



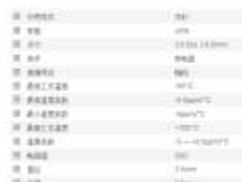
# 38度发烧友

## BBS.38HOT.NET


TC 16 50 34401 fluke 187 140

38Hot Volt-Nuts > Solartron 7081 Repairing (continue)



TDS220  
GDM-8055 ( )  
DL1740 500M  
6612C

1 2

### Solartron 7081 Repairing (continue)

2012-01-08



yjm2000 (2012-01-08)

Previous part: <http://bbs.38hot.net/read.php?tid=12456>

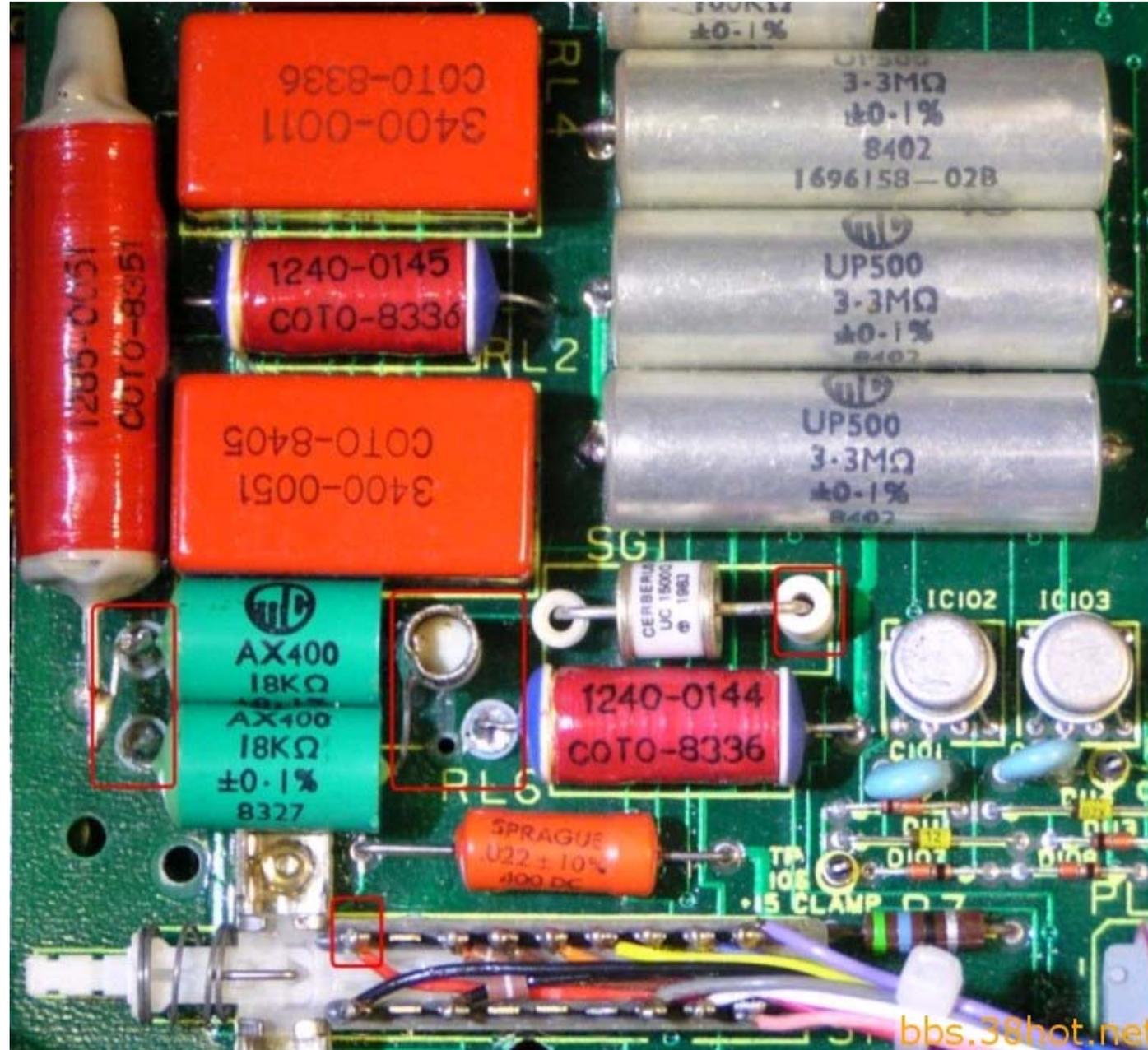
Three month ago I was purchase a Solartron 7081 DMM. It's one of the first model, dated Apr. 1984.  
1) My tests showed a huge input bias current and suspiciously large noise. After 8 hours of heating at 25 Celsius degrees input current was 330 pA causing a zero shift in the short-circuited input – 12 uV. After checking each critical item in the input circuits (attenuator, DC ranging, input amplifier with MDM channel) and installing the PTFE bushings and insulators input bias has been reduced down to 1-2 pA!

