TARFALA RESEARCH STATION

PACE (Permafrost And Climate in Europe) permafrost monitoring station, 2000–2014

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MONITORING REPORT

April 12, 2016

Contents

1 Instrumentation

The PACE (Permafrost and Climate In Europe) permafrost monitoring station was established on the Tarfala ridge ($\sim$1550 m a.s.l.) in 2000. Two bore holes, 15 m and 100 m were drilled and instrumented with overlapping thermistor strings. The two boreholes provide detailed coverage of near surface, rapidly fluctuating temperatures and the deeper temperatures at lower density. A data logger was installed at the ground surface also monitoring a T/Rh probe for air temperature and humidity. The station was replaced by a new CR1000-based system in September 2014. This report thus summarizes the data from the period 2000–2014 from the now discontinued older station setup.

Sensor	Serial number	Remark
Vaisala T/Rh		in Young screen
CR10X-2M data logger		

The thermistor strings use a PACE uniform standard for depth. The 15 m borehole has thermistors at 0.2, 0.4, 0.8, 1.2, 1.6, 2, 2.5, 3, 3.5, 4, 5, 7, 9, 10, 11, 13 and 15 m below the ground surface. The 100 m borehole has thermistors at 0.2, 0.4, 0.8, 1.2, 1.6, 2, 2.5, 3, 3.5, 4, 5, 7, 9, 10, 11, 13, 15, 20, 25, 30, 40, 50, 60, 70, 80, 85, 90, 95, 97.5, and 100 m below the ground surface. The thermistors down to 5 m in the 100 m borehole and all thermistors in the 15 m borehole are logged every six hours while the entire 100 m borehole down to the bottom is logged every 24 h.

2 Notes on the station data

- Data gaps at the beginning of the series is due to battery failure and a logger type that would not retain data when power was lost. The logger had a card storage but even this backup failed on occasions.
- The CR-10 data logger has been replaced on several occasion upgrading from the older CR-10 to CR-10X based loggers.
- The T/Rh probe has been replaced on several occasions due to failure
- Problems towards the end of the record is due to an ailing data logger

3 Data coverage

- General data gaps:
  Start date: 2000-89/1201
  Good data from:2000-05-18 12:01:00
  2001-01-14 12:01:00 - 2001-01-15 06:01:00
  2001-01-15 12:01:00
  2001-02-10 12:01:00 - 2001-02-10 18:01:00
  2001-02-19 00:01:00 - 2001-04-08 18:01:00
  2001-07-31 12:01:00
  2001-08-18 12:01:00 - 2002-04-20 06:01:00
  2002-07-22 06:01:00 - 2003-01-01 12:01:00
  2003-01-10 12:01:00 - 2003-03-31 12:01:00
  2003-07-30 18:01:00 - 2003-08-02 18:01:00
  2011-09-13 06:01:00 - 2012-04-20 00:01:00
  2012-04-23 06:01:00 - 2012-05-12 00:01:00
  2012-09-09 06:01:00 - 2013-07-10 18:01:00
  2013-11-09 12:01:00 - 2014-05-12 12:01:00
  End date: 2014-09-04 12:01:00

4 Notes on data storage

Data was collected and stored in four different output routines. The two bore hole thermistor strings are stored in separate rows at six hour intervals. Climate data is stored in a separate row at six hour intervals. Finally there is a row for daily output.

The raw data file has been split into separate files containing the different types of output. Missing data is indicated by `NaN` (Not-a-Number). The Day-of-Year/hour-minute time print has been replaced by an ISO date and time format (`yyyy-mm-dd HH:MM:SS`). Data gaps have been padded by `NaN`s to better signal the breaks. The raw data file, however, still retain the original data with its errors.

Example of six-hour data from the $100\,\mathrm{m}$ borehole:

```
2000-05-18 12:01:00,13.97,6.66,-0.310,8.60,3.196,1.144,
0.246,-0.035,-0.560,-1.148,-1.738,-1.562,-0.552,1.703,5.174
```

Column	Example data	Description
01:	`2000-05-18 12:01:00`	Date and time stamp
02:	`13.97`	Battery voltage
03:	`6.66`	Logger temperature
04:	`-0.310`	Rtherm1/Ttherm1
05:	`8.60`	Rtherm32/Ttherm32
06:	`3.196`	(and on) 11 thermistor temperatures down to $5\,\mathrm{m}$

Example of six-hour data from the $15\,\mathrm{m}$ borehole:

```
2000-05-18 12:01:00,13.97,6.66,-0.310,8.60,3.208,0.878,
-0.104,-0.966,-1.898,-2.218,-1.536,-0.478,-2.184,-3.515,-3.501,
-3.320,-3.036,-2.945,-2.937,-2.942,-2.787
```

Column	Example data	Description
01:	`2000-05-18 12:01:00`	Date and time stamp
02:	`13.97`	Battery voltage
03:	`6.66`	Logger temperature
04:	`-0.310`	Rtherm1/Ttherm1
05:	`8.60`	Rtherm32/Ttherm32
06:	`3.208`	(and on) 17 thermistor temperatures

Example of climate output:

```
2000-03-29 12:01:00,13.51,31.3
```

Column	Example data	Description
01:	`2000-03-29 12:01:00`	Date and time stamp
02:	`13.51`	Temperature
03:	`31.3`	Relative humidity

Example of daily output:

```
2000-05-19 00:01:00,13.24,2.449,-0.312,8.61,1.081,0.397,
0.002,-0.411,-1.332,-2.340,-3.345,-3.717,-3.596,-2.875,-2.300,
-3.347,-3.067,-3.005,-3.018,-3.043,-3.117,-3.260,-3.299,-3.299,
-3.243,-3.183,-3.108,-3.060,-2.946,-2.882,-2.832,-2.800,-2.754,-2.730
```

Column	Example data	Description
01:	`2000-05-19 00:01:00`	Date and time stamp
02:	`13.24`	Battery voltage
03:	`2.449`	Logger temperature
04:	`-0.312`	Rtherm1/Ttherm1
05:	`8.61`	Rtherm32/Ttherm32
06:	`1.081`	(and on) 30 thermistor temperatures

Example of monthly average values:
`2000,7,5.8527,124,76.239,124`

Column	Example data	Description
01:	`2000`	Year
02:	`7`	Month
03:	`5.8527`	Monthly average temperature
04:	`124`	Number of values in the average
05:	`76.239`	Monthly average relative humidity
06:	`124`	Number of values in the average

The data collected in the period 2000–2014 is summarized figure 1.

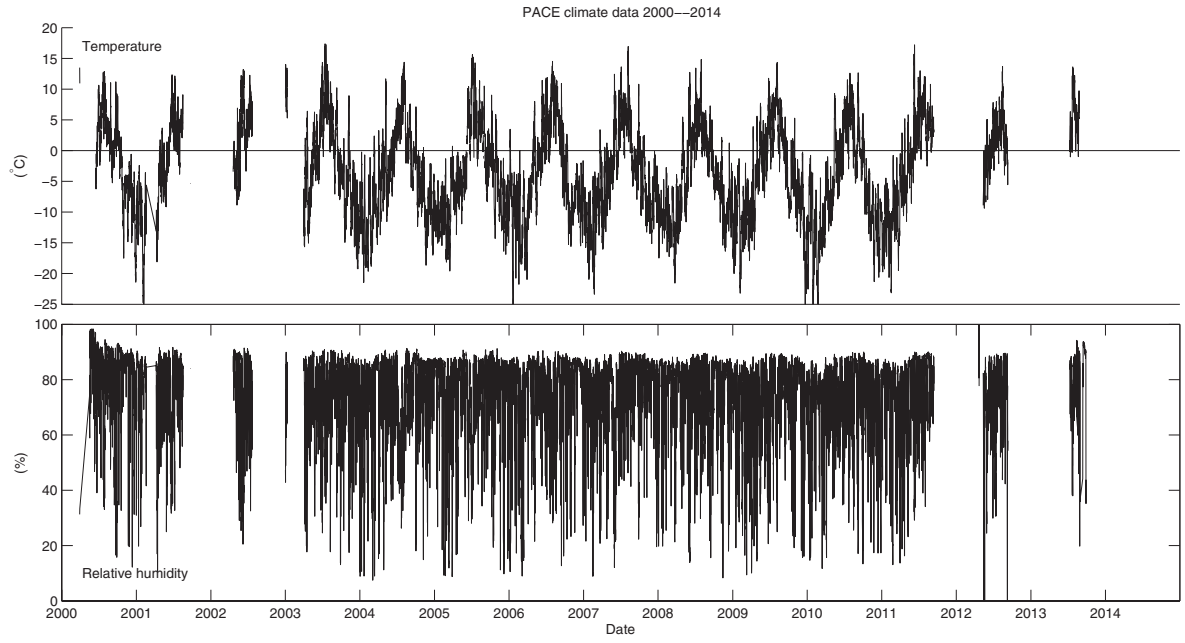

Figure. 1. Summary of meteorological data from the PACE Station 2000–2014.

