

Z88 Internal ROM Modifications

Updated 22 August 2004

OZ Patches

There is ongoing work to update OZ Cambridge Computer Z88 operating system version 4.0 to include support for international character sets as well as other improvements. See: [Z88 Development](#). Until finalized there are a couple of small modifications that could be applied to fix bugs, avoid bugs or improve the function of the Z88.

BBC BASIC Trappable Errors Bug

OZ version 3.12 to 3.26

There is a bug in the interface between OZ and BBC BASIC making the following errors not trappable:

17	Escape
192	Too many files open
222	Channel
252	File not found (etc.)
253	Sorry, not implemented
254	Bad command

Richard Russel's BASIC patch relies on error 253 being trappable. The error 'No room' is reported when trying to use the patch.

BASIC programs using ON ERROR to trap one of these does not work.

The cause of the bug was found by [Richard Russell](#), the author of BBC BASIC Z80, and reported to Cambridge Computer Ltd 27th January 1989 but was not corrected until OZ was updated to version 4.0.

This bug can be eliminated by reprogramming the (EP)ROM chip.

At ROM image offset 19960h (bank 6 offset 1960h) you find the byte sequence 7D B4 CA 76 FE hex.

```
In assembly:  LD      A, L
              OR      H
              JP      Z, FE76h
```

Change the first two bytes to make the sequence 24 25 CA 76 FE hex.

```
In assembly:  INC      H
              DEC      H
              JP      Z, FE76h
```

This is the fix that was introduced in OZ 4.0.

Serial Port Odd and Even Parity Bug

OZ version 2.2 to 4.0

There is a bug in the serial port receiving routines corrupting characters received using odd or even

parity by not stripping the parity bit.

The bug was reported by Michael J. Sims in the Z88 Users' Club newsletter [Z88 EPROM May/June 1988](#).

The cause of this bug was found when disassembling the OS_SI operating system call in July 1998.

This bug can be eliminated by reprogramming the (EP)ROM chip.

At ROM image offset 1D03Ch (bank 7 offset 103Ch) for OZ up to 2.6, (and 3.0) or offset 0A63Ch (bank 2 offset 263Ch) for OZ 3.12 and up, you find the byte sequence CB 75 28 02 E6 7F hex.

```
In assembly:  BIT      6,L
              JR       Z,9042h
              AND      7Fh
```

Change the second byte to make the sequence CB 7D 28 02 E6 7F hex.

```
In assembly:  BIT      7,L
              JR       Z,9042h
              AND      7Fh
```

:RAM.- Bug

OZ version 2.2/(3.0) to 2.6

The bug was reported by Steve Marsh in the Z88 Users' Club newsletter [Z88 EPROM Nov/Dec 1988](#).

- From The BBC BASIC(Z80) Reference Manual for the Z88: "There is a bug in versions of the filer up to and including version 3 that will cause the Z88 to crash if you use the device :RAM.- and then perform a soft reset whilst any files are still present in the device."
- From Z88 Developers' Notes v0.93: "Due to a bug in the current operating system (version 2.2/3.0) if any files are stored in the device when a Soft Reset occurs, the system becomes badly confused, and is it very likely that a crash will follow sometime later."
- From Z88 Developers' Notes v3.0: "NOTE: V4 has fixed the :RAM.- problem. Some foreign V3.xx versions contains the fix as well."

The effects of the bug can be more easily avoided by reprogramming the (EP)ROM chip for the OZ features related to Boot.cli, K.sgn and S.sgn, not to create or use files in :Ram.-.

At ROM image offset 080A9h (bank 2 offset 0A9h) you find the text: ':Ram.-/Boot.cli'.

At ROM image offset 089E4h (bank 2 offset 9E4h) you find the text: '.T<:Ram.-/K.sgn'.

At ROM image offset 089F7h (bank 2 offset 9F7h) you find the text: '.T>:Ram.-/S.sgn'.

Replace all occurrences of ':Ram.-' with ':Ram.0'.

A better alternative is to upgrade to OZ version 3.21, 4.0 or 4.01.

More Diaries

OZ version 2.2 to 4.0

The possibility of having more than one instance of the Diary application running at the same time. For

instance one for work and one private. The change was suggested by Gunther Strube in the Z88 Users' Club newsletter [Z88 EPROM April 1990](#) and offered as a service by Gunther in Tim Swenson's [Z88 Source Book](#).

This ability can be achieved by reprogramming the (EP)ROM chip.

At ROM image offset 1FE59h (bank 7 offset 3E59h) you find the sequence 11 00 48 hex.

These are the Diary application type byte 1 and 2 and the key 'H' to help section.

Change the first byte to make the sequence 01 00 48 hex.

Inverted Caps Shift as Default in BBC BASIC

OZ version 2.2 to 4.0

In BASIC it is useful to use inverted caps shift. That is type upper case letters when shift is not pressed and lower case letters when shift is pressed. You can press [] CAPSLOCK after starting BASIC to have inverted caps shift but it can also be made the default state when starting BASIC by reprogramming the (EP)ROM chip.

This modification was pioneered by [Keith Rickard](#).

