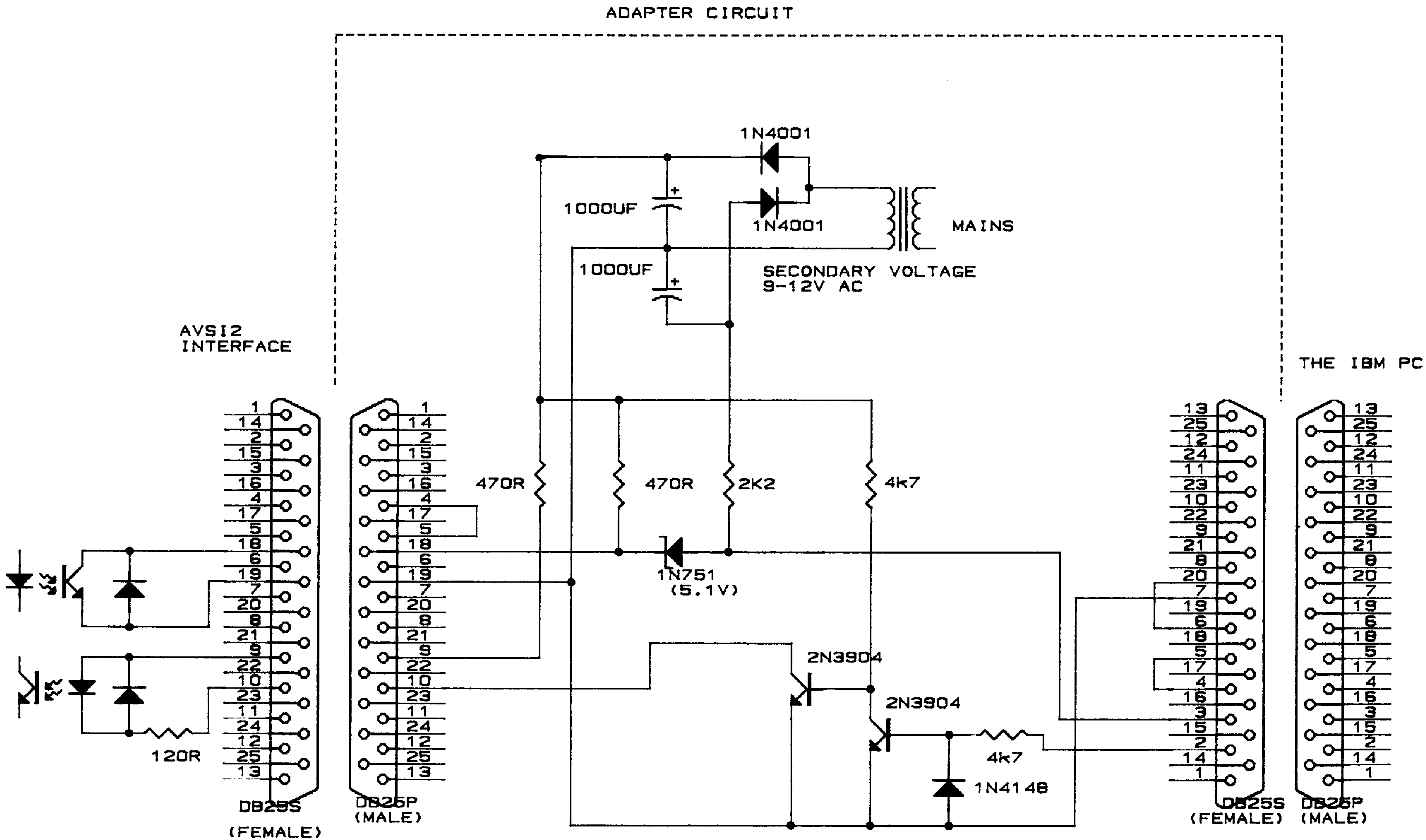


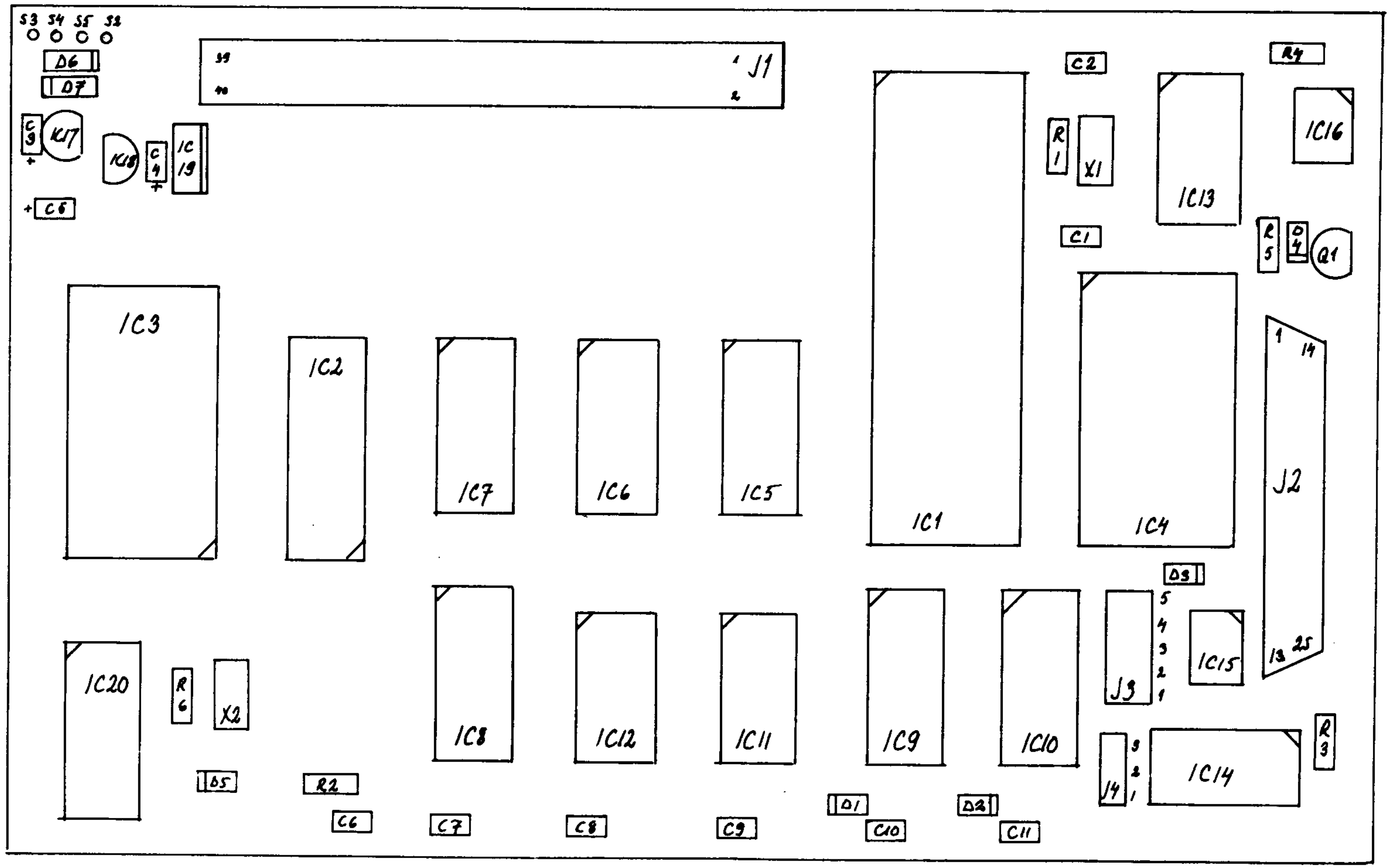
FIG 16-1: RS232 TO CURRENT LOOP ADAPTER
Note that jumpers 6-20 and 4-5 apply for the IBM PC. Jumpers for PC/AT are shown on page 7. AVSI2 pins 4 and 5 must be always connected together.