Logger program

4.1 Program for the period 2000–2014

```
;{CR10X}
;;*************************************************************
;PACE BORE HOLE TEMPERATURES PACEBHT10, 2 chains: 30 and 17 thermistors
;V4.1 24.4.99  PROGRAM Tarfala
;AlpuG, Hansueli Gubler, AlpuG@csi.com
;AlpuG, Richtstattweg2, CH-7270 Davos Platz
;T/F +41 (0)81 416 10 19
;copyright by AlpuG
;*************************************************************
;
;features:
;
;
;measurements intervals 60s wind, 1min meteo, 6h 12h Therm. chains
;21X logger connected to AM416 and CSM1 (data storage)
;stores thermistor temp. 1..11 at 6h intervals (chain 1)
;stores thermistor temp. 1..30 at 24h intervals (chain 1)
;stores thermistor temp. 1..17 at 6h intervals (chain 2)
;thermistors YSI 44006 wired to common exitation
;
;METEO
;TAir : Thermistor T107 (SelTair=1, SE5, EX2) or linear output (SelTair=2, SE5) or PT100 ( SE11/SE12 not together with longwave rad)
;RH% : SE6 PS 12V C1-switched 12V ( Rotronik, HMP....)
;Wind: low level AC or switch closure to p11
;WindDir: potentiometric SE10/EX3 not together with longwave rad
;CNR1 CM3 balance only to D4
;CNR1 CG3 balance only to D4 and reference temp PT100 to SE11/12 not together with wind dir or HMP45P
;
;temp calc. using Steinhart Hart eq.
;1/(T+DT)=A+B(lnR)+D(lnR)^3, DT corr. from 0C calibration
;Ref. resistors Rref = 1000E, 0.1% 3ppm/C
;resolution -5..5C 0.0025C / -30..15C 0.005C at VEX = 1000/ 5000mV, Sens 50 / 500mV
;settling time <1ms
;absolute errors: at 0+-5C after calibration = error of calbr. +- 0.01C max.
;full range +-0.02C
;data stored to PC card in CSM1 if inserted
;data measured and stored at 6h,12h (full set),18h, 24h
;calibration values:
;Mantissa coeff A, B, D:  @ coefA, @  coefB, @  coefC
;calibration bath temp  @ CalTempC
;value of bridge resistor in @  RefResist
;individual temp corrections thermistors L83 DTther_2 to L112 DTther_31: chain 1,Thermistor #1 ..#30
;L114 DTther_33 to L130 DTther_49 Chain 2 Thermistor #1..17
;Thermistor #1 at gound surface!
;Calibration is lost if progam is recompiled or powerd down etc. use only *6 command
;calibration values  DTther can be typed in manualy (or be corrected) using *6, better use PC208
;standard values for A,B,D are loaded any time prog is powered up or recompiled or Initflag L1 is set =0
;standard values A= 1.0232 E-3, B= 2.4038 E-4, C=1.4988 E-7
;BORE HOLE ID TARFALA, 2099, 2199
;
;AM416 wiring:
;AM416 inputs set1 H1 30k to EX1, set 8 L2 20k to EX1
;set 1, L1 ...set 8, H2 thermistor 1..30 (chain 1)
;set 9,H1 ...set 13,H1 thermistor 1..17 (chain 2)
;
;Logger wiring:
;SE1..SE4 to AM416 outputs H1..L2
;SE5 AirTemp Thermistor incl Exitation Ex2
;SE6 RH Sensor
;D4 CM3 differential (CNR1)
;D5 CG3 differential (CNR1) or SE10 WindDir with EX3 or (IRRef SE9 and IR SE10)
;S11/SE12 3wire half bridge for PT100 either for CNR1,CG3 or HMP45P. PT to AG, Ref to EX.
;
;EX1 to thermistor common
;Ex2 AirTemp, Ref Temp IR, Ref Temp CNR1
;Ex3 WindDir
;
;P1 Wind low level AC or switch closure
;
;C1 Control to switched 12V for RH%/AirTemp
;C2
;C3
;C4 SR50 SDI input (Snow height)
;C5
;C6 to AM417 CLK
;C7 to AM416 Res
;C8
; G to AM416 GRD
;12V to AM416 12V input
;
;Main table Table 1 at s.r. 60s. Include commands for additional measurements here or in table 2 ( not used yet)
;Subs
```

```
; 1 Initialisation ( sets loc 1, INITflag)
; 2 resistivity measurements all thermistors
; 3 temp. calcutation all sensors
; 4 save 6h values (ID 6)
; 5 save 24H values (ID24)
; 6 calibration ( flag7=1), Calibr.Temp 0C = 273.15K default(Loc 5, CalTempC)
; Calibration arrays resist. in kE, T in C , DT in C
; Calibration records ID 50 Res., T, DT
; 7 save 6h values ID206 profile
;82:Init. Status
;83:Sensor Quality Evaluation
;84:Quality calculation sub
;85:Status Convert Binary
;86:SHM snowheight
;90:SHM Temp. comp
;91:meteo measurements
;92:IR calibration

; Flags
; 1 inhibit measurements and store (profile 1 and profile 2 and any other measurements included)
; 2 inhibit measurements and store profile 2
; 3 Immediate chain meas. 1x. no storage
; 6  and 7 calibration profile 1( reset automatically)
; 5  and 7 calibration profile 2 (flag 2 reset!)
;
;Input Loc see also DB
; 1 INITFLAG
; 2 VBatt
; 3 TLOG
; 4 bore hole ID
; 5 CalTempC
; 6 RefResistors
; 7..8 Coef A,B,D
; 10 Status
; 11 Quality
; 12...23 Meteo
; 30..81  T measured
; 82..133  DT Temp. Korr values
; 143..185  R
;
;
;STATUS, QUALITY
;2^n, n=0..12, L10
;StatS (L220...234) is reset to Status(L10, Sub 82) after
;determination of QUALITY(L11) for past interval.
;value: Status, Quality
;Loc: Status-, Quality array L220..234
;
;n     0   1   2    3     4    5   6   7   8   9   10   11
;value 1   2   4    8     16   32  64  128 256 512 1024 2048
;Loc   220 221 222  223   224  225 226 227 228 229 230  231
;param TA  RH  WIND WindD HS1  KW  LW  IR      Batt
;
;12      13      14
;4096    8192    16384
;232     233     234
;
;
;Output Records (data)
;ID, HEADER, control data, data
;Header:
;bore hole ID, YEAR,DAY,HHMM
;Control Data:
;VBatt, TLOG, Rtherm_1/Ttherm_1,Rtherm_32/Ttherm_32 (same unit as data)
;Data:
;thermistor 1 ...thermistor 11 /30 (6h / 24h data) units Tin C, DT in C, R in KE
;6h data:
;6,HEADER,control data, T1..T11 (20 values)
;24h data:
;24, HEADER,control data, T1..T30 ( 39 values)
;206,Header,control data,T1(P2)....T17(P2)  (25values)
;calibration records:
;50, HEADER,  Rtherm_1....Rtherm_49,Ttherm_1..Ttherm_49, DTter_1..DTther_49
;(#1 and #32 are the test values with fixed resistors)
;Meteo 6h
;66,HEADER,Windmean, Winddirmean,TAir,RHAir,Shortwave incomming, Shortwavebalance,
;Longwave incoming, Longwave balance, Surf.Temp, Snowdepth
;
;Table 4 values @
;0 Status
;1 ID
;2 Calibr. bath temp. 0C
;3 Ref Resist. Therm Chains 1000E
;4 Coef, Mantissa A
;5                B
;6                D
;7 IRTC Beta
```

```
;8 IRTCP2
;9 SHMH1 instrument height
;10 SelTair 1 T107, 2 linear Volt, 3 PT100 (3)
;11 Wind input config: low level AC 21, switch closure 22 (21)
;12 wind speed multiplier
;13 and 14 meteo storage inertval (360min)
;15 CNR1 CM3 multipl.
;16 CNR1 CG3 multiplier
;17 RH% multipl.
;18 Tair multipl. (Volt. Input)
;19 Tair offset       "
;
;


*Table 1 Program
  01: 60        Execution Interval (seconds)
;-----------------------------------
;INIT Parameters
;-----------------------------------

1:  If (X<=>F) (P89)
 1: 1        X Loc [ INITFlag  ]
 2: 1        =
 3: 0        F
 4: 1        Call Subroutine 1

;-----------------------------------
;Test of Battery Voltage. Inhibit measurements and store if <10V
;-----------------------------------

2:  Batt Voltage (P10)
 1: 2        Loc [ VBatt     ]

3:  Internal Temperature (P17)
 1: 3        Loc [ TLOG      ]

4:  If (X<=>F) (P89)
 1: 2        X Loc [ VBatt     ]
 2: 4        <
 3: 10       F ;limiting batt. volt
 4: 0        Go to end of Program Table

;-----------------------------------
;Inhibit measurements if flag 1 set
;-----------------------------------

5:  If Flag/Port (P91)
 1: 11       Do if Flag 1 is High
 2: 0        Go to end of Program Table

;++++++++++++++++++++++++++++++++++++
;insert additional program instructions for meteo parameters here
;will be measured at 1 min interval, average for 6 hour output
;include extra meteo output record
;++++++++++++++++++++++++++++++++++++

6:  If (X<=>F) (P89)
 1: 221      X Loc [ StatS_2   ]
 2: 3        >=
 3: 1        F
 4: 30       Then Do


     7:  If time is (P92)
      1: 50    -- Minutes (Seconds --) into a
      2: 60       Interval (same units as above)
      3: 41       Set Port 1 High
; Turn 12V on for meteo measurements


8:  End (P95)


9:  IF (X<=>F) (P89)
 1: 222      X Loc [ StatS_3   ]
 2: 3        >=
 3: 1        F
 4: 30       Then Do
;.....................................................
;Sub 87 wind evaluation
;-----------------------------------------------------


     10:  Pulse (P3)
      1: 1        Reps
      2: 1        Pulse Input Channel
```

```
      3: 21       Low Level AC, Output Hz @@11
      4: 19       Loc [ Windvact  ]
      5: .09778   Mult @@12
      6: 0.0000   Offset
;.....................................................
;Input windpuls, calc. actual speed
;-----------------------------------------------------

     11:  IF (X<=>F) (P89)