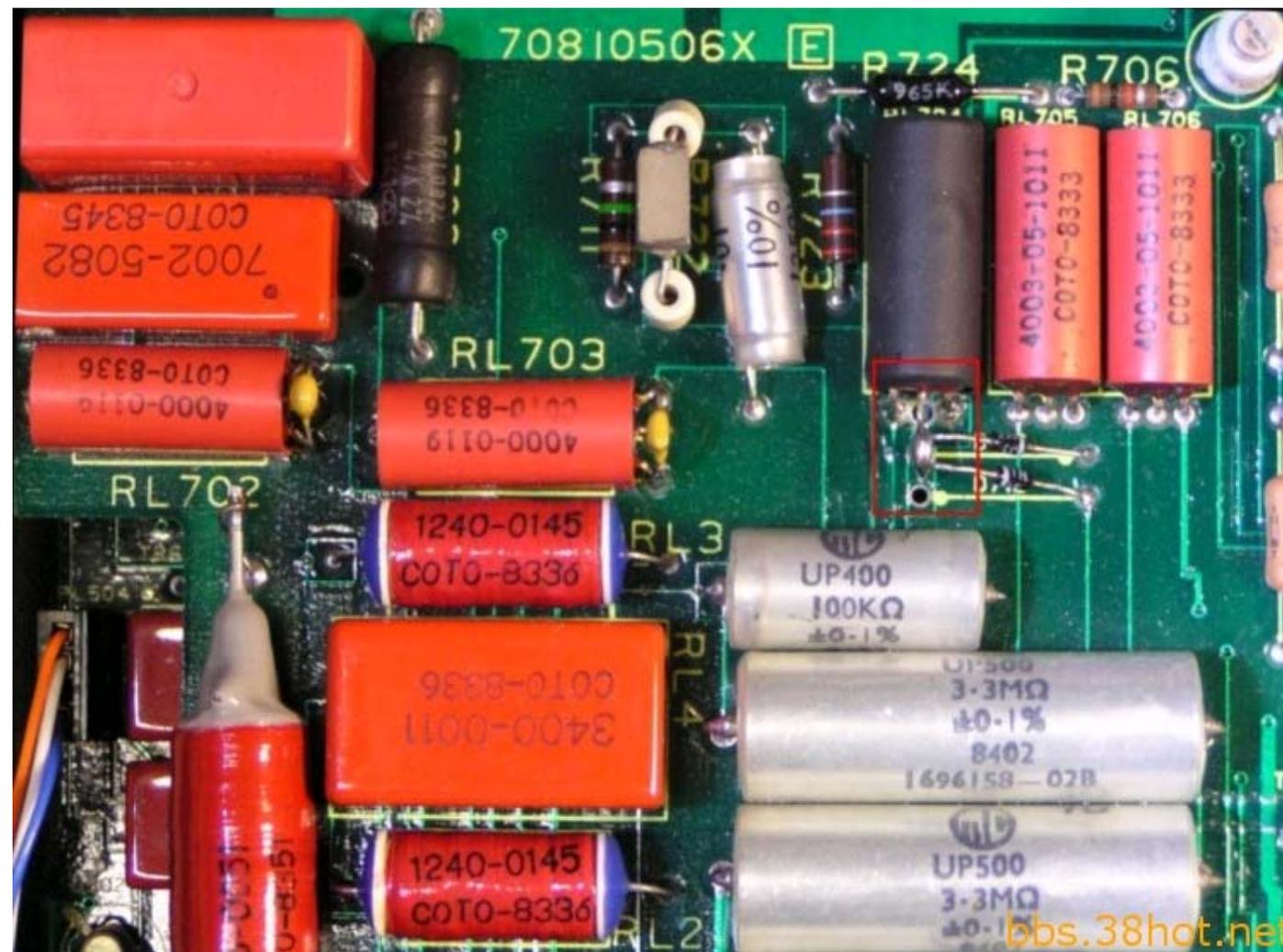


100

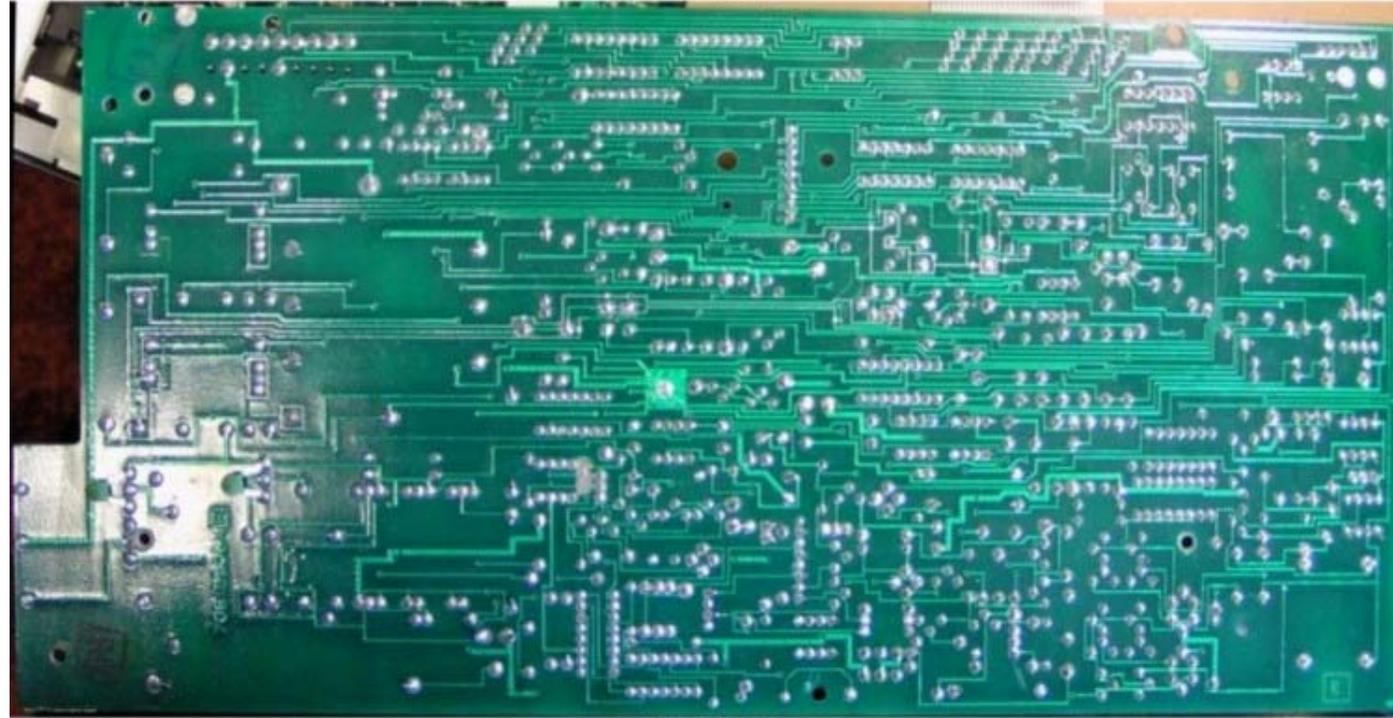
334

38

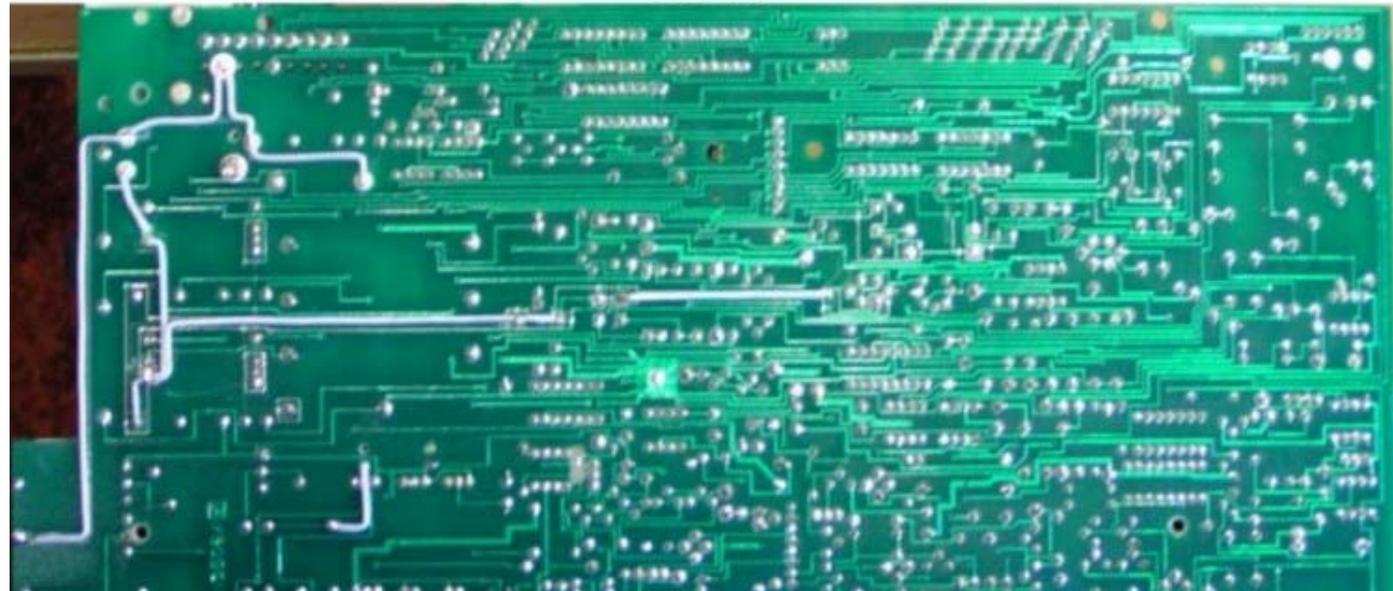




**BEFORE**



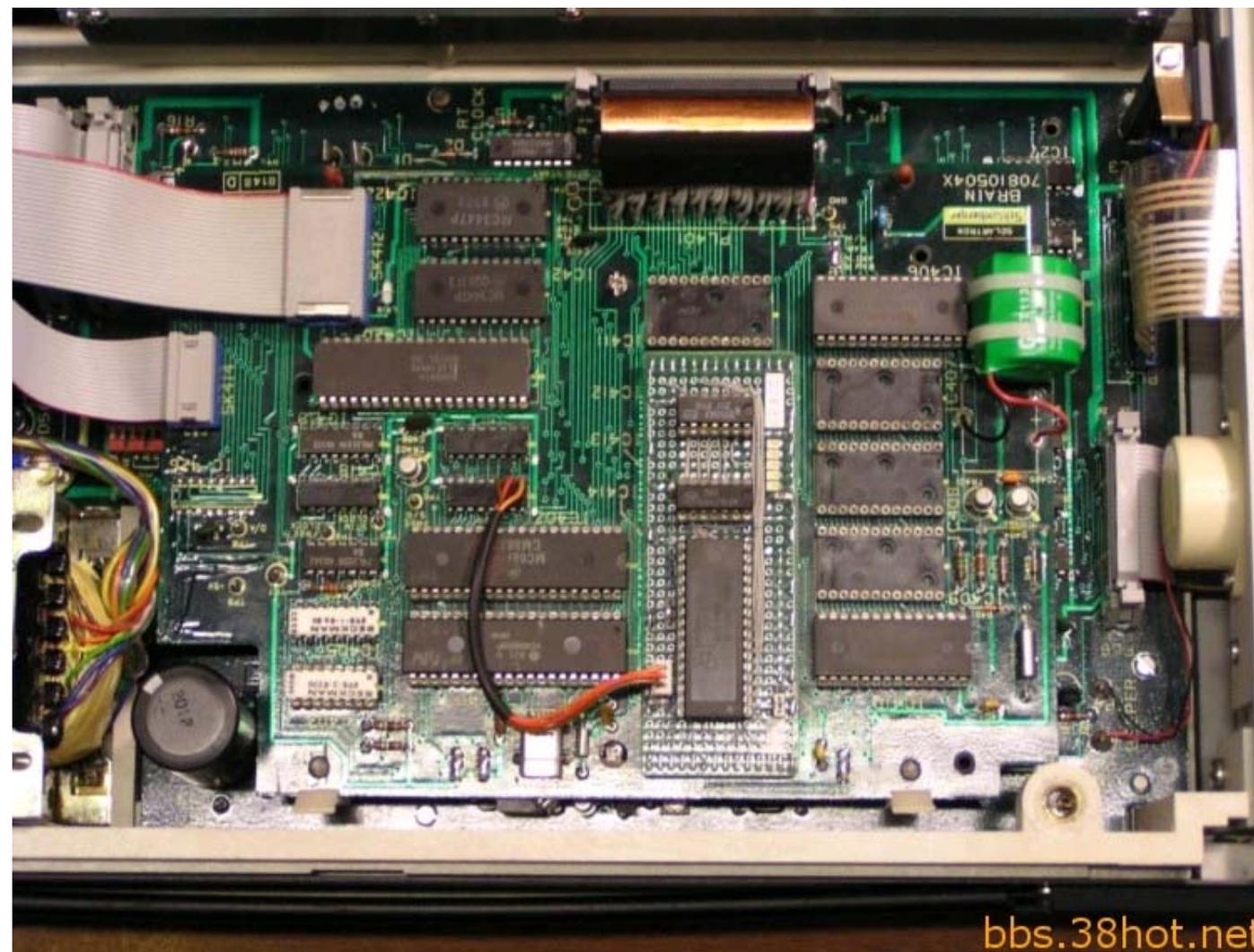
**AFTER**

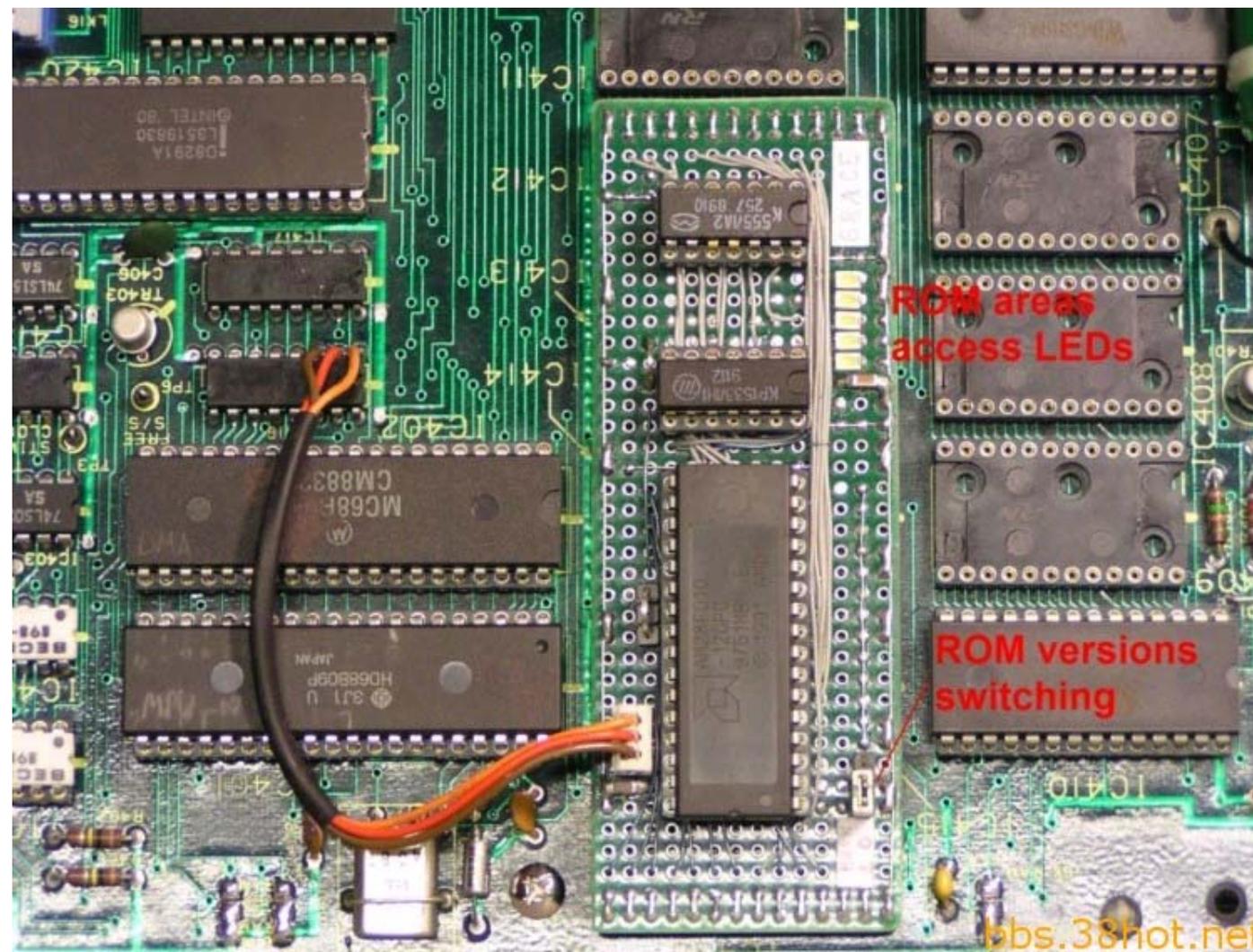


2) After six weeks my Solartron 7081 became very ill: no LED signs, no display, no life at all. I'm spent amount of time to research Earthy Logic and Processor boards, I/O and memory map, disassemble some of the early ROM procedures, emulate 7081 firmware via 6809 CPU emulator, change RAM/ROM chips decoding structure to replace the old