

\*\*\*\*\*Draft\*\*\*\*\*

## Hardware Testing Sdram, Bkram, and GPIO

04/12/21

\*\*\*\*\*Draft\*\*\*\*\*

- bkram(wx) : ORIGIN = 0x00a00000, LENGTH = 0x00002000
- sdram(wx) : ORIGIN = 0x01000000, LENGTH = 0x00800000
- + bkram(wx) : ORIGIN = 0x01400000, LENGTH = 0x00002000
- + sdram(wx) : ORIGIN = 0x02000000, LENGTH = 0x01000000

The goal with the chg below was trying to fix the above in hopes of getting arm-zipload working.

This chg in auto-data/sdramdev.txt

```
-@$NADDR=(1<<(@$THIS.LGMEMSZ-3))  
+@$NADDR=(1<<(@$THIS.LGMEMSZ-2))  
Results in 703 3108 24939 ../NADDR1.txt
```

In several files.

```
modified: auto-data/bkram.ld  
modified: auto-data/flashram.ld  
modified: auto-data/sdram.ld  
modified: auto-data/sdram_only.ld  
modified: auto-data/sdramdev.txt  
modified: doc/hardware-testing.odt  
modified: rtl/catzip/builddate.v  
modified: rtl/catzip/main.v  
modified: sim/verilated/main_tb.cpp  
modified: sw/board/board.h  
modified: sw/board/board.ld  
modified: sw/board/boardram.ld  
modified: sw/host/regdefs.h  
modified: sw/host/wr.sh  
modified: sw/host/wr1.sh  
modified: sw/zlib/board.h
```

With change in sdram required changes in rdsdram.cpp & wrsdram.cpp.

```
diff --git a/sw/host/wrsdram.cpp b/sw/host/wrsdram.cpp
```

```
index 538a1c4..b8a6911 100644
```

```
--- a/sw/host/wrsdram.cpp
```

```
+++ b/sw/host/wrsdram.cpp
```

```
@@ -53,10 +53,10 @@
```

```
FPGA *m_fpga;
```

```
//#define DUMPMEM SDRAMBASE  
-#define DUMPMEM 0x0100f120  
+#define DUMPMEM 0x0200f120  
//#define DUMPWORDS (FLASHLEN>>2) // 16MB Flash  
//#define DUMPWORDS (4000>>2)  
-#define DUMPWORDS 65535  
+#define DUMPWORDS 65536  
void usage(void) {  
    printf("USAGE:\tdumpflash [-n host] [-p port] filename.bin\n"  
    "\n")
```

```
diff --git a/sw/host/rdsdram.cpp b/sw/host/rdsdram.cpp
index 435eb01..7350a65 100644
```

```
--- a/sw/host/rdsdram.cpp
```

```
+++ b/sw/host/rdsdram.cpp
```

```
@@ -53,10 +53,10 @@
```

```
 FPGA *m_fpga;
```

```

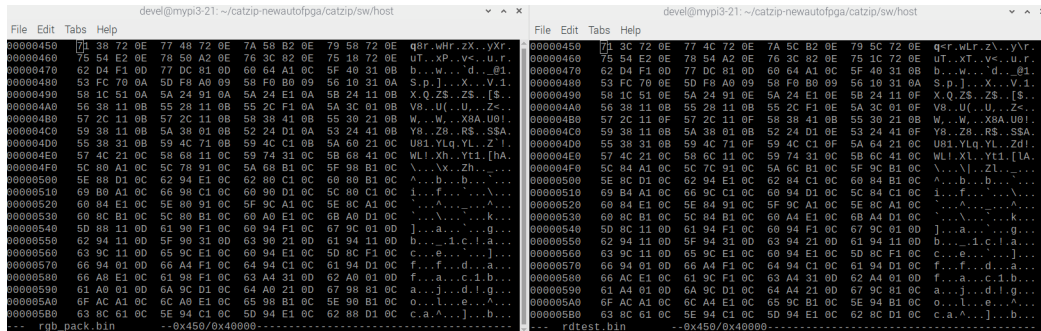
#define DUMPMEM SDRAMBASE
#define DUMPMEM 0x0100f120
#define DUMPMEM 0x0200f120
#define DUMPWORDS (FLASHLEN>>2) // 16MB Flash
#define DUMPWORDS (4000>>2)
#define DUMPWORDS 65535
#define DUMPWORDS 65536

void usage(void) {
    printf("USAGE: tdumpflash [-n host] [-p port] filename.bin\n")
}

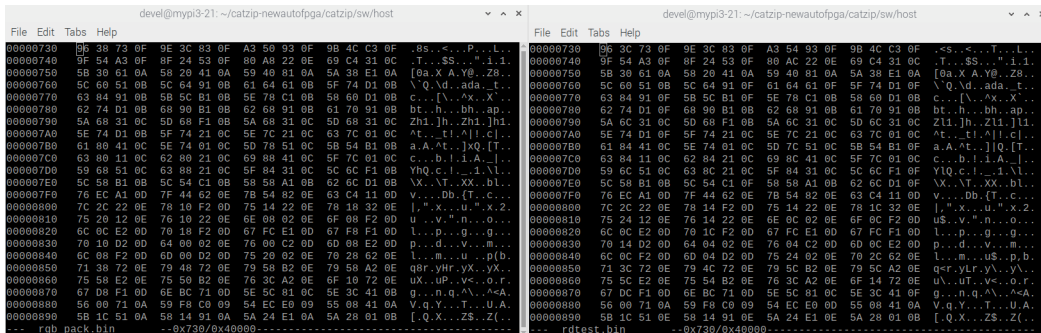
"
```