      1: 223      X Loc [ StatS_4   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do
;-----------------------------------------------------
;Wind  direction analys. measurement
;-----------------------------------------------------

          12:  Excite-Delay (SE) (P4)
           1: 1        Reps
           2: 15       ñ 2500 mV Fast Range
           3: 10       SE Channel
           4: 3        Excite all reps w/Exchan 3
           5: 2        Delay (units 0.01 sec)
           6: 1800     mV Excitation
           7: 20       Loc [ WindDirac ]
           8: .2       Mult
           9: 0.0000   Offset
;Windrichtung----------------------

          13:  If time is (P92)
           1: 0        Minutes (Seconds --) into a
           2: 360      Interval (same units as above) @@13
           3: 10       Set Output Flag High

          14:  Set Active Storage Area (P80)
           1: 3        Input Storage Area
           2: 264      Array ID or Loc [ WndScMea  ]

          15:  Wind Vector (P69)
           1: 1        Reps
           2: 600      Samples per Sub-Interval
           3: 01       S, é1 Polar
           4: 19       Wind Speed/East Loc [ Windvact  ]
           5: 20       Wind Direction/North Loc [ WindDirac ]

;Windmittelung---------------------------------


     16:  Else (P94)

          17:  Average (P71)
           1: 1        Reps
           2: 19       Loc [ Windvact  ]
; windmean without direction measurement

     18:  End (P95)


19:  End (P95) ;wind eval.

;-----------------------------------
;thermistor measurements and temp. calc. every 6h
;-----------------------------------

20:  If time is (P92)
 1: 0        Minutes into a
 2: 360      Minute Interval
 3: 30       Then Do

     21:  Do (P86)
      1: 2        Call Subroutine 2

     22:  Do (P86)
      1: 3        Call Subroutine 3

23:  End (P95)


24:  If Flag/Port (P91)
 1: 13       Do if Flag 3 is High
 2: 30       Then Do

     25:  Do (P86)
      1: 2        Call Subroutine 2

     26:  Do (P86)
      1: 3        Call Subroutine 3
```

```
     27:  Do (P86)
      1: 23       Set Flag 3 Low

28:  End (P95)
;-----------------------------------
;store temp. data at 6h intervall
;-----------------------------------

29:  If time is (P92) ;   profile 1
 1: 1        Minutes into a
 2: 1440     Minute Interval
 3: 5        Call Subroutine 5

30:  If time is (P92) ;   profile 1
 1: 1        Minutes into a
 2: 360      Minute Interval
 3: 4        Call Subroutine 4


31:  If Flag/Port (P91) ;   profile 2
 1: 22       Do if Flag 2 is Low
 2: 30       Then Do

     32:  If time is (P92)
      1: 1        Minutes into a
      2: 360      Minute Interval
      3: 7        Call Subroutine 7

33:  End (P95)

;-----------------------------------
; do calibration and store calibration data if flag 6/5  and 7 are set
;-----------------------------------

34:  If Flag/Port (P91)
 1: 17       Do if Flag 7 is High
 2: 30       Then Do

     35:  If Flag/Port (P91) ;  profile 1
      1: 16       Do if Flag 6 is High
      2: 6        Call Subroutine 6


     36:  If Flag/Port (P91) ;  profile 2
      1: 15       Do if Flag 5 is High
      2: 6        Call Subroutine 6


     37:  Do (P86)
      1: 26       Set Flag 6 Low

     38:  Do (P86)
      1: 27       Set Flag 7 Low


     39:  Do (P86)
      1: 25       Set Flag 5 Low

40:  End (P95)

; store on PC card

41:  Serial Out (P96)
 1: 71       SM192/SM716/CSM1

;*****************************************************

*Table 2 Program
  02: 60        Execution Interval (seconds)

1:  If (X<=>F) (P89)
 1: 2        X Loc [ VBatt     ]
 2: 4        <
 3: 10       F ;limiting batt. volt
 4: 0        Go to end of Program Table

2:  If Flag/Port (P91)
 1: 11       Do if Flag 1 is High
 2: 0        Go to end of Program Table

3:  Do (P86)
 1: 91       Call Subroutine 91
;.....................................................
;Standard measurements every 60s
;-----------------------------------------------------
```

```
4:  IF (X<=>F) (P89)
 1: 224      X Loc [ StatS_5   ]
 2: 3        >=
 3: 1        F
 4: 30       Then Do ; nur wenn shm1 vorhanden und EIN

     5:  Do (P86)
      1: 86       Call Subroutine 86

; check result replace with old value if error, set quality

     6:  If (X<=>Y) (P88)
      1: 18       X Loc [ HSactual  ]
      2: 3        >=
      3: 22       Y Loc [ SHMH1     ]
      4: 30       Then Do

          7:  Z=X (P31)
           1: 266      X Loc [ HSold     ]
           2: 18       Z Loc [ HSactual  ]


          8:  Z=Z+1 (P32)
           1: 224      Z Loc [ StatS_5   ]

     9:  Else (P94)

          10:  Z=X (P31)
           1: 18       X Loc [ HSactual  ]
           2: 266      Z Loc [ HSold     ]

     11:  End (P95)


12:  End (P95) ;SHM


13:  If time is (P92)
 1: 1        Minutes (Seconds --) into a
 2: 360      Interval (same units as above) @@14
 3: 10       Set Output Flag High (Flag 0)

;.....................................................
;Calc. Quality, prepare data for output 30min interval
;-----------------------------------------------------

14:  If Flag/Port (P91)
 1: 10       Do if Output Flag is High (Flag 0)
 2: 85       Call Subroutine 85
;.....................................................
;Quality bin,,r wandeln
;-----------------------------------------------------

15:  Set Active Storage Area (P80)
 1: 1        Final Storage Area 1
 2: 66       Array ID
;.....................................................
;prepare meteoarray
;-----------------------------------------------------


16:  Real Time (P77)
 1: 1110     Year,Day,Hour/Minute

17:  Sample (P70)
 1: 1        Reps
 2: 4        Loc [ BoreHole  ]

18:  Sample (P70)
 1: 2        Reps
 2: 264      Loc [ WndScMea  ]

19:  Average (P71)
 1: 2        Reps
 2: 12       Loc [ Tactual   ]

20:  Average (P71)
 1: 4        Reps
 2: 14       Loc [ ShortWdo  ]


21:  Average (P71)
 1: 1        Reps
 2: 21       Loc [ TsurfIR   ]

22:  Sample (P70)
 1: 1        Reps
```

```
 2: 18       Loc [ HSactual  ]


23:  If Flag/Port (P91)
 1: 10       Do if Output Flag is High (Flag 0)
 2: 82       Call Subroutine 82

;---------------------------------------------------


*Table 3 Subroutines

;*****************************************************
;Sub 1 Initialitation
;*****************************************************

1:  Beginning of Subroutine (P85)
 1: 1        Subroutine 1


     2:  Set Port(s) (P20)
      1: 9749     C8..C5 = nc/output/10ms/nc
      2: 9997     C4..C1 = nc/nc/nc/output


     3:  Z=F (P30)
      1: 515      F @@0
      2: 0        Exponent of 10
      3: 10       Z Loc [ Status    ]



     4:  Z=F (P30)
      1: 1        F
      2: 0        Exponent of 10
      3: 1        Z Loc [ INITFlag  ]

 ;Borehole ID

     5:  Z=F (P30)
      1: 2099     F @@1
      2: 0        Exponent of 10
      3: 4        Z Loc [ BoreHole  ]

;Calibration Bath Temp.

     6:  Z=F (P30)
      1: 0        F @@2
      2: 0        Exponent of 10
      3: 5        Z Loc [ CalTempC  ]

;Reference Resistor for Therm. Chains

     7:  Z=F (P30)
      1: 1000     F @@3
      2: 0        Exponent of 10
      3: 6        Z Loc [ RefResist ]

;Linearisation and calibration coefs

     8:  Z=F (P30)
      1: 1.0232   F @@4
      2: -3       Exponent of 10
      3: 7        Z Loc [ coefA     ]


     9:  Z=F (P30)
      1: 2.4038   F @@5
      2: -4       Exponent of 10
      3: 8        Z Loc [ coefB     ]


     10:  Z=F (P30)
      1: 1.4988   F @@6
      2: -7       Exponent of 10
      3: 9        Z Loc [ coefD     ]

;IR Surface temp

     11:  Z=F (P30)
      1: 5        F @@7
      2: 0        Exponent of 10
      3: 289      Z Loc [ IRTCBeta  ]

     12:  Z=F (P30)
      1: .7       F @@8
      2: 0        Exponent of 10
```

```
      3: 288      Z Loc [ IRTCP2    ]

; Snow Height ref. height

     13:  Z=F (P30)
      1: 500      F @@9
      2: 0        Exponent of 10
      3: 22       Z Loc [ SHMH1     ]

; Select type of Tair instr.

     14:  Z=F (P30)
      1: 3        F @@10
      2: 0        Exponent of 10
      3: 28       Z Loc [ SelTair   ]

; Prog. Vers.

     15:  Z=F (P30)
      1: 5        F
      2: 0        Exponent of 10
      3: 27       Z Loc [ ProgVers  ]

;Termistor Calibration TK008, TK009