and rare 2564 and 6117 chips and adopt PCB for new 28F010 and 6264 ones. I'm recompiling all of the 2564 ROM contents (1984 year) to the linear block and add to it recompiled ROMs content by Dave Partridge (1986 year) and flash its to the one 28F010 EEPROM. Now the DMM came to life again and I'm continue to research the ADC and analog subsystem. This is the replaced parts, including old and broken boards interconnection cable, two semi-defective RAM and ROM chips:

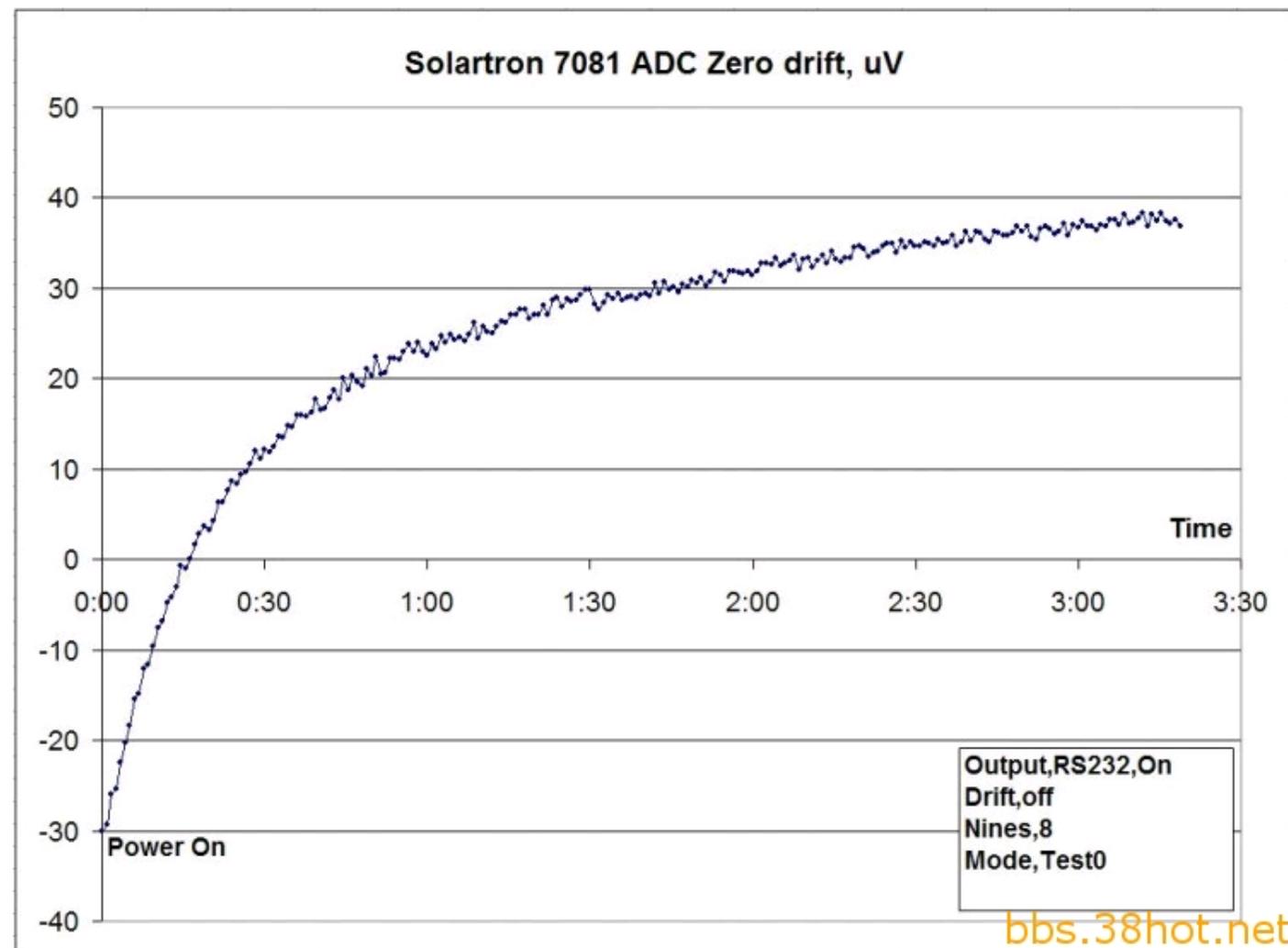


This is the new sub-PCB with two banked ROM 28F010 and address decoders:

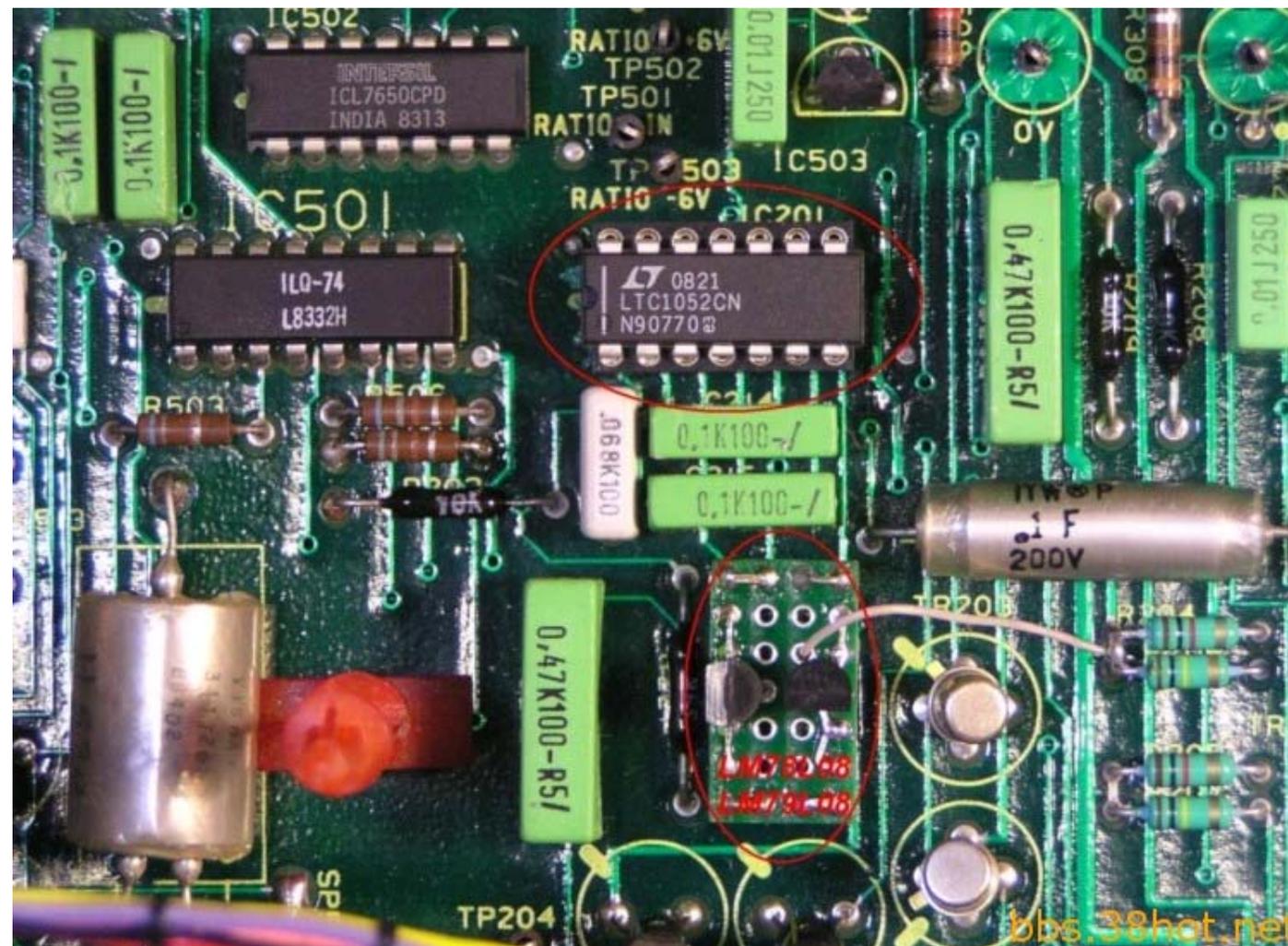




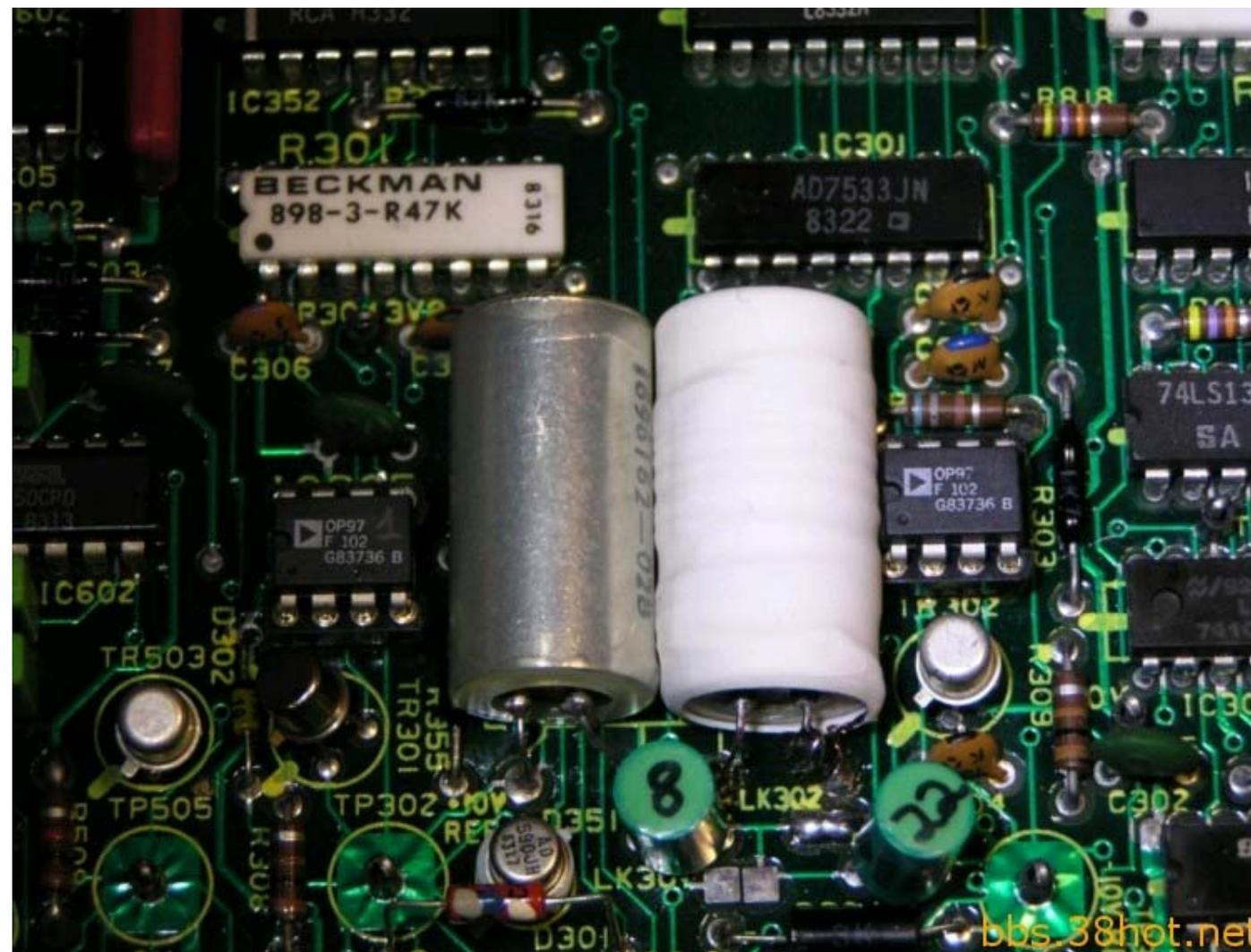
3) Next problem – extremely high ADC zero drift during 2-3 hours after the power up (up to 70  $\mu\text{V}$  = 7ppm).