The above changes were tested on hardware. The following 4 images show the write/read to sdram.

sdram1



sdram2



sdram3

```
File Edit Tabs Help
devel@mypi3-21: ~/catzip-newautofpga/catzip/sw/host
00000CF0 5A 78 81 0C 53 60 A1 0C 57 64 C1 0C 5B 7C D1 0C Zx.$ .Wd..[...
00000D00 5C 80 01 0D 59 80 D1 0C 64 94 B1 0C 5A 7C F1 0C \...Y...d...Zi...
00000D10 5F 84 D1 0C 61 8C A1 0C 5C 80 01 0D 61 7C A1 0C .....a...a...
00000D20 62 88 F1 0C 5F 9C 11 0D 5E 8C 01 0D 5C 8C C1 0C b.....A...A...
00000D30 60 8C C1 0C 58 80 F1 0C 60 88 21 0D 5A 80 E1 0C [...]...i.Z...
00000D40 5A 80 21 0D 68 24 F1 0C 63 9C F1 0C 62 94 11 0D Z.i.h...e...b...
00000D50 5F 94 21 0D 50 80 11 0D 61 94 51 0D 5F 94 41 0D [...]...a.Q...A...
00000D60 5E 90 21 0D 59 7C 41 0D 50 94 01 0D 5E 88 21 0D A.i.Y[A]...A.i...
00000D70 62 84 01 0D 63 88 E1 0C 5E 88 D1 0C 5D 8C 11 0D b...c...A...[...
00000D80 64 90 11 0D 63 90 E1 0C 5F 94 D1 0C 64 94 E1 0C d...c...d...d...
00000D90 65 98 D1 0C 58 80 F1 0C 5E 88 E1 0C 67 88 C1 0C e...].~...g...
00000DA0 71 84 A1 0C 65 88 C1 0C 6B 88 B1 0C 60 80 91 0C q...e...k...
00000DB0 62 A0 E1 0C 60 88 91 0C 60 94 E1 0C 58 7C E1 0C b...i...X]...
00000DC0 60 8C A1 0C 67 8C B1 0C 65 A4 B1 0C 61 84 A1 0C [...]...g...e...a...
00000DD0 60 98 91 0C 56 78 C1 0C 5C 90 D1 0C 5C 8C E1 0C [...]Vp...V...V...
00000DE0 64 A0 C1 0C 5D 8C 41 0D 60 A0 D1 0C 60 84 C1 0C d...].A...A...
00000DF0 60 94 01 0D 5C 80 E1 0C 63 98 01 0D 5C 8C 01 0D [...]...c...A...
00000E00 66 90 F1 0C 63 90 C1 0C 5E 90 01 0D 5C 80 E1 0C [...]...c...A...
00000E10 5B 78 A1 0C 64 88 51 0C 5D 7C C1 0C 6A 9C 81 0C [i...d.Q[i]...j...
00000E20 5B 74 C1 0C 5F 88 B1 0C 60 84 81 0C 5D 80 91 0C [t...t...t...
00000E30 5E 7C A1 0C 66 88 31 0C 59 80 F1 0C 61 80 E1 0C ^[...f.i.Y...a...
00000E40 61 8C A1 0C 60 84 C1 0C 62 84 C1 0C 5D 7C 81 0C a...[...b...[...
00000E50 65 84 91 0C 5B 78 C1 0C 5E 74 61 0C 60 7C 51 0C e...[...t...a...[Q...
--- rgb_pack.bin --0xC9F0/0x40000
File Edit Tabs Help
devel@mypi3-21: ~/catzip-newautofpga/catzip/sw/host
00000CF0 5A 78 81 0C 53 60 A1 0C 57 64 C1 0C 5B 7C D1 0C Zx.$ .Wd..[...
00000D00 5C 80 01 0D 59 80 D1 0C 64 94 B1 0C 5A 7C F1 0C \...Y...d...Zi...
00000D10 5F 84 D1 0C 61 8C A1 0C 5C 80 01 0D 61 7C A1 0C .....a...a...
00000D20 62 88 F1 0C 5F 9C 11 0D 5E 8C 01 0D 5C 8C C1 0C b.....A...A...
00000D30 60 8C C1 0C 58 80 F1 0C 60 88 21 0D 5A 80 E1 0C [...]...i.Z...
00000D40 5A 80 21 0D 68 24 F1 0C 63 9C F1 0C 62 94 11 0D Z.i.h...e...b...
00000D50 5F 94 21 0D 50 80 11 0D 61 94 51 0D 5F 94 41 0D [...]...a.Q...A...
00000D60 5E 90 21 0D 59 7C 41 0D 50 94 01 0D 5E 88 21 0D A.i.Y[A]...A.i...
00000D70 62 84 01 0D 63 88 E1 0C 5E 88 D1 0C 5D 8C 11 0D b...c...A...[...
00000D80 64 90 11 0D 63 90 E1 0C 5F 94 D1 0C 64 94 E1 0C d...c...d...d...
00000D90 65 98 D1 0C 58 80 F1 0C 5E 88 E1 0C 67 88 C1 0C e...].~...g...
00000DA0 71 84 A1 0C 65 88 C1 0C 6B 88 B1 0C 60 80 91 0C q...e...k...
00000DB0 62 A0 E1 0C 60 88 91 0C 60 94 E1 0C 58 7C E1 0C b...i...X]...
00000DC0 60 8C A1 0C 67 8C B1 0C 65 A4 B1 0C 61 84 A1 0C [...]...g...e...a...
00000DD0 60 98 91 0C 56 78 C1 0C 5C 90 D1 0C 5C 8C E1 0C [...]Vp...V...V...
00000DE0 64 A0 C1 0C 5D 8C 41 0D 60 A0 D1 0C 60 84 C1 0C d...].A...A...
00000DF0 60 94 01 0D 5C 80 E1 0C 63 98 01 0D 5C 8C 01 0D [...]...c...A...
00000E00 66 90 F1 0C 63 90 C1 0C 5E 90 01 0D 5C 80 E1 0C [...]...c...A...
00000E10 5B 78 A1 0C 64 88 51 0C 5D 7C C1 0C 6A 9C 81 0C [i...d.Q[i]...j...
00000E20 5B 74 C1 0C 5F 88 B1 0C 60 84 81 0C 5D 80 91 0C [t...t...t...
00000E30 5E 7C A1 0C 66 88 31 0C 59 80 F1 0C 61 80 E1 0C ^[...f.i.Y...a...
00000E40 61 8C A1 0C 60 84 C1 0C 62 84 C1 0C 5D 7C 81 0C a...[...b...[...
00000E50 65 84 91 0C 5B 78 C1 0C 5E 74 61 0C 60 7C 51 0C e...[...t...a...[Q...
--- rdtest.bin --0xC9F0/0x40000
```