     16:  Bulk Load (P65)
      1: .018     F ;                 TK008
      2: -.032    F
      3: -.032    F
      4: .011     F
      5: .026     F
      6: -.011    F
      7: -.018    F
      8: .004     F
      9: 83       Loc [ DTther_2  ]

     17:  Bulk Load (P65)
      1: .062     F
      2: .004     F
      3: -.011    F
      4: .011     F
      5: .004     F
      6: -.076    F
      7: .084     F
      8: .018     F
      9: 91       Loc [ DTther_10 ]

     18:  Bulk Load (P65)
      1: -.025    F
      2: -.076    F
      3: -.003    F
      4: .069     F
      5: -.018    F
      6: .011     F
      7: .004     F
      8: -.04     F
      9: 99       Loc [ DTther_18 ]

     19:  Bulk Load (P65)
      1: -.047    F
      2: -.054    F
      3: .026     F
      4: .069     F
      5: .004     F
      6: .048     F
      7: 0.0      F ;   Calib. value
      8: .062     F ;               TK009
      9: 107      Loc [ DTther_26 ]

     20:  Bulk Load (P65)
      1: .077     F
      2: .033     F
      3: .011     F
      4: .084     F
      5: -.040    F
      6: .011     F
      7: -.003    F
      8: .004     F
      9: 115      Loc [ DTther_34 ]

     21:  Bulk Load (P65)
      1: .004     F
      2: -.003    F
      3: -.12     F
      4: .011     F
      5: -.040    F
```

```
      6: .12      F
      7: .105     F
      8: -.003    F
      9: 123      Loc [ DTther_42 ]

     22:  Do (P86)
      1: 82       Call Subroutine 82

23:  End (P95) ;sub

;**********************************
; measurement of R(thermistors) 1..30 incl. control data
;**********************************


24:  Beginning of Subroutine (P85)
 1: 2        Subroutine 2


     25:  Set Port(s) (P20)
      1: 9749     C8..C5 = nc/output/10ms/nc
      2: 9999     C4..C1 = nc/nc/nc/nc

; reset and enable AM416

     26:  Do (P86)
      1: 47       Set Port 7 High

     27:  Z=F (P30)
      1: 133      F
      2: 0        Exponent of 10
      3: 201      Z Loc [ destloc   ]

     28:  Beginning of Loop (P87)
      1: 0        Delay
      2: 13       Loop Count


          29:  Do (P86)
           1: 76       Pulse Port 6


;+++++++SE1
;Low resolution measurement Vex = 2500mV, Sens = 250mV

          30:  Excite Delay Volt (SE) (P4)
           1: 4        Reps
           2: 4        250 mV Slow Range
           3: 1        SE Channel
           4: 1        Excite all reps w/Exchan 1
           5: 1        Delay (units 0.01 sec)
           6: 2500     mV Excitation
           7: 186      Loc [ inphi_1   ]
           8: .0004    Mult
           9: 0.0      Offset

; High resolution measurement Vex = 500mV, Sens = 25mV

          31:  Excite Delay Volt (SE) (P4)
           1: 4        Reps
           2: 3        25 mV Slow Range
           3: 1        SE Channel
           4: 1        Excite all reps w/Exchan 1
           5: 1        Delay (units 0.01 sec)
           6: 500      mV Excitation
           7: 191      Loc [ inplo_1   ]
           8: .002     Mult
           9: 0.0      Offset

          32:  Beginning of Loop (P87)
           1: 0        Delay
           2: 4        Loop Count


               33:  If (X<=>F) (P89)
                1: 186   -- X Loc [ inphi_1   ]
                2: 4        <
                3: .049     F ; switch to higher resolution
                4: 30       Then Do


                    34:  Z=X (P31)
                     1: 191   -- X Loc [ inplo_1   ]
                     2: 186   -- Z Loc [ inphi_1   ]


               35:  End (P95) ;hi/lo resolution data
```

```
               36:  Z=X (P31)
                1: 186   -- X Loc [ inphi_1   ]
                2: 205      Z Loc [ Xref      ]


               37:  BR Transform Rf[X/(1-X)] (P59)
                1: 1        Reps
                2: 205      Loc [ Xref      ]
                3: 1.0      Mult (Rf)

               38:  Z=1/X (P42)
                1: 205      X Loc [ Xref      ]
                2: 198      Z Loc [ Rtherm0   ]


               39:  Z=X*Y (P36)
                1: 198      X Loc [ Rtherm0   ]
                2: 6        Y Loc [ RefResist ]
                3: 198      Z Loc [ Rtherm0   ]


               40:  Z=F (P30)
                1: 198      F
                2: 0        Exponent of 10
                3: 200      Z Loc [ sourceloc ]

               41:  Z=Z+1 (P32)
                1: 201      Z Loc [ destloc   ]

               42:  Indirect Move (P61)
                1: 200      Source Loc [ sourceloc ]
                2: 201      Destination Loc [ destloc   ]

          43:  End (P95) ;loopinp set1..4

          44:  If Flag/Port (P91)
           1: 12       Do if Flag 2 is High
           2: 30       Then Do

; measure only first chain

               45:  If (X<=>F) (P89)
                1: 201      X Loc [ destloc   ]
                2: 1        =
                3: 165      F
                4: 31       Exit Loop if True

          46:  End (P95)


     47:  End (P95) ;loop input sets


     48:  Z=X (P31)
      1: 190      X Loc [ inphi_5   ]
      2: 196      Z Loc [ VExit     ] ;test not used, check VExit L106

; reset, disable AM416

     49:  Do (P86)
      1: 57       Set Port 7 Low

50:  End (P95) ;Sub 2

;**********************************
;SUB 3 Calculation of temperatures incl. corrections in C
;**********************************


51:  Beginning of Subroutine (P85)
 1: 3        Subroutine 3


     52:  Z=F (P30)
      1: 3        F
      2: 0        Exponent of 10
      3: 206      Z Loc [ expD      ]


     53:  Z=F (P30)
      1: 0        F
      2: 0        Exponent of 10
      3: 204      Z Loc [ loopindex ]

     54:  Beginning of Loop (P87)
      1: 0        Delay
```

```
      2: 49       Loop Count


          55:  Z=Z+1 (P32)
           1: 204      Z Loc [ loopindex ]

;Calc temp in K

          56:  Z=LN(X) (P40)
           1: 134   -- X Loc [ Rtherm_1  ]
           2: 202      Z Loc [ lnT       ]

          57:  Z=X^Y (P47)
           1: 202      X Loc [ lnT       ]
           2: 206      Y Loc [ expD      ]
           3: 203      Z Loc [ lnT3      ]


          58:  Z=X*Y (P36)
           1: 202      X Loc [ lnT       ]
           2: 8        Y Loc [ coefB     ]
           3: 202      Z Loc [ lnT       ]

          59:  Z=X*Y (P36)
           1: 203      X Loc [ lnT3      ]
           2: 9        Y Loc [ coefD     ]
           3: 203      Z Loc [ lnT3      ]

          60:  Z=X+Y (P33)
           1: 7        X Loc [ coefA     ]
           2: 202      Y Loc [ lnT       ]
           3: 207      Z Loc [ Ttherm0   ]

          61:  Z=X+Y (P33)
           1: 207      X Loc [ Ttherm0   ]
           2: 203      Y Loc [ lnT3      ]
           3: 207      Z Loc [ Ttherm0   ]

          62:  Z=1/X (P42)
           1: 207      X Loc [ Ttherm0   ]
           2: 207      Z Loc [ Ttherm0   ]

;Convert to C

          63:  Z=X+F (P34)
           1: 207      X Loc [ Ttherm0   ]
           2: -273.15  F
           3: 207      Z Loc [ Ttherm0   ]

;Apply correction and store

          64:  Z=X+Y (P33)
           1: 207      X Loc [ Ttherm0   ]
           2: 82    -- Y Loc [ DTther_1  ]
           3: 30    -- Z Loc [ Ttherm_1  ]

          65:  If Flag/Port (P91)
           1: 12       Do if Flag 2 is High
           2: 30       Then Do

               66:  If (X<=>F) (P89)
                1: 204      X Loc [ loopindex ]
                2: 1        =
                3: 32       F
                4: 31       Exit Loop if True

          67:  End (P95)

     68:  End (P95) ;loop


69:  End (P95) ;Sub 3


;****************************************
;Sub 4 store 6hvalues
;****************************************

70:  Beginning of Subroutine (P85)
 1: 4        Subroutine 4

     71:  Do (P86)
      1: 10       Set Output Flag High

     72:  Set Active Storage Area (P80)
      1: 1        Final Storage
      2: 6        Array ID
```

```
     73:  Sample (P70)
      1: 1        Reps
      2: 4        Loc [ BoreHole  ]

     74:  Real Time (P77)
      1: 1110     Year,Day,Hour/Minute (midnight = 0000)

     75:  Sample (P70)
      1: 2        Reps
      2: 2        Loc [ VBatt     ]

     76:  Sample (P70)
      1: 1        Reps
      2: 30       Loc [ Ttherm_1  ]

     77:  Sample (P70)
      1: 1        Reps