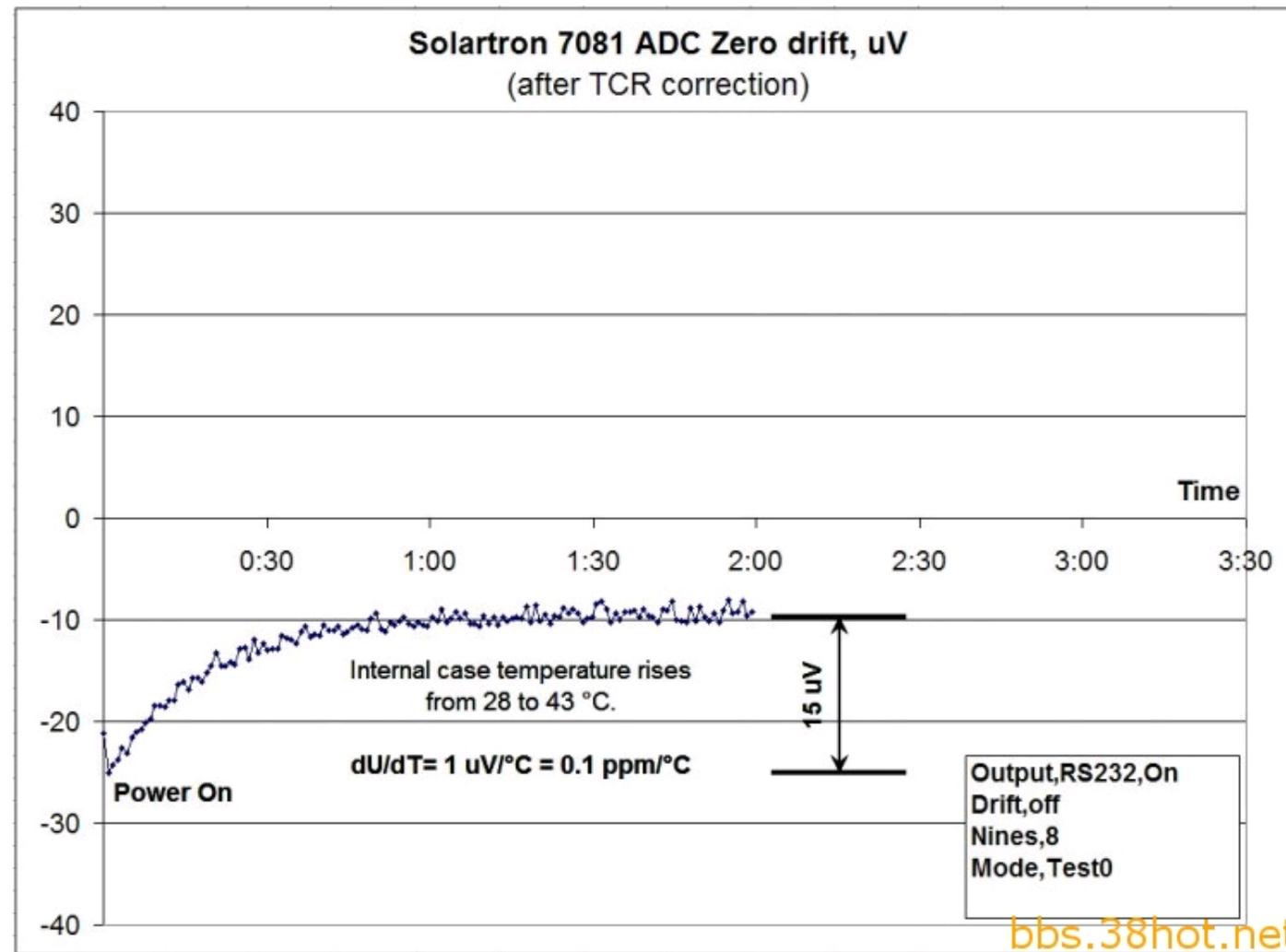


After the change of the integrators DC path op-amp ICL7650CPD to LTC1052CN, reference op-amps OP07EZ to selected OP97F, and after correction of the TCR of the reference divider with Cu wire the Solartron 7081 ADC zero drift was reduced to 15 uV (is equivalent to 0.1 ppm/C).

