

Background subtraction by using scaling technique.

Design for Background subtraction model by using FLASH

```
col_sub           : integer := 640; --- cols total means 640 (640x400)
mem_limit         : integer :=640; --- same as col 640
mem_limit_ram     : integer :=4095; --- 1 less than depth 4095
fram_back_sub     : integer :=2; --- after how many frames background needs to be stored
fram_cam_sub      : integer :=3; --- no need for this after how many frames came frame needs to be forward
fram_limit_sub    : integer :=3; --- limit for frame count, after this reset to fram_cam_sub
width_sub         : integer:=14; --- 14-- data size increase because of the summation for averaging.
depth_sub         : integer:=81; --- 81-- col/8+1 --- for 8x8 8 elements of a row can scaled to one
addr_sub          : integer:=7; --- 7-- how many bits to represent the depth in this 81
width_ram_sub     : integer:=8; --- 8 --For grayscale, after averging resultant value is 8 bits
depth_ram_sub     : integer:=4095; --- 4095-- how many total locations (640/8)(400*/8)= 4000 bytes
addr_ram_sub      : integer:=12 --- 12-- how many bits to represent the depth in this 40000
```

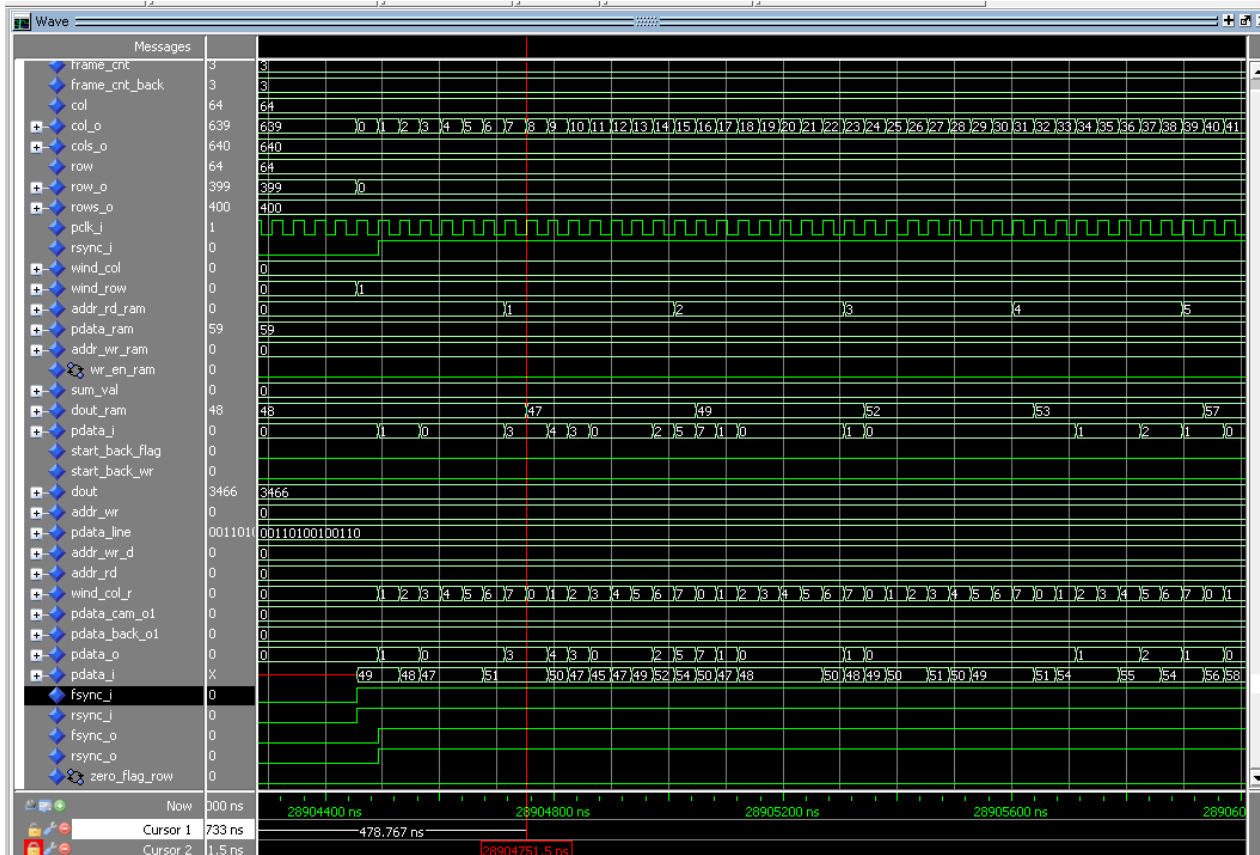
In FLASH, we need to write 15 pages since we have $(640/8 \times 400/8)=4000$ which requires $4000/256= 15$ pages. Presently clock frequency is 27 MHz but can be changes to a maximum of FLASH supported. Test bench has 18.5 ns for a clock period of 37 ns.