      2: 61       Loc [ Ttherm_32 ]

     78:  Sample (P70)
      1: 11       Reps
      2: 31       Loc [ Ttherm_2  ]

     79:  Do (P86)
      1: 20       Set Output Flag Low

80:  End (P95) ;Sub 4

;***************************************
;Sub 5 store 24hvalues
;***************************************

81:  Beginning of Subroutine (P85)
 1: 5        Subroutine 5

     82:  Do (P86)
      1: 10       Set Output Flag High

     83:  Set Active Storage Area (P80)
      1: 1        Final Storage
      2: 24       Array ID

     84:  Sample (P70)
      1: 1        Reps
      2: 4        Loc [ BoreHole  ]

     85:  Real Time (P77)
      1: 1110     Year,Day,Hour/Minute (midnight = 0000)

     86:  Sample (P70)
      1: 2        Reps
      2: 2        Loc [ VBatt     ]

     87:  Sample (P70)
      1: 1        Reps
      2: 30       Loc [ Ttherm_1  ]

     88:  Sample (P70)
      1: 1        Reps
      2: 61       Loc [ Ttherm_32 ]

     89:  Sample (P70)
      1: 30       Reps
      2: 31       Loc [ Ttherm_2  ]

     90:  Do (P86)
      1: 20       Set Output Flag Low

91:  End (P95) ;Sub 5


;***************************************
;Sub 7 store 6hvalues  Profile 2
;***************************************

92:  Beginning of Subroutine (P85)
 1: 7        Subroutine 7

     93:  Do (P86)
      1: 10       Set Output Flag High

     94:  Set Active Storage Area (P80)
      1: 1        Final Storage
      2: 206      Array ID
```

```
     95:  Z=X*F (P37)
      1: 4        X Loc [ BoreHole  ]
      2: .01      F
      3: 292      Z Loc [ borehole2 ]

     96:  Z=X+F (P34)
      1: 292      X Loc [ borehole2 ]
      2: 1        F
      3: 292      Z Loc [ borehole2 ]

     97:  Z=X*F (P37)
      1: 292      X Loc [ borehole2 ]
      2: 100      F
      3: 292      Z Loc [ borehole2 ]

     98:  Sample (P70)
      1: 1        Reps
      2: 292      Loc [ borehole2 ]

     99:  Real Time (P77)
      1: 1110     Year,Day,Hour/Minute (midnight = 0000)

    100:  Sample (P70)
      1: 2        Reps
      2: 2        Loc [ VBatt     ]

    101:  Sample (P70)
      1: 1        Reps
      2: 30       Loc [ Ttherm_1  ]

    102:  Sample (P70)
      1: 1        Reps
      2: 61       Loc [ Ttherm_32 ]

    103:  Sample (P70)
      1: 17       Reps
      2: 62       Loc [ Ttherm_33 ]

    104:  Do (P86)
      1: 20       Set Output Flag Low

105:  End (P95) ;Sub 7



;****************************************
;SUB 6 Calibration
;****************************************


106:  Beginning of Subroutine (P85)
 1: 6        Subroutine 6


    107:  If Flag/Port (P91)
      1: 16       Do if Flag 6 is High
      2: 30       Then Do

         108:  Beginning of Loop (P87) ;reset corrections DT to 0
          1: 0        Delay
          2: 32       Loop Count


             109:  Z=F (P30)
              1: 0        F
              2: 0        Exponent of 10
              3: 82       Z Loc [ DTther_1  ]

         110:  End (P95) ;loop

    111:  End (P95)


    112:  If Flag/Port (P91)
      1: 15       Do if Flag 5 is High
      2: 30       Then Do

         113:  Beginning of Loop (P87) ;reset corrections DT to 0
          1: 0        Delay
          2: 17       Loop Count


             114:  Z=F (P30)
              1: 0        F
              2: 0        Exponent of 10
              3: 114      Z Loc [ DTther_33 ]
```

```
          115:  End (P95) ;loop

     116:  End (P95)

     117:  Do (P86)
      1: 2        Call Subroutine 2 ; measure thermistors

     118:  Do (P86)
      1: 3        Call Subroutine 3 ;calc temps

; calc difference calibr temp. - measured temp and store in DT array


     119:  If Flag/Port (P91) ; profile 1
      1: 16       Do if Flag 6 is High
      2: 30       Then Do


          120:  Beginning of Loop (P87)
           1: 0        Delay
           2: 30       Loop Count

               121:  Z=X-Y (P35)
                1: 5        X Loc [ CalTempC  ]
                2: 31    -- Y Loc [ Ttherm_2  ]
                3: 83    -- Z Loc [ DTther_2  ]

          122:  End (P95) ;loop


     123:  End (P95)

     124:  If Flag/Port (P91) ; profile 2
      1: 15       Do if Flag 5 is High
      2: 30       Then Do


          125:  Beginning of Loop (P87)
           1: 0        Delay
           2: 17       Loop Count

               126:  Z=X-Y (P35)
                1: 5        X Loc [ CalTempC  ]
                2: 62    -- Y Loc [ Ttherm_33 ]
                3: 114   -- Z Loc [ DTther_33 ]

          127:  End (P95) ;loop


     128:  End (P95)

; Store calibration records

     129:  Do (P86)
      1: 10       Set Output Flag High

     130:  Set Active Storage Area (P80)
      1: 1        Final Storage
      2: 50       Array ID ;      Resistance in KE

     131:  Sample (P70)
      1: 1        Reps
      2: 4        Loc [ BoreHole  ]

     132:  Real Time (P77)
      1: 1110     Year,Day,Hour/Minute (midnight = 0000)

     133:  Sample (P70)
      1: 2        Reps
      2: 2        Loc [ VBatt     ]

     134:  Beginning of Loop (P87)
      1: 0        Delay
      2: 49       Loop Count

          135:  Z=X*F (P37)
           1: 134   -- X Loc [ Rtherm_1  ]
           2: .001     F
           3: 199      Z Loc [ TthKE     ]

          136:  Sample (P70)
           1: 1        Reps
           2: 199      Loc [ TthKE     ]

     137:  End (P95) ;loop
```

```
     138:  Sample (P70)
      1: 49       Reps
      2: 30       Loc [ Ttherm_1  ]

     139:  Sample (P70)
      1: 49       Reps
      2: 82       Loc [ DTther_1  ]

     140:  Do (P86)
      1: 20       Set Output Flag Low


141:  End (P95) ;Sub 6



142:  Beginning of Subroutine (P85)
 1: 82       Subroutine 82
;--------------------------------------------------
;Status initialisieren nach Loc 220...235
;--------------------------------------------------

     143:  Z=X (P31)
      1: 10       X Loc [ Status    ]
      2: 208      Z Loc [ statscr   ]

     144:  Z=F (P30)
      1: 14       F
      2: 0        Exponent of 10
      3: 209      Z Loc [ statscr_1 ]

     145:  Z=F (P30)
      1: 2        F
      2: 0        Exponent of 10
      3: 210      Z Loc [ statscr_2 ]

     146:  Beginning of Loop (P87)
      1: 0        Delay
      2: 15       Loop Count

          147:  Z=X^Y (P47)
           1: 210      X Loc [ statscr_2 ]
           2: 209      Y Loc [ statscr_1 ]
           3: 211      Z Loc [ statscr_3 ]

          148:  Z=X+F (P34)
           1: 209      X Loc [ statscr_1 ]
           2: -1       F
           3: 209      Z Loc [ statscr_1 ]

          149:  Z=X-Y (P35)
           1: 208      X Loc [ statscr   ]
           2: 211      Y Loc [ statscr_3 ]
           3: 212      Z Loc [ statscr_4 ]

          150:  IF (X<=>F) (P89)
           1: 212      X Loc [ statscr_4 ]
           2: 3        >=
           3: -.7      F
           4: 30       Then Do

               151:  Z=X (P31)
                1: 212      X Loc [ statscr_4 ]
                2: 208      Z Loc [ statscr   ]

               152:  Z=F (P30)
                1: 1        F
                2: 0        Exponent of 10
                3: 220   -- Z Loc [ StatS_1   ]

          153:  Else (P94)

               154:  Z=F (P30)
                1: 0        F
                2: 0        Exponent of 10
                3: 220   -- Z Loc [ StatS_1   ]

          155:  End (P95); Status setzen

     156:  End (P95); status loop
;
;Umordnen der statuswerte loc 220..235

     157:  Block Move (P54)
      1: 15       No. of Values
      2: 220      First Source Loc [ StatS_1   ]
      3: 1        Source Step
```

```
 4: 235      First Destination Loc [ StaCp_1   ]
 5: 1        Destination Step

158:  Z=F (P30)
 1: 249      F
 2: 0        Exponent of 10
 3: 209      Z Loc [ statscr_1 ]

159:  Z=F (P30)
 1: 220      F
 2: 0        Exponent of 10
 3: 210      Z Loc [ statscr_2 ]

160:  Beginning of Loop (P87)
 1: 0        Delay
 2: 15       Loop Count

     161:  Indirect Move (P61)
      1: 209      Source Loc [ statscr_1 ]
      2: 210      Destination Loc [ statscr_2 ]

     162:  Z=Z+1 (P32)
      1: 210      Z Loc [ statscr_2 ]

     163:  Z=X+F (P34)
      1: 209      X Loc [ statscr_1 ]
      2: -1       F
      3: 209      Z Loc [ statscr_1 ]

164:  End (P95)