sdram4

```
File Edit Tabs Help
devel@mypi3-21: ~/catzip-newautofpga/catzip/sw/host
00001FA0 53 6C E1 0B 5E 64 F1 0F 5A 6C 31 0C 60 74 01 0C c1...d..Z1i...t...
00001FB0 5C 78 21 0C 5F 78 31 0C 5D 7C 71 0C 5E 70 11 0C \x1...x1.]q.^p...
00001FC0 5D 74 61 0C 5D 78 41 0C 58 7C 41 0C 64 88 91 0C [ta...X]A.d...
00001FD0 63 94 D1 0C 63 94 B1 0C 5F 84 E1 0C 5C 60 51 0C c...c...~\iQ...
00001FE0 51 18 91 0A 43 8C 08 08 3E 4C F0 05 49 7C C0 05 Q...c...~L...I...
00001FF0 41 60 A0 05 3B 54 A0 05 42 7C C0 05 42 68 C0 05 A...T..Bp..Bh...
00002000 6F 04 32 0E 6D 04 02 0E 6C 08 02 0E 67 F8 11 0E o.2.m...l...g...
00002010 6C 0C 12 0E 66 04 32 0E 70 0C 12 0E 67 04 22 0E l...f.2.p...g...
00002020 67 F8 21 0E 68 04 32 0E 69 08 12 0E 69 04 32 0E g.i.k.2...i.2...
00002030 65 F4 01 0E 6E F8 E1 0D 68 FC 11 0E 76 28 22 0E e...n...h...v...
00002040 6D 24 52 0E 74 38 62 0E 6F 48 72 0E 71 40 42 0E mSR.t8b.Ohr.q8B...
00002050 6F 44 72 0E 70 3C A2 0E 6A 3C A2 0E 6C 24 A2 0E odr.p8...j.s...l4...
00002060 6E 3C 02 0E 6D 24 62 0E 66 0C 62 0E 67 EC F1 0D n8...msb.f.b.g...
00002070 5A 8B D1 0D 5C 9C 31 0D 59 5C 91 0C 52 1C 61 0B Z...i.YV...R.a...
00002080 4A E8 60 0A 4C D8 F0 09 48 D8 F0 09 4F F4 10 0A J...L...H...O...
00002090 48 E0 70 0A 52 14 C1 0A 51 20 21 0B 4B F4 F0 0A H.p.R...Q I.K...
000020A0 52 2C 71 0F 4D 20 41 0B 50 1C 31 0B 57 30 51 0B R.q.W.A.P.1.WoQ...
000020B0 53 1C 01 0B 54 18 11 0B 4F 14 F1 0A 55 28 31 0B S...T...O...U(1...
000020C0 4C 10 21 0B 4E 0C 41 0F 49 0C 11 0B 4E 0C 51 0B L.I.N.A.I...N.Q...
000020D0 4F 34 61 0F 50 34 C1 0F 55 44 01 0C 52 44 01 0C O4a.P4..UD..RD...
000020E0 51 4C 51 0C 56 64 71 0C 59 64 91 0C 62 6C 51 0C Q.Q.V.n.Yd...b1Q...
000020F0 5A 70 61 0C 57 6C B1 0C 5A 74 A1 0C 59 74 D1 0C Zta.W1..Zt..Yt...
00002100 5C 80 F1 0C 5B 78 F1 0C 59 78 C1 0C 62 94 B1 0C \...[...Y]...b...
--- rgb_pack.bin --0x1FA0/0x40000