Flash erasing

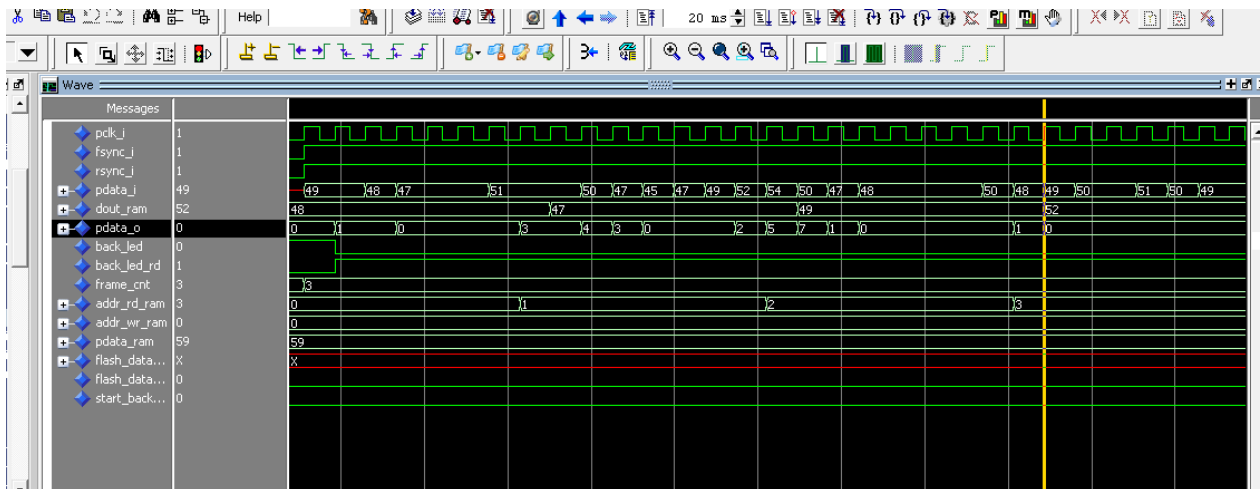
For Flash erasing from sector—page location 410100 use spi_top_module_erase.bit and then press push button BTCN F5.

Note! FLASH writing only after each power up cycle. In middle, no control for writing.Power off is needed.