At ROM image offset 1FEC9h (bank 7 offset 3EC9h) you find the sequence 22 01 48 hex.

These are the BASIC application type byte 1 and 2 and the key 'H' to help section.

Change the second byte to make the sequence 22 03 48 hex.

Date at Hard Reset

OZ version 2.2 to 4.0

At ROM image offset 1D44Eh (bank 7 offset 144Eh) for OZ up to 2.6, (and 3.0) or offset 1D58Eh (bank 7 offset 158Eh) for OZ 3.12 and up, you find the byte sequence 11 yy YY 01 dd mm E7 09 16 hex.

This is the date setting at hard reset. In assembly from OZ 2.2/3.0:

```
LD      DE,07C3h      ;1987
LD      BC,0901h     ;September 1st
RST     20h          ;OZ system call GN_DEI, Convert zoned format date to internal f
DEFW    1609h
```

To be conventional you should set it to the date of your modification.

Version String

OZ version 2.2 to 4.0

Version strings can be found at the following locations:

ROM Image Bank 7 Version

Offset	Offset	String
1E437h	2437h	" 2.2"
		" 3.0"
1E49Fh	249Fh	" 2.5"
		" 2.6"
1E681h	2681h	" 3.12"
1E698h	2698h	" 3.13"
1E67Ah	267Ah	" 3.17 (Turkey) "
		" 3.18 (Germany) "
1E6AEh	26AEh	" 3.19 (Spain) "
1E682h	2682h	" 3.21 (Denmark) "
		" 3.23 (Italy) "
1E68Eh	268Eh	" 3.26 (France) "
1E680h	2680h	" 4.001 (UK) "
1E680h	2680h	" 4.0 (UK) "

I suggest replacing the dot in the OZ version number with a lower case p to indicate that a patch is applied.

Notes

The OZ version 3.0 chip cannot be reprogrammed because it is not an EPROM chip.

Finnish/Swedish OZ 4.01 (FI)

Jorma Oksanen from Finland have made a significant patch on OZ 4.0 to include support for Finnish/Swedish keyboard and screen font. It also includes the patches for Serial Port Odd and Even Parity Bug, More Diaries and Inverted Caps Shift as Default in BBC BASIC. The :RAM.- Bug was already fixed in OZ 4.0.

Some words from the author:

Standard disclaimers apply, if it blows your Z88 then it isn't my fault.

Anyone willing to part with his EPROM emulator, or lending it for non-specified period? :)

Jorma

Download Finnish/Swedish OZ 4.01 (FI) [ROM](#), 6 November 2002, 93K.

OZ Chips

I have bought some 128 KB ROM compatible pinout EPROMs which I can supply with your choice of OZ version and patches. Not sure about how much to charge. It will depend on demand. If interested, please email me with details and what you think is a reasonable cost.

512 KB Internal ROM

For wiring the missing top address lines see Don Waltermans [instructions](#) for 512 KB internal RAM at Z88 Forever!

For a JEDEC pinout SGS-Thomson 27C4001 EPROM, I used the following connections:

	+-----+				
	VCC 1	+--+	32	VCC	
Leg bent out and connected to A16	ROE 2		31	VCC	Leg bent out and connected to A18
	A15 3		30	VCC	Leg bent out and connected to A17
	A12 4		29	A14	
	A7 5		28	A13	
	A6 6		27	A8	
	A5 7	Z88	26	A9	
	A4 8	ROM	25	A11	
	A3 9	PCB	24	A16	Leg bent out and connected to ROE
	A2 10		23	A10	
	A1 11		22	CE	
	A0 12		21	D7	
	D0 13		20	D6	
	D1 14		19	D5	
	D2 15		18	D4	
	VSS 16		17	D3	
	+-----+				

There is a much better way to connect the chip outlined in [Z88 Motherboard Modifications](#).

[Layout](#) courtesy Thierry Peycru.

Copy from the bottom of a 128 KB OZ image, offset address 0 to 1FFD2h, to bottom of 512 KB ROM image, offset address 0 to 1FFD2h. That's including application front DOR.

Copy from the top of the same OZ image, offset address 1FFC0h to 1FFFFh, to top of 512 KB ROM image, offset address 7FFC0h to 7FFFFh. That's the application front DOR and card header.

The application front DOR card size at 7FFFCh should be changed from 8 to 20h (32 banks).

Now you have a 512 KB OZ image that runs exactly like the original 128 KB OZ ROM.

To add more applications, prepare and add bank images like you would for an external ROM card with one exception. All bank references in internal ROM DORs should be absolute or relative to the top of internal ROM bank space. Top bank is 1Fh and not 3Fh like on external ROMs. For internal 512 KB and external 1024 KB ROMs, absolute and relative bank addressing is the same.

Any bank switching code in added applications is almost certain to need changes as per above.

The application front DOR of the last original OZ application Imp-Export is located at 07FC5h. Change the brother link to point to your first added application.

[Keith Rickard](#) pioneered this this technique too and put OZ 4.0, QuickEdit and SpellMaster on a 512 KB EPROM with 256 KB still free.

Email: dennisgr@algonet.se

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