165:  End (P95); Sub 82
;*****************************************************


166:  Beginning of Subroutine (P85)
 1: 83       Subroutine 83
;-------------------------------------------------------
;Sensor quality evaluation
;-------------------------------------------------------

167:  Z=X (P31);                    Batt
 1: 229      X Loc [ StatS_10  ]
 2: 254      Z Loc [ Statold   ]

168:  Z=X (P31)
 1: 2        X Loc [ VBatt     ]
 2: 250      Z Loc [ Value     ]

169:  Z=F (P30)
 1: 14       F
 2: 0        Exponent of 10
 3: 251      Z Loc [ Meansoll  ]

170:  Z=F (P30)
 1: 2.5      F
 2: 0        Exponent of 10
 3: 252      Z Loc [ Deltasoll ]

171:  Do (P86)
 1: 84       Call Subroutine 84

172:  Z=X (P31)
 1: 253      X Loc [ Result    ]
 2: 229      Z Loc [ StatS_10  ]
;.................................


173:  Z=X (P31);                    TLuft
 1: 220      X Loc [ StatS_1   ]
 2: 254      Z Loc [ Statold   ]

174:  Z=F (P30)
 1: 0        F
 2: 0        Exponent of 10
 3: 251      Z Loc [ Meansoll  ]

175:  Z=F (P30)
 1: 48       F
 2: 0        Exponent of 10
 3: 252      Z Loc [ Deltasoll ]

176:  Z=X (P31)
 1: 12       X Loc [ Tactual   ]
 2: 250      Z Loc [ Value     ]

177:  Do (P86)
```

```
      1: 84       Call Subroutine 84

     178:  Z=X (P31)
      1: 253      X Loc [ Result    ]
      2: 220      Z Loc [ StatS_1   ]
;.................................


     179:  Z=X (P31);                  Tsurf
      1: 227      X Loc [ StatS_8   ]
      2: 254      Z Loc [ Statold   ]

     180:  Z=F (P30)
      1: 0        F
      2: 0        Exponent of 10
      3: 251      Z Loc [ Meansoll  ]

     181:  Z=F (P30)
      1: 48       F
      2: 0        Exponent of 10
      3: 252      Z Loc [ Deltasoll ]

     182:  Z=X (P31)
      1: 12       X Loc [ Tactual   ]
      2: 250      Z Loc [ Value     ]

     183:  Do (P86)
      1: 84       Call Subroutine 84

     184:  Z=X (P31)
      1: 253      X Loc [ Result    ]
      2: 227      Z Loc [ StatS_8   ]
;.................................

     185:  Z=X (P31)
      1: 225      X Loc [ StatS_6   ]; ShortWave
      2: 254      Z Loc [ Statold   ]

     186:  Z=F (P30)
      1: 740      F
      2: 0        Exponent of 10
      3: 251      Z Loc [ Meansoll  ]

     187:  Z=F (P30)
      1: 750      F
      2: 0        Exponent of 10
      3: 252      Z Loc [ Deltasoll ]

     188:  Z=X (P31)
      1: 15       X Loc [ ShortWdif ]
      2: 250      Z Loc [ Value     ]

     189:  Do (P86)
      1: 84       Call Subroutine 84

     190:  Z=X (P31)
      1: 253      X Loc [ Result    ]
      2: 225      Z Loc [ StatS_6   ]
;.................................

     191:  Z=X (P31)
      1: 226      X Loc [ StatS_7   ]; LongWave
      2: 254      Z Loc [ Statold   ]

     192:  Z=F (P30)
      1: 0        F
      2: 0        Exponent of 10
      3: 251      Z Loc [ Meansoll  ]

     193:  Z=F (P30)
      1: 350      F
      2: 0        Exponent of 10
      3: 252      Z Loc [ Deltasoll ]

     194:  Z=X (P31)
      1: 17       X Loc [ LongWdif  ]
      2: 250      Z Loc [ Value     ]

     195:  Do (P86)
      1: 84       Call Subroutine 84

     196:  Z=X (P31)
      1: 253      X Loc [ Result    ]
      2: 226      Z Loc [ StatS_7   ]
;.................................

     197:  Z=X (P31)
```

```
 1: 221      X Loc [ StatS_2   ]; RH%
 2: 254      Z Loc [ Statold   ]

198:  Z=F (P30)
 1: 50       F
 2: 0        Exponent of 10
 3: 251      Z Loc [ Meansoll  ]

199:  Z=F (P30)
 1: 70       F
 2: 0        Exponent of 10
 3: 252      Z Loc [ Deltasoll ]

200:  Z=X (P31)
 1: 13       X Loc [ RHactual  ]
 2: 250      Z Loc [ Value     ]

201:  Do (P86)
 1: 84       Call Subroutine 84

202:  Z=X (P31)
 1: 253      X Loc [ Result    ]
 2: 221      Z Loc [ StatS_2   ]
;................................

203:  End (P95); Sub 83
;******************************************************


204:  Beginning of Subroutine (P85)
 1: 84       Subroutine 84
;------------------------------------------------------
;Quality Calc sub
;------------------------------------------------------

205:  IF (X<=>F) (P89)
 1: 254      X Loc [ Statold   ]
 2: 3        >=
 3: 1        F
 4: 30       Then Do

     206:  Z=X-Y (P35)
      1: 250      X Loc [ Value     ]
      2: 251      Y Loc [ Meansoll  ]
      3: 208      Z Loc [ statscr   ]

     207:  Z=ABS(X) (P43)
      1: 208      X Loc [ statscr   ]
      2: 208      Z Loc [ statscr   ]

     208:  IF (X<=>Y) (P88)
      1: 208      X Loc [ statscr   ]
      2: 3        >=
      3: 252      Y Loc [ Deltasoll ]
      4: 30       Then Do

          209:  Z=F (P30)
           1: 2        F
           2: 0        Exponent of 10
           3: 253      Z Loc [ Result    ]


     210:  Else (P94)

          211:  Z=X (P31)
           1: 254      X Loc [ Statold   ]
           2: 253      Z Loc [ Result    ]

     212:  End (P95); end check

205:  Else (P94)

     214:  Z=X (P31)
      1: 254      X Loc [ Statold   ]
      2: 253      Z Loc [ Result    ]

205:  End (P95); sensor eingeschaltet

216:  End (P95); sub 84
;******************************************************
;


217:  Beginning of Subroutine (P85)
 1: 85       Subroutine 85
;------------------------------------------------------
;Sensor status values to binary
```

```
;-----------------------------------------------------

     218:  Z=F (P30)
      1: 0        F
      2: 0        Exponent of 10
      3: 209      Z Loc [ statscr_1 ]
;binar status

     219:  Z=F (P30)
      1: 1        F
      2: 0        Exponent of 10
      3: 210      Z Loc [ statscr_2 ]
;binar Wert

     220:  Beginning of Loop (P87)
      1: 0        Delay
      2: 14       Loop Count

          221:  IF (X<=>F) (P89)
           1: 220   -- X Loc [ StatS_1   ]
           2: 3        >=
           3: 2        F
           4: 30       Then Do

               222:  Z=X+Y (P33)
                1: 209      X Loc [ statscr_1 ]
                2: 210      Y Loc [ statscr_2 ]
                3: 209      Z Loc [ statscr_1 ]

          223:  End (P95); add error

          224:  Z=X*F (P37)
           1: 210      X Loc [ statscr_2 ]
           2: 2        F
           3: 210      Z Loc [ statscr_2 ]

     225:  End (P95); Quality loop

     226:  Z=X (P31)
      1: 209      X Loc [ statscr_1 ]
      2: 11       Z Loc [ Quality   ]
;.....................................................
;prepare Quality and status for output array (limit to
;4095)


227:  End (P95); end SUB 85
;*****************************************************


228:  Beginning of Subroutine (P85)
 1: 86       Subroutine 86
;-----------------------------------------------------
;SHM SR50 SDI measurement
;-----------------------------------------------------


     229:  SDI-12 Recorder (OS10 1.1) (P105)
      1: 0        SDI-12 Address; ADDRESS 0
      2: 1        Start Measurement (aM1!)
      3: 4        Port
      4: 258      Loc [ SHMmess1  ]
      5: 100      Mult
      6: 0.0000   Offset


     230:  Z=X*F (P37)
      1: 259      X Loc [ SHMQ      ]
      2: .01      F
      3: 259      Z Loc [ SHMQ      ]

     231:  Z=X (P31)
      1: 259      X Loc [ SHMQ      ]
      2: 23       Z Loc [ SHMQ1     ]

     232:  IF (X<=>F) (P89)
      1: 258      X Loc [ SHMmess1  ]
      2: 4        <
      3: 10       F
      4: 30       Then Do

          233:  Z=F (P30)
           1: 999      F
           2: 0        Exponent of 10
           3: 258      Z Loc [ SHMmess1  ]

     234:  Else (P94)
```

```
          235:  Do (P86)
           1: 90       Call Subroutine 90; Temp. compemsation

          236:  Z=X-Y (P35)
           1: 22       X Loc [ SHMH1     ]
           2: 258      Y Loc [ SHMmess1  ]
           3: 18       Z Loc [ HSactual  ]

     237:  End (P95)

238:  End (P95) ;sub 86


;*******************************************************

239:  Beginning of Subroutine (P85)
 1: 90       Subroutine 90
;-------------------------------------------------------
;SHM TEMP Compensation
;-------------------------------------------------------

     240:  Z=X+F (P34)
      1: 12       X Loc [ Tactual   ]
      2: 273.15   F
      3: 257      Z Loc [ SHMscr_7  ]

     241:  Z=F (P30)
      1: 273.15   F
      2: 0        Exponent of 10