File Edit Tabs Help
devel@mypi3-21: ~/catzip-newautofpga/catzip/sw/host
00001FA0 53 6C E1 0B 5E 64 F1 0F 5A 6C 31 0C 60 74 01 0C c1...d..Z1i...t...
00001FB0 5C 7C 21 0C 5F 7C 31 0C 5D 7C 71 0C 5E 74 11 0C \i...i.]q.^t...
00001FC0 5D 74 61 0C 5D 7C 41 0C 58 7C 41 0C 64 8C 91 0C [ta...X]A.d...
00001FD0 63 94 D1 0C 63 94 B1 0C 5F 84 E1 0C 5C 60 51 0C c...c...~\iQ...
00001FE0 51 18 91 0A 43 8C 08 08 3E 4C F0 05 49 7C C0 05 Q...c...~L...I...
00001FF0 41 64 A0 05 3B 54 A0 05 42 74 C0 05 42 6C C0 05 Ad...T..Bt..B1...
00002000 6F 04 32 0E 6D 04 02 0E 6C 0C 02 0E 67 FC 11 0E o.2.m...l...g...
00002010 6C 0C 12 0E 66 04 32 0E 70 0C 12 0E 67 04 22 0E l...f.2.p...g...
00002020 67 FC 21 0E 68 04 32 0E 69 0C 12 0E 69 04 32 0E g.i.k.2...i.2...
00002030 65 F4 01 0E 6E FC E1 0D 68 FC 11 0E 76 2C 22 0E e...n...h...v...
00002040 6D 24 52 0E 74 3C 62 0E 6F 4C 72 0E 71 44 42 0E mSR.t8b.Ohr.q8B...
00002050 6F 44 72 0E 70 3C A2 0E 6A 3C A2 0E 6C 24 A2 0E odr.p8...j.s...l4...
00002060 6E 3C 02 0E 6D 24 62 0E 66 0C 62 0E 67 EC F1 0D n8...msb.f.b.g...
00002070 5A 8B D1 0D 5C 9C 31 0D 59 5C 91 0C 52 1C 61 0F Z...i.YV...R.a...
00002080 4A E8 60 0A 4C D8 F0 09 48 D8 F0 09 4F F4 10 0E J...L...H...O...
00002090 48 E0 70 0A 52 14 C1 0E 51 20 21 0B 4B F4 F0 0E H.p.R...Q I.K...
000020A0 52 2C 71 0F 4D 20 41 0B 50 1C 31 0F 57 30 51 0B R.q.W.A.P.1.WoQ...
000020B0 53 1C 01 0F 54 18 11 0B 4F 14 F1 0E 55 28 31 0B S...T...O...U(1...
000020C0 4C 10 21 0B 4E 0C 41 0F 49 0C 11 0F 4E 0C 51 0F L.I.N.A.I...N.Q...
000020D0 4F 34 61 0F 50 34 C1 0F 55 44 01 0C 52 44 01 0C O4a.P4..UD..RD...
000020E0 51 4C 51 0C 56 64 71 0C 59 64 91 0C 62 6C 51 0C Q.Q.V.n.Yd...b1Q...
000020F0 5A 74 61 0C 57 6C B1 0C 5A 74 A1 0C 59 74 D1 0C Zta.W1..Zt..Yt...
00002100 5C 84 F1 0C 5B 7C F1 0C 59 7C C1 0C 62 94 B1 0C \...[...Y]...b...
--- rdtest.bin --0x1FA0/0x40000
```