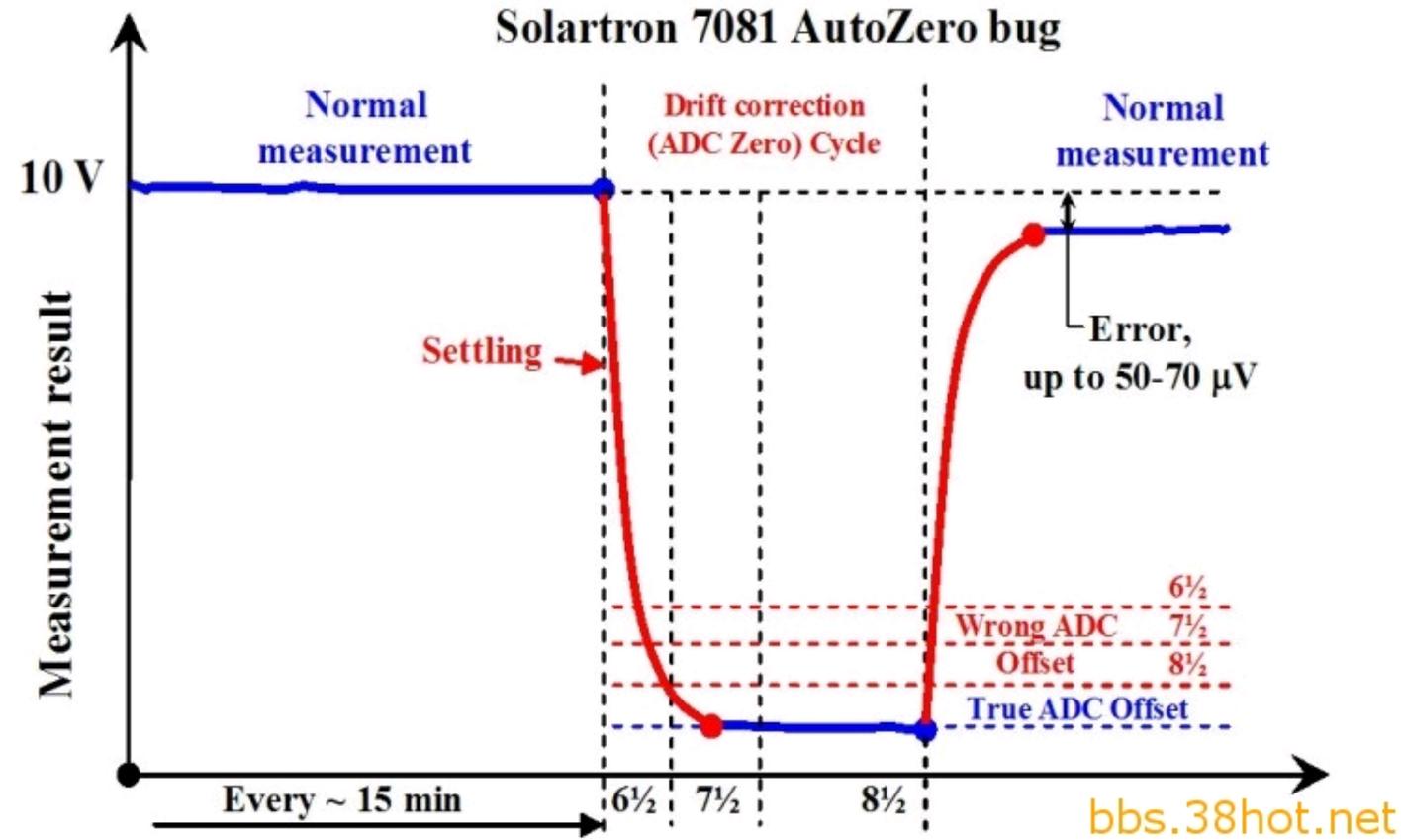


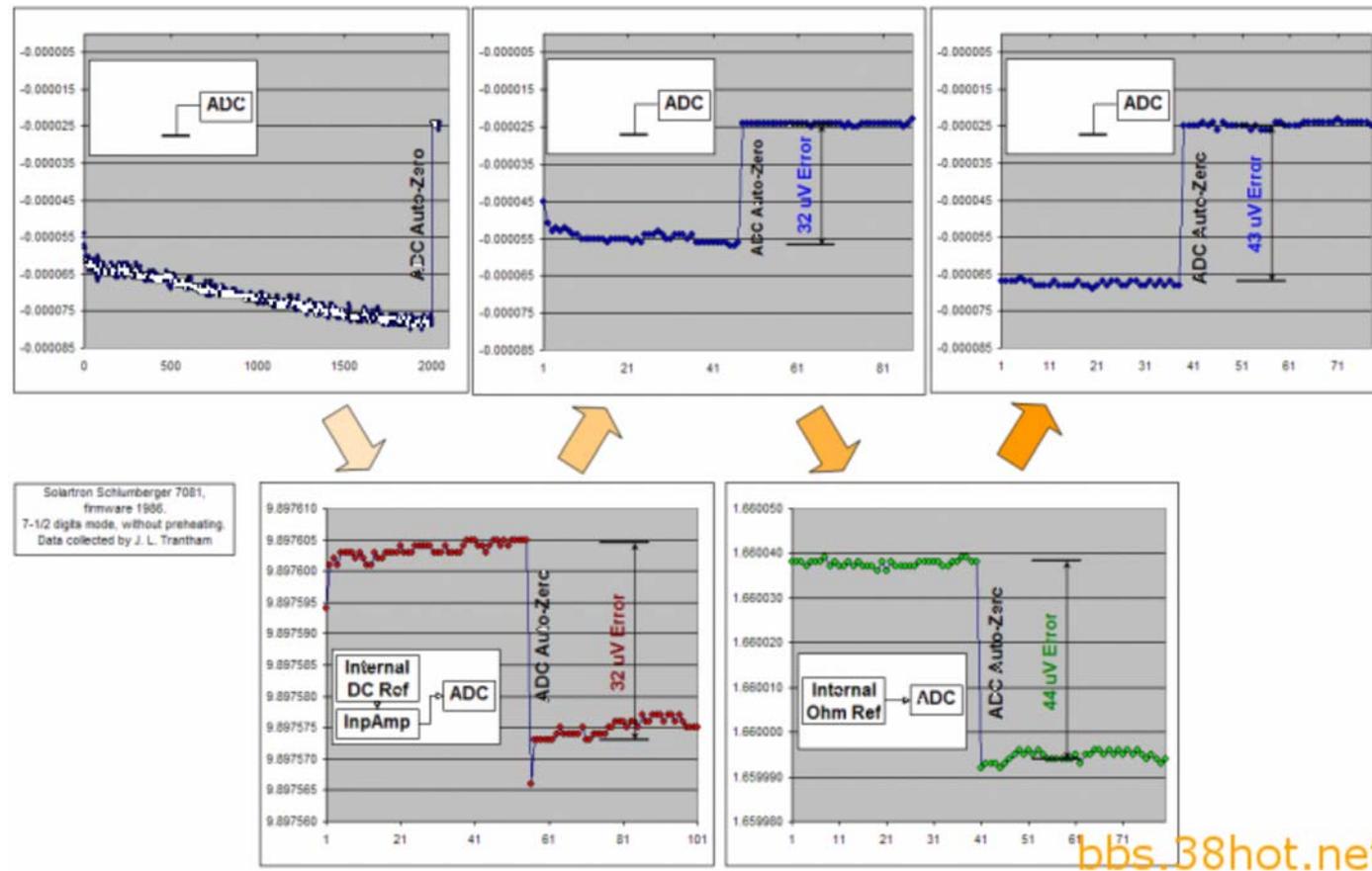




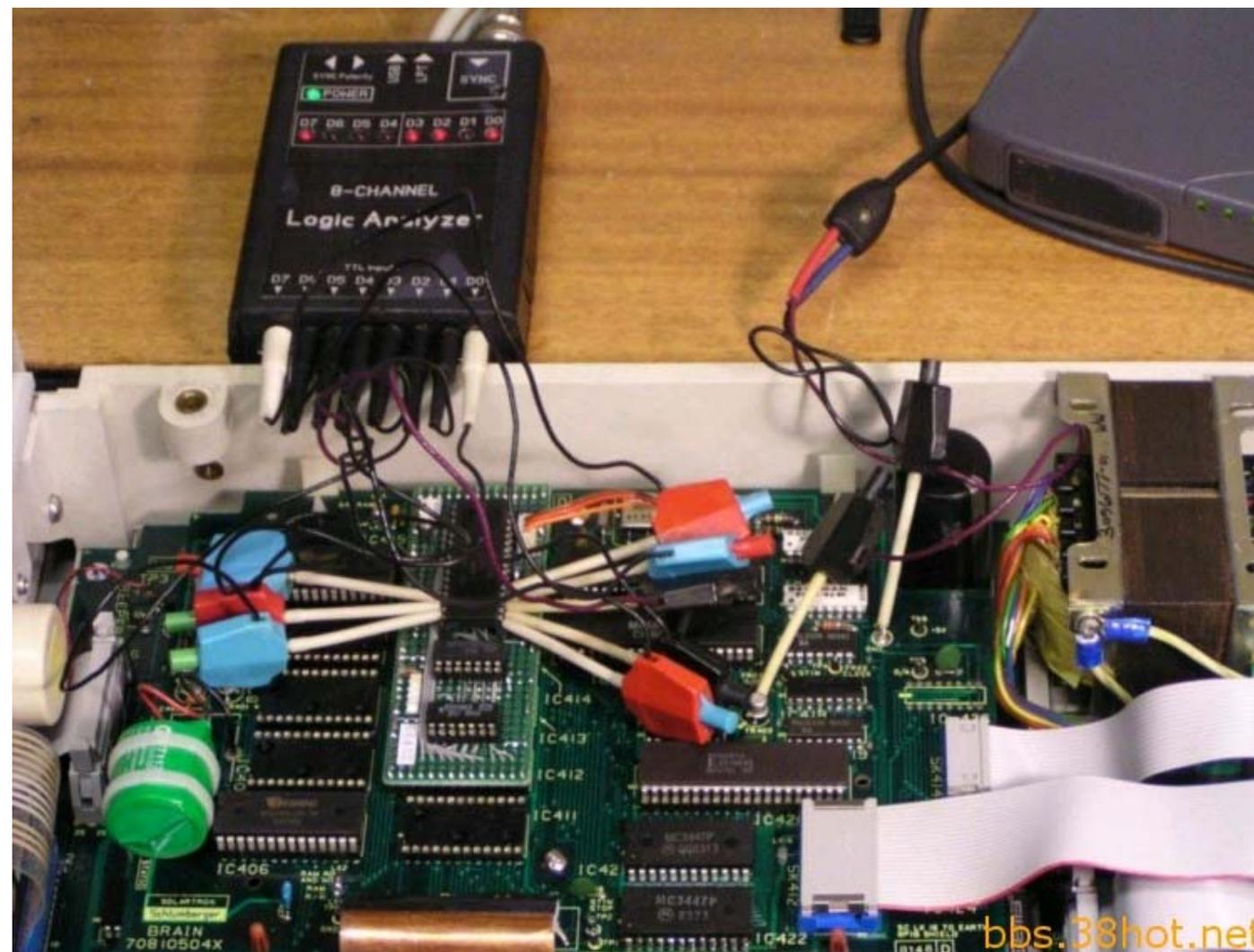


4) Finally, I've found a serious lack of the Solartron 7081 design: improper function of the periodic drift correction (ADC Zero, AutoZero), that lead to large DC voltage measurement errors (discontinuities), up to 5-7 ppm at the all ranges. The source of this problem is very simple: PWM ADC full settling time is much more than specified 13 ms. But the problem solution is hidden in the Floating Logic processor's firmware (IC803 ROM). IC803 firmware contains all of the hardware-specific delays, registers look-upables, two complicated finite-state machines, virtual software timers, software GLUGs integrator, inter-board messaging system interface, calibration NVRAM support e.t.c.





First of all I tried to build a Solartron 7081 processors IO/Memory maps and reconstruct inter-boards messaging system protocol. Then, within two weeks, I reversed the Floating Logic processor's firmware and drew one of the two Finite-State Machines. After that I wrote a patch code using the free areas at the end of the ROM space.



## Earthy Logic I/O Map

Base address, hex	Devices
5C00	IC27 -> IC16 ?
5800	GPIB Address Switches
5400	PIA: Minate interface, NVClock, Beeper
5000	R/WQ, Floating UART
4C00	PIA: Keyboard, NVClock, Calibration key
4800	RS232
4400	GPIB I/O
4000	DMA Select

## Floating Logic Memory Map

Address range, hex	Devices	
E000-FFFF	ROM	
C000-DFFF	Free space (no decoding)	
A000-A3FF, A400-A7FF	NVM pages	
8000-9FFF	Free space (no decoding)	
6000-7FFF	I/O space	
4000-5FFF	GLUG LO -	Read word at 3FFF-4000
2000-3FFF	GLUG HI - / Reset	
0000-1FFF	RAM, CPU internal registers and ports	

## Floating Logic I/O Map

Port	6000h (OUT LO-)	6100h (OUT HI-)	6200h (OUT AC-)	6300 (OUT TC-)
bit 7	RATIO Control	RLD7 (protection)	AC	FRSS (6302h)
bit 6	I/P AMP Control	-	AC+DC	FAS (6304h)
bit 5	RATIO HI Control	RLD501 (TestK)	AC Filter	TC6
bit 4	Test0	RLD6 (in. Div100)	TestAC	TC5
bit 3	10 uA Control	RLD5 (in. InpAmp)	AC ?	TC4
bit 2	x100	RLD4 (Div100)	1	TC3



## Earthy to Floating Processors messaging system

The basis of the Earthy and Floating Processors interface is a simple serial link and special messaging protocol. Serial link have a two selectable clocks: 76800 bauds for normal operation and 300 bauds for debug purposes.