RTL simulation signals without flash



RTL simulation signals with flash

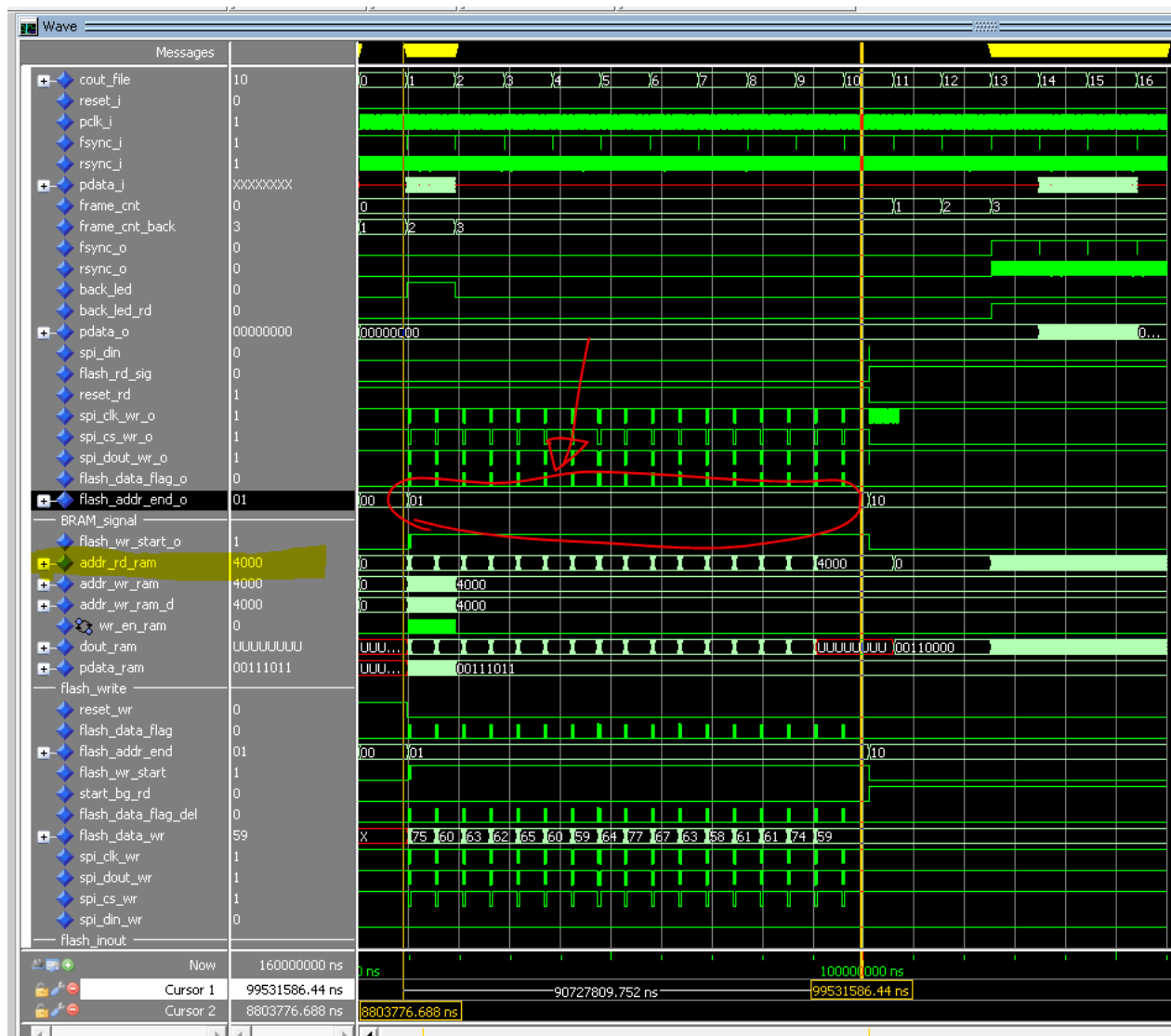


RTL simulation signals with FLASH writing once

Please remember that during each background write in FLASH, the internal memory (BRAMs used for stored background) cannot be accessed for any other purposes.

In particular to our design, add_rd_ram should not be accessed from other processes during flash_addr_end_o is 00 and 01 (the red marked portion). This is because the FLASH writing speed is slow. See FLASH we are using: Numonyx's N25Q128 datasheet:

As soon as flash_addr_end_o is 10, the BRAMs can be accessed for subtraction operation for next wake up and sleep cycles. flash_addr_end_o shows that FLASH writing status.