Make a copy of the working software to test on RPi3 with Catboard.

devel@mypi3-16:~/testbuilds \$ rsync -avl catzip-newautofpga mypi3-21:~/

devel@mypi3-21:~ \$ cd catzip-newautofpga/catzip/sw/host

Program the FPGA using config\_cat

devel@mypi3-21:~/catzip-newautofpga/catzip/sw/host \$ sudo config\_cat ../rtl/catzip/catzip.bin

GPIO 25 not exported, trying to export...  
GPIO 17 not exported, trying to export...  
GPIO 22 not exported, trying to export...

OK: SPI driver loaded

Setting GPIO directions  
out  
out  
in  
Setting output to low  
0  
Reseting FPGA  
0  
1  
Checking DONE pin  
0  
Continuing with configuration procedure  
263+1 records in

263+1 records out  
135100 bytes (135 kB, 132 KiB) copied, 0.0268802 s, 5.0 MB/s  
Setting output to high  
1  
Checking DONE pin  
1  
Start the software that listens to local port & a remote port.

```
devel@mypi3-21:~/catzip-newautofpga/catzip/sw/host $ sudo ./arm-netpport  
Listening on port 8363  
Listening on port 8364
```

Check the date the catzip was created using local software.

```
devel@mypi3-21:~/catzip-newautofpga/catzip/sw/host $ ./arm-wbregs version  
01000014 ( VERSION) : [!..] 20210410
```

Check the date the catzip was created using remote software.

```
devel@mypi3-16:~/testbuilds/catzip-newautofpga/catzip/sw/host $ ./arm-wbregs -n mypi3-21 -p  
8363 version  
00800014 ( VERSION) : [!..] 20210408
```