      3: 260      Z Loc [ shmscr_8  ]

     242:  Z=X/Y (P38)
      1: 257      X Loc [ SHMscr_7  ]
      2: 260      Y Loc [ shmscr_8  ]
      3: 257      Z Loc [ SHMscr_7  ]

     243:  Z=SQRT(X) (P39)
      1: 257      X Loc [ SHMscr_7  ]
      2: 257      Z Loc [ SHMscr_7  ]

     244:  Z=X*Y (P36)
      1: 258      X Loc [ SHMmess1  ]
      2: 257      Y Loc [ SHMscr_7  ]
      3: 258      Z Loc [ SHMmess1  ]

245:  End (P95); SUB 90 Temp. comp.
;*******************************************************



246:  Beginning of Subroutine (P85)
 1: 91       Subroutine 91
;-------------------------------------------------------
;SUB2 Standard 60s input
;-------------------------------------------------------

     247:  IF (X<=>F) (P89)
      1: 221      X Loc [ StatS_2   ]
      2: 3        >=
      3: 1        F
      4: 41       Set Port 1 High

     248:  IF (X<=>F) (P89)
      1: 225      X Loc [ StatS_6   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do
;.....................................................
;short wave

;*****CNR1 Strahlungsbilanz*****
; CM3 und CG3 einzeln messen

          249:  Volt (Diff) (P2)
           1: 1        Reps
           2: 04       ñ 250 mV Slow Range
           3: 4        DIFF Channel
           4: 15       Loc [ ShortWdif ]
           5: 104.17   Mult @@15
           6: 0.0      Offset
;Multiplier: 1/(Sensitivity)*1000      Sensitivity: siehe Calibration
;certificate des Geraetes


     250:  End (P95)
```

```
     251:  IF (X<=>F) (P89)
      1: 226      X Loc [ StatS_7   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do
;.................................................
;short longwave

          252:  Volt (Diff) (P2)
           1: 1        Reps
           2: 04       250 mV Slow Range
           3: 5        DIFF Channel
           4: 271      Loc [ LWdifscr  ]
           5: 104.17   Mult @@16
           6: 0.0      Offset

;Korrektur der Werte  die Eigenemissivitt des Gertes
; PT100 messen
          253:  3W Half Bridge (P7)
           1: 1        Reps
           2: 33       ñ 25 mV 50 Hz Rejection Rangefur
           3: 11       SE Channel
           4: 3        Excite all reps w/Exchan 3
           5: 2100     mV Excitation
           6: 272      Loc [ RS_Ro     ]
           7: 100      Mult
           8: 0.0      Offset

          254:  Temperature RTD (P16)
           1: 1        Reps
           2: 272      R/RO Loc [ RS_Ro     ]
           3: 273      Loc [ Pt100_C   ]
           4: 1        Mult
           5: 0.0      Offset

; Umrechnen von øC in Kelvin
          255:  Z=X+F (P34)
           1: 273      X Loc [ Pt100_C   ]
           2: 273.15   F
           3: 274      Z Loc [ Pt100_K   ]

;Eigenemissivit,,t der CG3

; T hoch 4
          256:  Z=F (P30)
           1: 4        F
           2: 00       Exponent of 10
           3: 275      Z Loc [ hoch4     ]

          257:  Z=F (P30)
           1: 5.67     F
           2: -8       Exponent of 10
           3: 276      Z Loc [ S_Bkonst  ]

          258:  Z=X^Y (P47)
           1: 274      X Loc [ Pt100_K   ]
           2: 275      Y Loc [ hoch4     ]
           3: 277      Z Loc [ Khoch4    ]

          259:  Z=X*Y (P36)
           1: 277      X Loc [ Khoch4    ]
           2: 276      Y Loc [ S_Bkonst  ]
           3: 278      Z Loc [ epsilon   ]

;Korrektur der Werte
          260:  Z=X+Y (P33)
           1: 271      X Loc [ LWdifscr  ]
           2: 278      Y Loc [ epsilon   ]
           3: 17       Z Loc [ LongWdif  ]


     261:  End (P95)


     262:  IF (X<=>F) (P89)
      1: 227      X Loc [ StatS_8   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do
;.................................................
;Infrared surface temp. reference and IR

          263:  Temp (107) (P11)
           1: 1        Reps
           2: 9        SE Channel
```

```
           3: 32       Excite all reps w/E2, 50Hz, 10ms delay
           4: 279      Loc [ IRRefTemp ]
           5: 1        Mult
           6: 0        Offset
;Referenz Temp IR--------------------------------


          264:  Excite-Delay (SE) (P4)
           1: 1        Reps
           2: 31       2.5 mV 50 Hz Rejection Range (Delay must be zero)
           3: 10       SE Channel
           4: 2        Excite all reps w/Exchan 2
           5: 2        Delay (units 0.01 sec)
           6: 0        mV Excitation
           7: 29       Loc [ IRscrin   ]
           8: 1.0      Mult
           9: 0.0      Offset


          265:  Thermocouple Temp (SE) (P13)
           1: 1        Reps
           2: 31       2.5 mV 50 Hz Rejection Range
           3: 29    -- Loc [ IRscrin   ]
           4: 3        Type K (Chromel-Alumel)
           5: 279      Ref Temp Loc [ IRRefTemp ]
           6: 281      Loc [ IRscr_1   ]
           7: 1        Mult
           8: 0        Offset
;IR-TEMP

          266:  Do (P86)
           1: 92       Call Subroutine 92
;...................................................
;IR correction sub

     267:  End (P95); status       IR

     268:  IF (X<=>F) (P89)
      1: 221      X Loc [ StatS_2   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do
;...................................................
;RH%

          269:  Volts (SE) (P1)
           1: 1        Reps
           2: 15       ñ 2500 mV Fast Range
           3: 6        SE Channel
           4: 13       Loc [ RHactual  ]
           5: 0.1      Mult @@17; ++++++++++++++++++++++++Kalibrierung RH%
           6: 0        Offset
;RH% ------------------------

     270:  End (P95); status   RH%

     271:  IF (X<=>F) (P89)
      1: 220      X Loc [ StatS_1   ]
      2: 3        >=
      3: 1        F
      4: 30       Then Do
;...................................................
;TAIR

          272:  If (X<=>F) (P89)
           1: 28       X Loc [ SelTair   ]
           2: 1        =
           3: 1        F
           4: 30       Then Do

               273:  Temp (107) (P11)
                1: 1        Reps
                2: 5        SE Channel
                3: 32       Excite all reps w/E2, 50Hz, 10ms delay
                4: 12       Loc [ Tactual   ]
                5: 1.0      Mult
                6: 0.0      Offset

          274:  End (P95)

          275:  If (X<=>F) (P89)
           1: 28       X Loc [ SelTair   ]
           2: 1        =
           3: 2        F
           4: 30       Then Do

               276:  Volts (SE) (P1)
```

```
               1: 1        Reps
               2: 15       ñ 2500 mV Fast Range
               3: 5        SE Channel
               4: 12       Loc [ Tactual   ]
               5: .1       Mult @@18; ++++++++++++++++++++++++++++Kalibrierung TLuft
               6: -40      Offset @@19

          277:  End (P95)


          278:  If (X<=>F) (P89)
           1: 28       X Loc [ SelTair   ]
           2: 1        =
           3: 3        F
           4: 30       Then Do

; PT100 messen
               279:  3W Half Bridge (P7)
                1: 1        Reps
                2: 33       ñ 25 mV 50 Hz Rejection Range
                3: 11       SE Channel
                4: 2        Excite all reps w/Exchan 2
                5: 2100     mV Excitation
                6: 272      Loc [ RS_Ro     ]
                7: 100      Mult
                8: 0.0      Offset

               280:  Temperature RTD (P16)
                1: 1        Reps
                2: 272      R/RO Loc [ RS_Ro     ]
                3: 12       Loc [ Tactual   ]
                4: 1        Mult
                5: 0.0      Offset


          281:  End (P95)

     282:  End (P95); status   TAIR


     283:  Do (P86)
      1: 51       Set Port 1 Low


;Speisung RH%,TL ausschalten

     284:  Do (P86)
      1: 83       Call Subroutine 83
;Status rechnen

285:  End (P95); Sub 91
;*****************************************************

286:  Beginning of Subroutine (P85)
 1: 92       Subroutine 92
;-----------------------------------------------------
;IR correction/calibration
;-----------------------------------------------------

     287:  Z=X*Y (P36)
      1: 288      X Loc [ IRTCP2    ]
      2: 279      Y Loc [ IRRefTemp ]
      3: 283      Z Loc [ IRscr_3   ]

     288:  Z=X-Y (P35)
      1: 281      X Loc [ IRscr_1   ]
      2: 283      Y Loc [ IRscr_3   ]