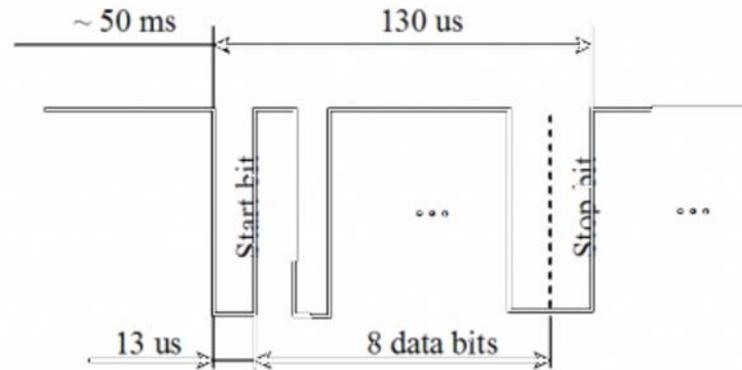


Table 1 – Single message structure

Byte #	1	2	3	4	5	6	7	8
Function	81h	CRC	Range	Mode	Nines	State	Cmd	8Dh

Byte #	Function	Description
1	81h	Begin of the message flag / Message type
2	CRC	Message checksum = 0FFh – sum(byte[3:8])
3	Range	DMM Range selection. For DCV:
		0 = Auto      1 = 0.1 V      2 = 1.0 V      3 = 10 V 4 = 100 V      5 = 1000 V
4	Mode	DMM Mode selection:
		0 = VDC      1 = VAC      2 = Ohms      3 = VAC + VDC 4 = Test0      5 = Test10      6 = TestK      7 = TestAC ? 8 = Reference      9 = [1]+filt      0Ah = [3] + filt      0Bh = True Ohms
		Integration time / Digits selection:
5	Nines	3 = 3x9      4 = 4x9      5 = 5x9      6 = 6x9



```

IDA View-A
RAN:E923 ; ----- SUBROUTINE -----
RAN:E923
RAN:E923
RAN:E923 Test_Zero_on: ; CODE XREF: Parsing_7F+4F1p
RAN:E923 ldaa OUT_LO_Shadow ;
RAN:E925 anda #0F ; '?'
RAN:E927 oraa #0 ;
RAN:E929 staa OUT_LO_Shadow ; All inputs disabled, integrator shorts
RAN:E92B ldd #0 ;
RAN:E92E staa byte_09 ; ?
RAN:E930 staa byte_30 ; ?
RAN:E932 staa Integration_Done ; Integration is started
RAN:E934 std Tick_counter_w ;
RAN:E936 std T_int_Counter ; Clear GLUBS counter
RAN:E938 std Buffer_05 ;
RAN:E93A std Buffer_03 ; Clear Integrator
RAN:E93C std Buffer_01 ;
RAN:E93E ldaa DMM_Mines ;
RAN:E940 staa var_36 ; Temporarily store DMM_Mines
RAN:E942 cnpa #6 ;
RAN:E944 bcc loc_E94A ;
RAN:E946 ldaa #6 ;
RAN:E948 staa DMM_Mines ; If DMM_Mines<6 then DMM_Mines=6
RAN:E94A
RAN:E94A loc_E94A: ; CODE XREF: Test_Zero_on+211j
RAN:E94A jsr Sample_Delay_Select ;
RAN:E94C jsr Tint_select ;
RAN:E94E ldaa var_36 ;
RAN:E950 staa DMM_Mines ; Restore DMM_Mines
RAN:E952 ldaa #1 ;
RAN:E954 staa byte_03 ; ?
RAN:E956 ldaa #7 ;
RAN:E958 staa State_Machine ; ?
RAN:E95C ldx #Buffer_qByte_0 ;
RAN:E95F stx Buffer_qByte_Ptr ;
RAN:E961 clr byte_33 ;
RAN:E963 rts ;
RAN:E964 ; End of Function Test_Zero_on
RAN:E966
RAN:E965 ; ----- SUBROUTINE -----
RAN:E965

```

Name window:

- F AB2I
- F %QAB
- D Message\_A5
- F Transmit\_Msg\_A5
- F WMM\_Chk\_Pages
- A aDirEmFloat
- F Monitor\_Enter
- A aBytec
- F Transmit\_Hex
- F Receive\_Hex
- F Receive\_Char\_Echo
- F Transmit\_Test
- F Receive\_Char
- F Transmit\_Char
- C Man
- D Message\_A3
- F Transmit\_Msg\_A3
- F Parsing\_7F
- F SM\_Chk\_Mode8
- F Test\_Zero\_on
- F Update\_State
- F Update\_State\_0\_3
- F Tint\_select
- F Chk\_DMM\_Mode\_Range
- D Tint\_array
- F OUT\_Lookup\_Apply
- F Input\_RLDS\_On
- F RATIO\_Hi\_on
- F RATIO\_Hi\_off
- F DMM\_Range\_Check
- F DMM\_Range\_Dec
- F OUT\_Lookup\_Addr
- D OUT\_Lookup\_Table
- D DMM\_Modes\_Table
- F Sample\_Delay\_Select
- F Sample\_Delay\_Set
- D Table\_offsets
- C Update\_State\_4\_7
- F Update\_State\_8\_9
- F INT\_Increment

Line 129 of 146

**Patch for Solartron 7081 Floating Processor ROM (VAF BSW 13 Fe 84)**

Version 1.0b:

+ fixed AutoZero errata (wrong settling time)

Mickle T. aka iddq2001 (Russia), 2011

**Procedure Test\_Zero\_On (modified code)**

ROM offset	CPU offset	Opcodes	Mnemonics
923	E923	86 00	ldaa 00h
925	E925	97 68	staa OUT_HI_Shadow
927	E927	BD F2 10	jsr Test_Zero_Patch
92A	E92A	01	nop
...	...	...	...
94A	E94A	BD F2 20	jsr Test_Zero_Patch2
...	...	...	...

**Procedure Test\_Zero\_Patch (new code)**

ROM offset	CPU offset	Opcodes	Mnemonics
1210	F210	96 67	ldaa OUT_LO_Shadow
1212	F212	84 3F	anda 3Fh
1214	F214	8A 10	oraa 10h
1216	F216	97 67	staa OUT_LO_Shadow
1218	F218	39	rts

**Procedure Test\_Zero\_Patch2 (new code)**

ROM offset	CPU offset	Opcodes	Mnemonics
1220	F220	CC XX YY	ldd XYYY (Delay, ms) *
1223	F223	DD 3A	std Sample_Delay
1224	F224	39	rts

\* For 3200 ms XX=0C, YY=80

**OPTIONAL****Procedure Parsing\_7F**

ROM offset	CPU offset	Opcodes	Mnemonics
...	...	...	...
8AB	E8AB	C1 0D	Auto-Zero interval *
...	...	...	...