The address of both sdram & bkram changed.

```
#define R_BKRAM          0x01400000    // 01400000, wbregs names: RAM  
#define R_SDRAM          0x02000000    // 02000000, wbregs names: SDRAM
```

```
devel@mypi3-21:~/catzip-newautofpga/catzip/sw/host $ cat wr.sh  
#!/bin/bash  
./arm-wbregs 33554432 0x55  
./arm-wbregs 33554436 0xaa  
./arm-wbregs 33554440 0x01  
./arm-wbregs 33554444 0x02  
./arm-wbregs 33554448 0x00010000  
./arm-wbregs 33554452 0x00020000  
./arm-wbregs 33554432  
./arm-wbregs 33554436  
./arm-wbregs 33554440  
./arm-wbregs 33554444  
./arm-wbregs 33554448  
./arm-wbregs 33554452
```

```
devel@mypi3-21:~/catzip-newautofpga/catzip/sw/host $ cat wr1.sh  
#!/bin/bash  
./arm-wbregs 20971520 0x55  
./arm-wbregs 20971524 0xaa  
./arm-wbregs 20971528 0x01  
./arm-wbregs 20971532 0x02  
./arm-wbregs 20971536 0x00010000  
./arm-wbregs 20971540 0x00020000  
./arm-wbregs 20971520
```

```
./arm-wbregs 20971524
./arm-wbregs 20971528
./arm-wbregs 20971532
./arm-wbregs 20971536
./arm-wbregs 20971540
```

```
devel@mypi3-21:~/catzip-newautofpga/catzip/sw/host $ ./wr1.sh
```

```
01400000 ( RAM)-> 00000055
01400004 ( )-> 000000aa
01400008 ( )-> 00000001
0140000c ( )-> 00000002
01400010 ( )-> 00010000
01400014 ( )-> 00020000
01400000 ( RAM) : [...U] 00000055
01400004 ( ) : [...] 000000aa
01400008 ( ) : [...] 00000001
0140000c ( ) : [...] 00000002
01400010 ( ) : [...] 00010000
01400014 ( ) : [...] 00020000
```

A program using ./arm-wbregs which is Poke & Peek to the FPGA.

```
devel@mypi3-21:~/catzip-newautofpga/catzip/sw/host $ ./wr.sh
```

```
02000000 ( SDRAM)-> 00000055
02000004 ( )-> 000000aa
02000008 ( )-> 00000001
0200000c ( )-> 00000002
02000010 ( )-> 00010000
02000014 ( )-> 00020000
02000000 ( SDRAM) : [...U] 00000055
02000004 ( ) : [...] 000000aa
02000008 ( ) : [...] 00000001
0200000c ( ) : [...] 00000002
02000010 ( ) : [...] 00010000
02000014 ( ) : [...] 00020000
```

```
devel@mypi3-21:~/catzip-newautofpga/catzip/sw/host $ ./arm-wbregs 20971520
```

```
01000004 ( ) : [...] 000000aa
```

```
devel@mypi3-21:~/catzip-newautofpga/catzip/sw/host $ ./arm-wbregs 20971540
```

```
01000014 ( ) : [...] 00020000
```

```
devel@mypi3-21:~/catzip-newautofpga/catzip/sw/host $ ./arm-wbregs 0x02000000
```

```
01000000 ( SDRAM) : [...U] 00000055
```

```
devel@mypi3-21:~/catzip-newautofpga/catzip/sw/host $ ./arm-wbregs 0x02000010
```

```
01000010 ( ) : [...] 00010000
```

Turns on Led4

```
devel@mypi3-21:~/testbuilds/catzip-newautofpga/catzip/sw/host $ ./arm-wbregs gpio 0x00010001
0080000c ( GPIO)-> 00010001
```

Turns on Led2

```
devel@mypi3-21:~/testbuilds/catzip-newautofpga/catzip/sw/host $ ./arm-wbregs gpio 0x00020002
0080000c ( GPIO)-> 00020002
```

```
devel@mypi3-21:~/testbuilds/catzip-newautofpga/catzip/sw/host $ ./arm-wbregs gpio 0x00070000  
0080000c ( GPIO)-> 00070000
```





Leds 4 & 2 on.