RV-Elektroniikka Oy
Veromiehentie 14
SF-01510 VANTAA
FINLAND

ALPHABETICAL INDEX

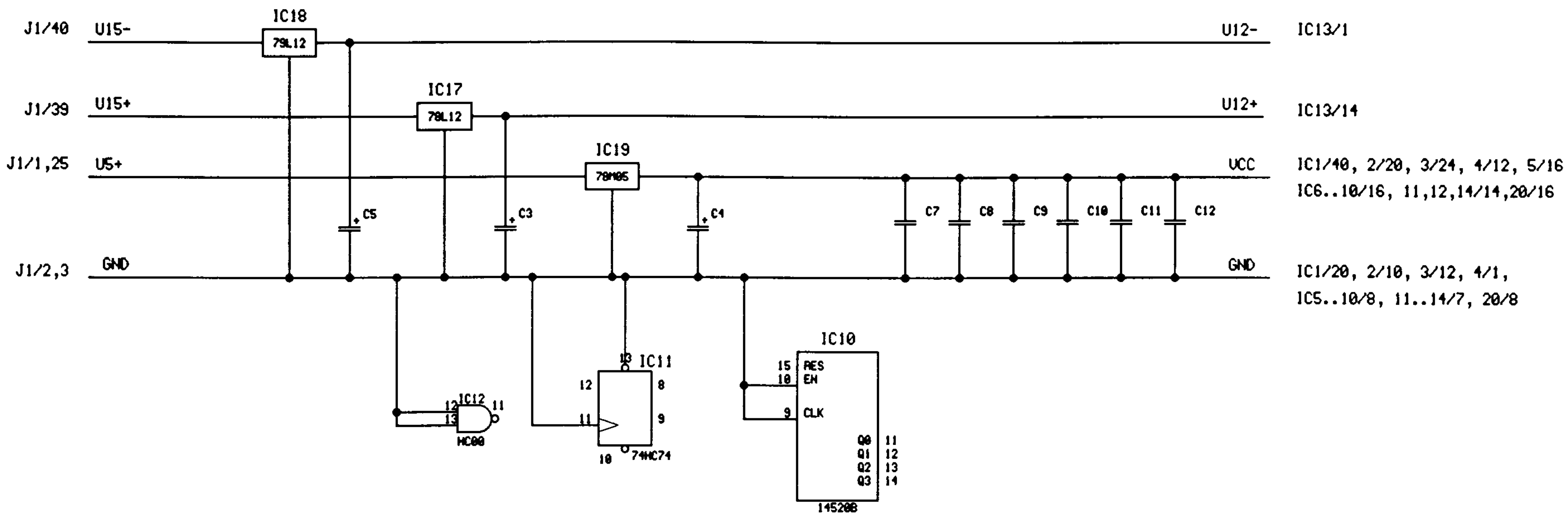
DC-500 PARTS LIST (TSI Serial Interface Unit)

SYMB	TYPE
X1	Crystal TQ HC-18U 5,000 MHz
IC1	MC146805E2
IC2	74HC573N
IC3	M2716 SGS
IC4	MC6850
IC5	MC74HC365N
IC6	MC74HC365N
IC7	MC74HC365N
IC8	MC74HC138N
IC9	MC14526BCP
IC10	MC14520BCP
IC11	MM74C74N
IC12	MM74C00N
IC13	MC1488P
IC14	MC1489L
IC15	TIL116
IC16	TIL116
IC17	MC78L12CP
IC18	MC79L12CP
IC19	MC7805CT
R1	10 M, 250 mW/5 %
R2	10 K, 250 mW/5 %
R3	120R, 250 mW/5 %
R4	150R, 250 mW/5 %
R5	10 k, 250 mW/5 %
R6	10 M, 250 mW/5 %
R7	100k, 250 mW/5 %
C1	15 pF/63 V ker. kond
C2	15 pF/63 V ker. kond
C3	1 uF/35 V tant.
C4	1 uF/35 V tant.
C5	1 uF/35 V tant.
C6	100 nF/63 V
C7	100 nF/63 V
C8	100 nF/63 V
C9	100 nF/63 V
C10	100 nF/63 V
C11	100 nF/63 V
C12	0,47 uF/35 V tant.
D1	1N4148
D2	1N4148
D3	1N4148
D4	1N4148
D5	1N4148
D6	1N4001
D7	1N4001
J1	40 PIN CONN PANDUIT
J2	DB25S-1B1N ITT CANNON
J3P	PINS 2 x 5S
J4P	PINS 1 x 3
J3	STRAP AKS/Z
J4	STRAP AKS/Z
J5	SOCKET 24 PIN DIL