      3: 283      Z Loc [ IRscr_3   ]

     289:  IF (X<=>F) (P89); Kodierung von Beta wenn >50 dann
      1: 289      X Loc [ IRTCBeta  ]; BETA -50, neg Korr
      2: 3        >=
      3: 50       F
      4: 30       Then Do

          290:  Z=X+F (P34)
           1: 289      X Loc [ IRTCBeta  ]
           2: -50      F
           3: 282      Z Loc [ IRscr_2   ]

          291:  Z=F (P30)
           1: -2       F
           2: 0        Exponent of 10
           3: 284      Z Loc [ IRscr_4   ]

     292:  Else (P94)
```

```
          293:  Z=X (P31)
           1: 289      X Loc [ IRTCBeta  ]
           2: 282      Z Loc [ IRscr_2   ]

          294:  Z=F (P30)
           1: 1        F
           2: 0        Exponent of 10
           3: 284      Z Loc [ IRscr_4   ]

     295:  End (P95)

     296:  Z=X+Y (P33)
      1: 283      X Loc [ IRscr_3   ]
      2: 282      Y Loc [ IRscr_2   ]
      3: 283      Z Loc [ IRscr_3   ]

     297:  IF (X<=>F) (P89)
      1: 284      X Loc [ IRscr_4   ]
      2: 4        <
      3: 0        F
      4: 30       Then Do

          298:  IF (X<=>F) (P89)
           1: 283      X Loc [ IRscr_3   ]
           2: 4        <
           3: 0        F
           4: 30       Then Do

               299:  Z=F (P30)
                1: 1        F
                2: 0        Exponent of 10
                3: 284      Z Loc [ IRscr_4   ]

          300:  End (P95)

     301:  End (P95)

     302:  Z=X*Y (P36)
      1: 283      X Loc [ IRscr_3   ]
      2: 283      Y Loc [ IRscr_3   ]
      3: 283      Z Loc [ IRscr_3   ]

     303:  Z=X*F (P37)
      1: 283      X Loc [ IRscr_3   ]
      2: .00435   F
      3: 283      Z Loc [ IRscr_3   ]

     304:  Z=X*Y (P36)
      1: 283      X Loc [ IRscr_3   ]
      2: 284      Y Loc [ IRscr_4   ]
      3: 283      Z Loc [ IRscr_3   ]

     305:  Z=X+F (P34)
      1: 283      X Loc [ IRscr_3   ]
      2: -1       F
      3: 283      Z Loc [ IRscr_3   ]

     306:  Z=X-Y (P35)
      1: 281      X Loc [ IRscr_1   ]
      2: 283      Y Loc [ IRscr_3   ]
      3: 21       Z Loc [ TsurfIR   ]

307:  End (P95); SUB 92 IR
;*******************************************************
;

End Program

-Input Locations-
1 INITFlag  3 1 1
2 VBatt     3 7 1
3 TLOG      3 4 1
4 BoreHole  3 5 1
5 CalTempC  3 2 1
6 RefResist 3 1 1
7 coefA     3 1 1
8 coefB     3 1 1
9 coefD     3 1 1
10 Status    3 1 1
11 Quality   3 0 1
12 Tactual   3 4 3
13 RHactual  3 2 1
14 ShortWdo  3 1 0
15 ShortWdif 3 1 1
16 LongWdo   2 0 0
17 LongWdif  3 1 1
18 HSactual  3 3 2
```

```
19 Windvact  3 2 1
20 WindDirac 3 1 1
21 TsurfIR   3 1 1
22 SHMH1     3 2 1
23 SHMQ1     3 0 1
24 _________ 2 0 0
25 _________ 2 0 0
26 _________ 2 0 0
27 ProgVers  3 0 1
28 SelTair   1 3 1
29 IRscrin   3 1 1
30 Ttherm_1  5 4 1
31 Ttherm_2  9 4 0
32 Ttherm_3  9 3 0
33 Ttherm_4  9 3 0
34 Ttherm_5  9 3 0
35 Ttherm_6  9 3 0
36 Ttherm_7  9 3 0
37 Ttherm_8  9 3 0
38 Ttherm_9  9 3 0
39 Ttherm_10 9 3 0
40 Ttherm_11 9 3 0
41 Ttherm_12 9 3 0
42 Ttherm_13 9 2 0
43 Ttherm_14 9 2 0
44 Ttherm_15 9 2 0
45 Ttherm_16 9 2 0
46 Ttherm_17 9 2 0
47 Ttherm_18 9 2 0
48 Ttherm_19 9 2 0
49 Ttherm_20 9 2 0
50 Ttherm_21 9 2 0
51 Ttherm_22 9 2 0
52 Ttherm_23 9 2 0
53 Ttherm_24 9 2 0
54 Ttherm_25 9 2 0
55 Ttherm_26 9 2 0
56 Ttherm_27 9 2 0
57 Ttherm_28 9 2 0
58 Ttherm_29 9 0 0
59 Ttherm_30 9 2 0
60 Ttherm_31 9 2 0
61 Ttherm_32 9 4 0
62 Ttherm_33 9 3 0
63 Ttherm_34 9 2 0
64 Ttherm_35 9 2 0
65 Ttherm_36 9 2 0
66 Ttherm_37 9 2 1
67 Ttherm_38 9 2 0
68 Ttherm_39 9 2 0
69 Ttherm_40 9 2 0
70 Ttherm_41 9 2 0
71 Ttherm_42 9 2 0
72 Ttherm_43 9 2 0
73 Ttherm_44 9 2 0
74 Ttherm_45 9 2 0
75 Ttherm_46 9 2 0
76 Ttherm_47 9 2 0
77 Ttherm_48 9 2 0
78 Ttherm_49 8 0 0
79 Ttherm_50 8 0 0
80 Ttherm_51 8 0 0
81 Ttherm_52 16 0 0
82 DTther_1   5 2 1
83 DTther_2  13 1 2
84 DTther_3   9 1 1
85 DTther_4   9 1 1
86 DTther_5   9 1 1
87 DTther_6   9 1 1
88 DTther_7   9 1 1
89 DTther_8   9 1 1
90 DTther_9  25 1 1
91 DTther_10 5 1 1
92 DTther_11 9 1 1
93 DTther_12 9 1 1
94 DTther_13 9 1 1
95 DTther_14 9 1 1
96 DTther_15 9 1 1
97 DTther_16 9 1 1
98 DTther_17 25 1 1
99 DTther_18 13 1 1
100 DTther_19 9 1 1
101 DTther_20 9 1 1
102 DTther_21 9 1 1
103 DTther_22 9 1 1
104 DTther_23 9 1 1
105 DTther_24 9 1 1
```

```
106 DTther_25 25 1 1
107 DTther_26 13 1 1
108 DTther_27 9 1 1
109 DTther_28 9 1 1
110 DTther_29 9 1 1
111 DTther_30 9 1 1
112 DTther_31 9 1 1
113 DTther_32 9 1 1
114 DTther_33 25 1 3
115 DTther_34 13 1 1
116 DTther_35 9 1 1
117 DTther_36 9 1 1
118 DTther_37 9 1 1
119 DTther_38 9 1 1
120 DTther_39 9 1 1
121 DTther_40 9 1 1
122 DTther_41 25 1 1
123 DTther_42 13 1 1
124 DTther_43 9 1 1
125 DTther_44 9 1 1
126 DTther_45 9 1 1
127 DTther_46 9 1 1
128 DTther_47 9 1 1
129 DTther_48 9 1 1
130 DTther_49 25 0 1
131 DTther_50 1 0 0
132 DTther_51 1 0 0
133 DTther_52 1 0 0
134 Rtherm_1  1 2 0
135 Rtherm_2  1 0 0
136 Rtherm_3  1 0 0
137 Rtherm_4  1 0 0
138 Rtherm_5  1 0 0
139 Rtherm_6  8 0 0
140 Rtherm_7  8 0 0
141 Rtherm_8  8 0 0
142 Rtherm_9  8 0 0
143 Rtherm_10 8 0 0
144 Rtherm_11 8 0 0
145 Rtherm_12 8 0 0
146 Rtherm_13 8 0 0
147 Rtherm_14 8 0 0
148 Rtherm_15 8 0 0
149 Rtherm_16 8 0 0
150 Rtherm_17 8 0 0
151 Rtherm_18 8 0 0
152 Rtherm_19 8 0 0
153 Rtherm_20 8 0 0
154 Rtherm_21 8 0 0
155 Rtherm_22 8 0 0
156 Rtherm_23 8 0 0
157 Rtherm_24 8 0 0
158 Rtherm_25 8 0 0
159 Rtherm_26 8 0 0
160 Rtherm_27 8 0 0
161 Rtherm_28 8 0 0
162 Rtherm_29 8 0 0
163 Rtherm_30 8 0 0
164 Rtherm_31 8 0 0
165 Rtherm_32 8 0 0
166 Rtherm_33 8 0 0
167 Rtherm_34 8 0 0
168 Rtherm_35 8 0 0
169 Rtherm_36 8 0 0
170 Rtherm_37 8 0 0
171 Rtherm_38 8 0 0
172 Rtherm_39 8 0 0
173 Rtherm_40 8 0 0
174 Rtherm_41 8 0 0
175 Rtherm_42 8 0 0
176 Rtherm_43 8 0 0
177 Rtherm_44 8 0 0
178 Rtherm_45 8 0 0
179 Rtherm_46 8 0 0
180 Rtherm_47 8 0 0
181 Rtherm_48 8 0 0
182 Rtherm_49 8 0 0
183 Rtherm_50 8 0 0
184 Rtherm_51 8 0 0
185 Rtherm_52 16 0 0
186 inphi_1   5 2 2
187 inphi_2   9 0 1
188 inphi_3   9 0 1
189 inphi_4   17 0 1
190 inphi_5   1 1 0
191 inplo_1   5 1 1
192 inplo_2   9 0 1
```

```
193 inplo_3   9 0 1
194 inplo_4   25 0 1
195 inplo_5   16 0 0
196 VExit     3 0 1
197 Vref      2 0 0
198 Rtherm0   3 1 2
199 TthKE     3 1 1
200 sourceloc 3 1 1
201 destloc   3 1 3
202 lnT       3 3 2
203 lnT3      3 2 2
204 loopindex 3 1 2
205 Xref      3 2 2
206 expD      3 1 1
207 Ttherm0   3 4 4
208 statscr   3 3 4
209 statscr_1 5 6 6
210 statscr_2 9 3 6
211 statscr_3 9 1 1
212 statscr_4 9 2 1
213 statscr_5 16 0 0
214 _________ 2 0 0
215 _________ 2 0 0
216 _________ 2 0 0
217 _________ 2 0 0
218 _________ 2 0 0
219 _________ 2 0 0
220 StatS_1   5 4 3
221 StatS_2   9 5 1
222 StatS_3   9 2 0
223 StatS_4   1 2 0
224 StatS_5   9 2 1
225 StatS_6   9 3 1
226 StatS_7   9 3 1
227 StatS_8   9 3 1
228 StatS_9   9 1 0
229 StatS_10  9 2 1
230 StatS_11  1 1 0
231 StatS_12  9 1 0
232 StatS_13  9 1 0
233 StatS_14  9 1 0
234 StatS_15  17 1 0
235 StaCp_1   5 0 1
236 StaCp_2   9 0 1
237 StaCp_3   9 0 1
238 StaCp_4   9 0 1
239 StaCp_5   9 0 1
240 StaCp_6   9 0 1
241 StaCp_7   9 0 1
242 StaCp_8   9 0 1
243 StaCp_9   9 0 1
244 StaCp_10  9 0 1
245 StaCp_11  9 0 1
246 StaCp_12  9 0 1
247 StaCp_13  9 0 1
248 StaCp_14  9 0 1
249 StaCp_15  17 0 1
250 Value     1 1 6
251 Meansoll  1 1 6
252 Deltasoll 1 1 6
253 Result    1 6 3
254 Statold   1 3 6
255 shmscr_5  1 0 0
256 shmscr_6  1 0 0
257 SHMscr_7  1 3 3
258 SHMmess1  1 3 3
259 SHMQ      1 2 1
260 shmscr_8  1 1 1
261 SHMCnt    1 0 0
262 Wndpuls   1 0 0
263 WindDact  1 0 0
264 WndScMea  1 1 1
265 WndDirmea 1 0 0
266 HSold     1 1 1
267 _________ 1 0 0
268 _________ 1 0 0
269 _________ 1 0 0
270 _________ 1 0 0
271 LWdifscr  1 1 1
272 RS_Ro     1 2 2
273 Pt100_C   1 1 1
274 Pt100_K   1 1 1
275 hoch4     1 1 1
276 S_Bkonst  1 1 1
277 Khoch4    1 1 1
278 epsilon   1 1 1
279 IRRefTemp 1 2 1
```

```
280 _________ 1 0 0
281 IRscr_1   7 2 1
282 IRscr_2   11 1 2
283 IRscr_3   11 9 7
284 IRscr_4   11 2 3
285 IRscr_5   10 0 0
286 IRscr_6   10 0 0
287 IRscr_7   18 0 0
288 IRTCP2    1 1 1
289 IRTCBeta  1 3 1
290 _________ 1 0 0
291 RHrelice  1 0 0
292 borehole2 1 3 3
293 _________ 1 0 0
294 _________ 1 0 0
295 _________ 1 0 0
1112 _________ 1 0 0
-Program Security-
0000
0000
0000
-Mode 4-
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
-Final Storage Area 2-
0
-CR10X ID-
0
-CR10X Power Up-
3
```