\* Default 0Dh=15 min, 1=65.6 sec.

```

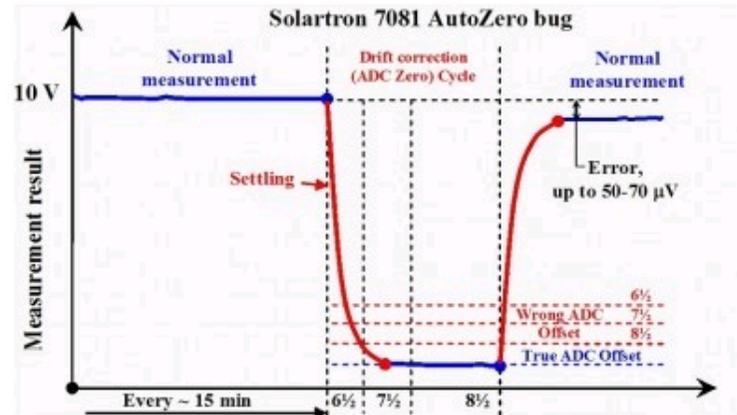
RAM:E893 Parsing_7F:                                ; CODE XREF: RAM:loc_E87B7P
RAM:E893      ldaa    byte_7F                        ;
RAM:E894      tst     byte_2E                        ;
RAM:E895      bne    loc_E8AF                        ;
RAM:E896      cmpa   #3                               ;
RAM:E897      beq    loc_E8BC                        ; Jump if =3
RAM:E898      ldab   DMH_Nines                       ;
RAM:E899      cmpb   #4                               ;
RAM:E89A      bcs   loc_E8BC                        ; Jump if DMH_Nines<4
RAM:E89B      tst     IC_Running_Flag                ;
RAM:E89C      beq    loc_E8BC                        ; Jump if Tick Counter stopped
RAM:E89D      ldab   Tick_counter_hi_byte            ;
RAM:E89E      cmpb   #5D                             ; Zero interval (15 min. default)
RAM:E89F      bcs   loc_E8BC                        ; Jump if less
RAM:E8A0      loc_E8AF:                               ; CODE XREF: Parsing_7F+51j
RAM:E8A1      clr    byte_3E                        ;
RAM:E8A2      cmpa   #A                               ;
RAM:E8A3      beq    loc_E8BC                        ;
RAM:E8A4      staa   byte_64                        ;
RAM:E8A5      ldaa   #A                               ;
RAM:E8A6      staa   byte_7F                        ;
RAM:E8A7
RAM:E8A8

```

**ROM checksum!!!**

ROM offset	CPU offset	Opcodes	Mnemonics
0000	E000	ZZ	Checksum additional constant: ZZ+sum(E000:FFFF)=0

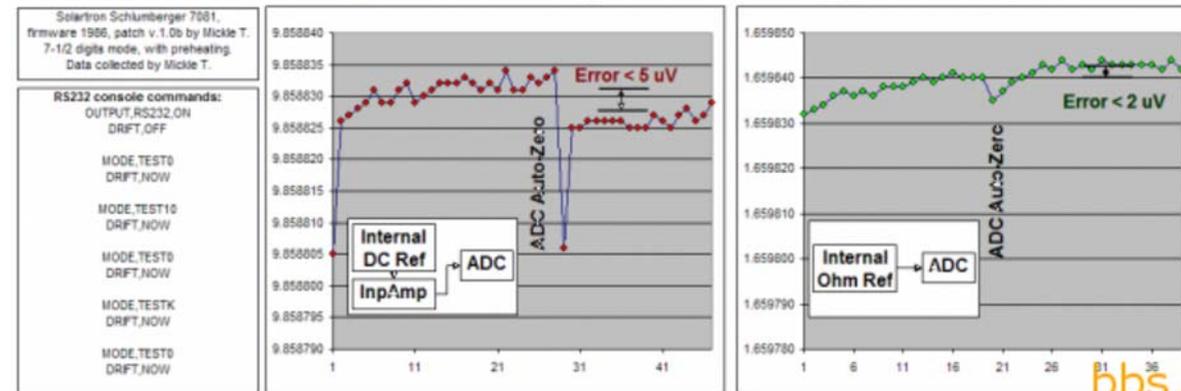
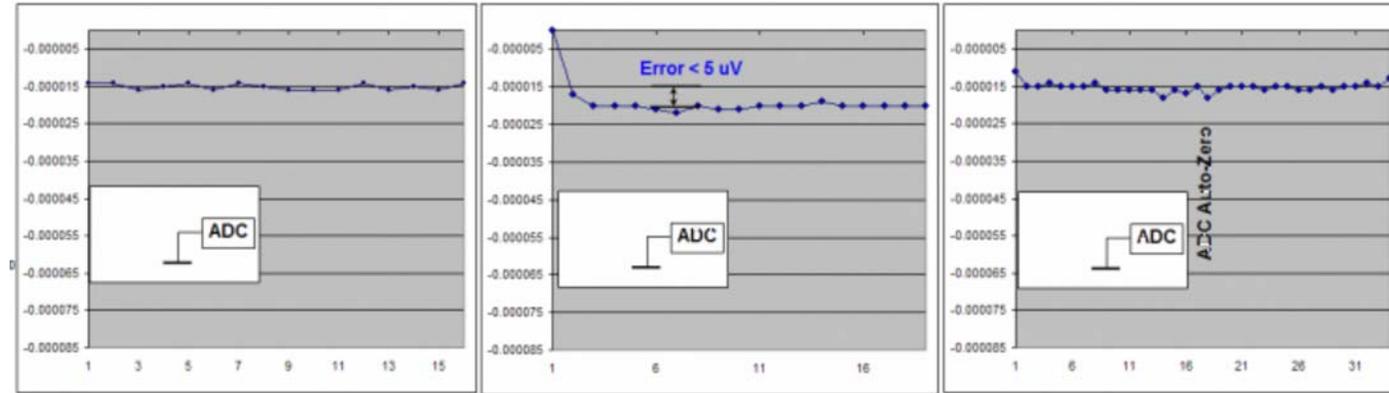
bbs.38hot.net



[http://www.fileserve.com/file/kctz34r/7081\\_Docs.rar](http://www.fileserve.com/file/kctz34r/7081_Docs.rar)

[http://www.fileserve.com/file/G36ugDs/7081\\_IC803\\_patched.rar](http://www.fileserve.com/file/G36ugDs/7081_IC803_patched.rar)

Now, the problem is solved:

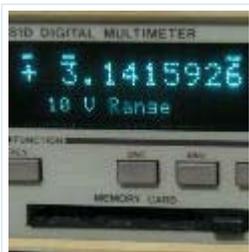


bbs.38hot.net

[ 2012-01-08 18:12 ]

14 14 +42 +12





1458



23034



134



<http://shop62201038.taobao.com/>



LM399 AD588BQ LTZ1000 Itflu



iddqd2001

2012-01-08



Can't understand why appeared two last pictures in my post? Can't delete it





100

334

38



3: 2012-01-08





1663



1823



5



4 2012-01-08



Move over the picture to be deleted, when the upper left corner box when prompted, choose the right [ ] either.

130 5885 1820 Q\_Q 2 4 7 5 0 3 4

ruching.wong@hotmail.com







50 70 90 05



50 50 254

41 41 363

50 01 1

50 51 50 50 50 50

iddqd2001

40 50

6 50 50 50 50 50: 2012-01-08

50 77 50 50 50 50

50 50 50, thank you! Extra pictures deleted!

No problem with Google Translate. With it I can understand more then 80% of posts.

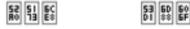
50 50



100

334

38



7: 2012-01-08



38





50 70 50



50 50 215

41 41 166

50 01 2

50 51 50 50 50 50

cdma

8 50 50 50 50 50: 2012-01-08

50 77 50 50 50 50

Good good study day day up

50 50

50 50



48 50  
01 02



53 56  
01 02

587

41 44  
01 02

22630

58 61  
01 02

42

50 51 52  
01 02 03

53 54 55  
01 02 03

redtony

9 12 2012-01-08

53 54 55 56  
01 02 03 04

43 46 49 52  
01 02 03 04



56 59 62 65  
01 02 03 04

46 49 52 55 58 61 64  
01 02 03 04 05 06 07

56 59 62 65  
01 02 03 04

53 56 59 62 65 68 71  
01 02 03 04 05 06 07

58 59



2659



694



137



redtony

10: 2012-01-08

re: n





72 46 38



2659  
694  
137

52 51 50 53 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

xplore

11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100: 2012-01-08

52 51 50 53 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

Great 01

26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

52 51 50 53 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100



824



824

869

46

824 869 46

mige062

824

12 2012-01-08

824 869 46



824









50 70 80 90



50 50

479

41 41

11442

50 01

0

50 51 52

50 50 51

7r093

50 50

40 40

16 16: 2012-01-08

50 50 50 50

40 40 40 40 40 40 40 40

50 50

40 40



158



9089



4



iking921

17: 2012-01-08





NE 7B 8E



SD 01 5E

2590

NI 01 44

1503238851

SM 01 12

25

SD 01 5E

NI 01 44

roller

18 : 2012-01-08

very interesting

but I wondered you have spent a lot time to repair this antique DMM is just for fun or it really can be used as an measuring instrument after repair?

I also like buy old instrument but i'd rather for keep them as antiques than use them as measuring instrument for their out of date hardware and software could not meet the requirement which an single chip would do



58 78



59 58

59

41 44

180

58 01

1



iking921

58 54

48 88

19 2012-01-08

58 77 58 08

xplore

xplore:Great

(2012-01-08 20:00)

58 78 58 01



Empty rectangular box at the top of the page.

Navigation links: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

Powered by [phpwind v8.7](#) Certificate Copyright Time now is:01-11 03:06  
©2003-2011 38Hot Volt-Nuts Gzip enabled ICP 09201492 Total 0.083121(s) query 7,