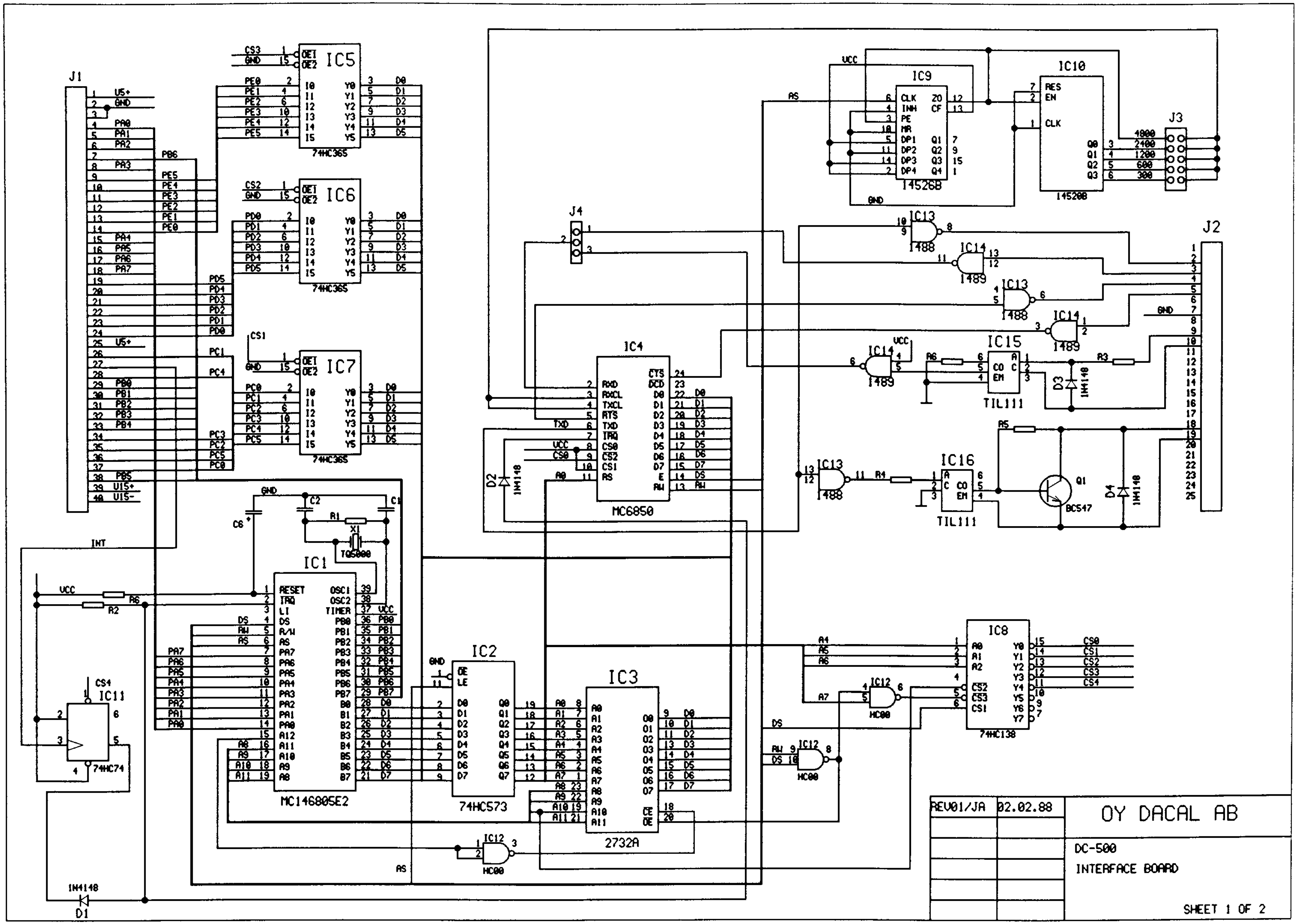


TSI Serial Interface Unit

6/85		OY DACAL AB
7/85		
		DC-500
		PARTS LAYOUT 1/1



REV01/JA	02.02.88	OY DACAL AB
		DC-500 POWER CIRCUITS UNUSED COMPONENTS SHEET 2 OF 2



OY DACAL AB
DC-500
INTERFACE BOARD
SHEET 1 OF 2
REV01/JA 02.02.88
IC1 MC146805E2
IC2 74HC573
IC3 2732A
IC4 MC6850
IC5 74HC365
IC6 74HC365
IC7 74HC365
IC8 74HC138
IC9 14526B
IC10 14520B
IC11 74HC74
IC12 HC00
IC13 1488
IC14 1489
IC15 TIL111
IC16 TIL111
Q1 BC547
D1 1N4148
D2 1N4148
D3 1N4148
D4 1N4148
X1 TQ5000
J1
J2
J3
J4