Memory contents

Memory Data - /sim_3x3_08bits/cam_back/b_img/back_bram/ram1

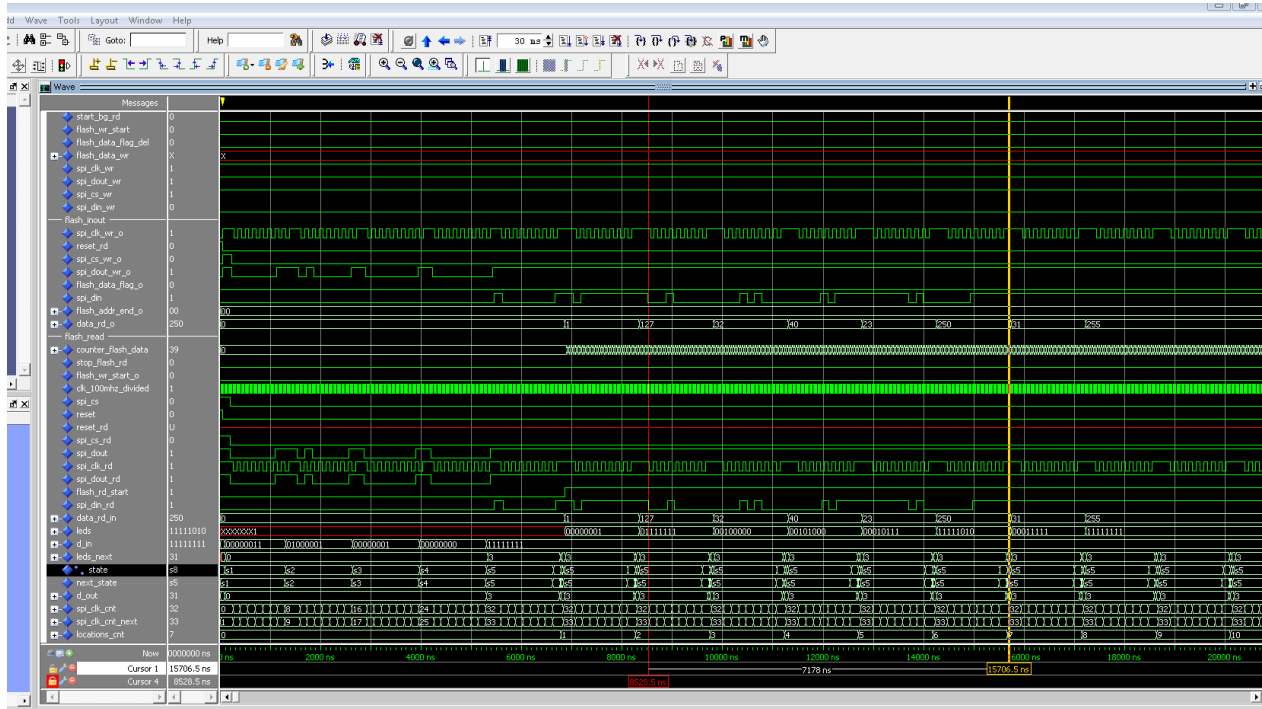
File Edit View Window

Memory Data - /sim_3x3_08bits/cam_back/b_img/back_bram/ram1

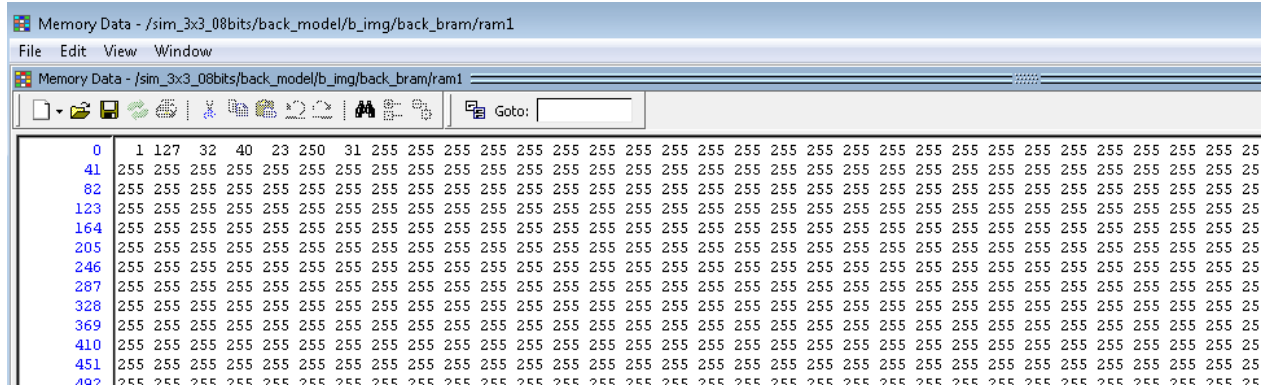
Goto:

0	48	47	49	52	53	57	60	55	68	59	57	60	64	66	74	91	67	77	83	98	102	101	87	70	63	74	81	67
28	63	76	70	63	66	80	67	64	61	64	63	63	60	75	75	65	69	60	65	66	66	65	63	63	58	61	63	70
56	58	60	60	58	58	56	63	59	56	59	59	55	55	52	52	53	58	57	57	59	55	54	54	52	49	49	50	51
84	54	54	59	55	58	61	62	61	63	71	73	74	68	75	74	69	58	60	69	59	61	65	64	75	59	64	59	62
112	62	69	71	66	61	65	74	64	65	71	67	62	63	62	81	78	64	62	61	66	60	60	58	65	70	65	66	61
140	58	56	63	64	65	62	57	56	60	55	54	57	60	60	59	58	56	57	59	56	55	51	51	55	65	57	60	62
168	62	73	67	66	65	69	74	95	72	69	65	62	62	65	66	63	66	66	64	59	64	60	66	67	62	63	64	62
196	58	62	62	62	69	70	65	59	61	60	63	70	64	62	61	75	62	62	61	71	62	59	69	66	58	56	62	66
224	61	57	57	60	56	53	58	67	61	69	61	59	58	58	56	54	58	50	58	67	63	57	66	57	61	63	60	66
252	66	78	73	75	77	61	62	75	70	64	74	64	66	67	61	61	61	59	60	63	74	70	63	60	62	66	63	60
280	65	73	67	61	67	67	66	64	64	66	63	67	71	63	65	63	63	61	62	60	58	58	57	55	56	57	53	53
308	53	51	53	58	58	56	57	58	54	54	52	52	54	52	64	60	56	58	63	59	59	58	60	69	65	82	69	76
336	83	66	62	66	70	61	76	64	62	60	62	60	68	69	58	62	68	67	70	58	69	65	62	64	63	61	61	66
364	61	67	63	70	63	64	65	63	68	64	62	63	63	64	68	58	58	56	56	55	62	55	55	54	55	52	52	55
392	59	54	60	56	54	54	54	51	52	53	56	61	60	66	70	63	66	58	61	71	70	64	65	71	75	65	68	60
420	59	62	71	66	65	64	63	63	61	70	58	68	65	61	61	61	61	58	64	59	60	63	57	65	59	64	68	69
448	62	63	64	64	64	64	64	65	65	61	60	60	57	58	60	65	58	56	59	54	61	53	55	59	60	60	59	55
476	58	54	62	53	58	57	53	61	61	62	71	68	58	60	65	64	69	68	65	77	71	61	66	68	63	62	63	58
504	62	71	60	76	62	60	61	60	58	64	57	60	60	63	69	64	65	68	56	59	59	62	67	67	65	68	67	67
532	63	71	64	68	64	64	59	60	57	57	59	64	58	56	63	72	56	55	58	68	57	69	58	56	60	70	57	55
560	54	57	56	56	58	55	58	60	57	58	60	60	67	67	61	67	70	67	66	74	67	67	64	61	63	66	63	66
588	72	59	59	60	62	70	61	61	62	68	63	63	62	66	57	63	66	74	70	64	73	65	64	58	59	61	69	66
616	65	66	66	64	60	64	58	59	58	55	64	63	55	55	60	59	58	58	59	56	62	68	55	54	59	53	61	59
644	58	55	57	58	58	62	60	57	65	66	66	62	58	65	67	64	64	69	62	61	60	64	63	65	61	63	61	66
672	70	63	59	59	60	56	60	54	57	59	63	62	62	65	69	63	66	68	63	61	60	56	63	64	62	64	61	60
700	60	60	61	59	63	58	59	58	56	56	59	59	59	60	57	59	61	56	56	65	57	56	59	66	61	59	58	58
728	60	62	61	59	61	64	64	62	63	62	61	64	62	69	64	63	61	61	61	62	61	60	60	61	62	63	62	61
756	61	57	59	61	59	60	60	63	66	68	70	63	69	68	64	63	59	58	63	72	63	65	61	64	64	62	58	58
784	65	61	60	57	56	66	59	61	67	58	68	62	57	56	56	64	57	64	65	56	63	58	69	56	69	68	63	59
812	67	66	64	69	65	63	62	64	60	63	61	61	60	59	58	60	62	58	62	61	61	59	61	61	69	63	59	60
840	60	59	60	60	64	62	72	64	66	65	65	61	59	57	60	72	65	64	63	61	60	58	58	65	58	69	61	61
868	56	56	59	58	65	58	65	58	71	62	57	56	57	58	58	58	61	60	58	58	64	62	67	63	67	65	63	64
896	67	63	67	62	62	63	67	63	63	64	65	71	66	60	61	63	62	57	58	60	63	58	58	66	60	58	59	58
924	63	64	65	62	63	68	67	66	61	62	66	63	67	65	68	60	60	61	57	59	61	61	59	58	59	55	56	59
952	63	60	61	60	59	58	57	57	63	56	56	59	57	71	63	61	58	60	65	61	63	62	61	63	70	69	63	62
980	68	79	78	70	67	67	65	64	62	61	61	61	58	59	59	65	61	60	60	65	62	59	61	63	64	68	59	64
1008	61	65	77	68	65	63	63	59	64	78	67	61	60	62	59	62	64	60	60	58	57	54	56	61	58	60	60	59
1036	61	59	58	55	68	66	61	61	64	61	60	60	63	60	68	66	66	64	72	65	77	74	61	61	79	74	86	71
1064	94	77	61	64	58	65	73	64	58	60	62	58	59	63	60	59	60	62	60	65	66	62	71	72	59	65	65	63
1092	66	66	64	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66

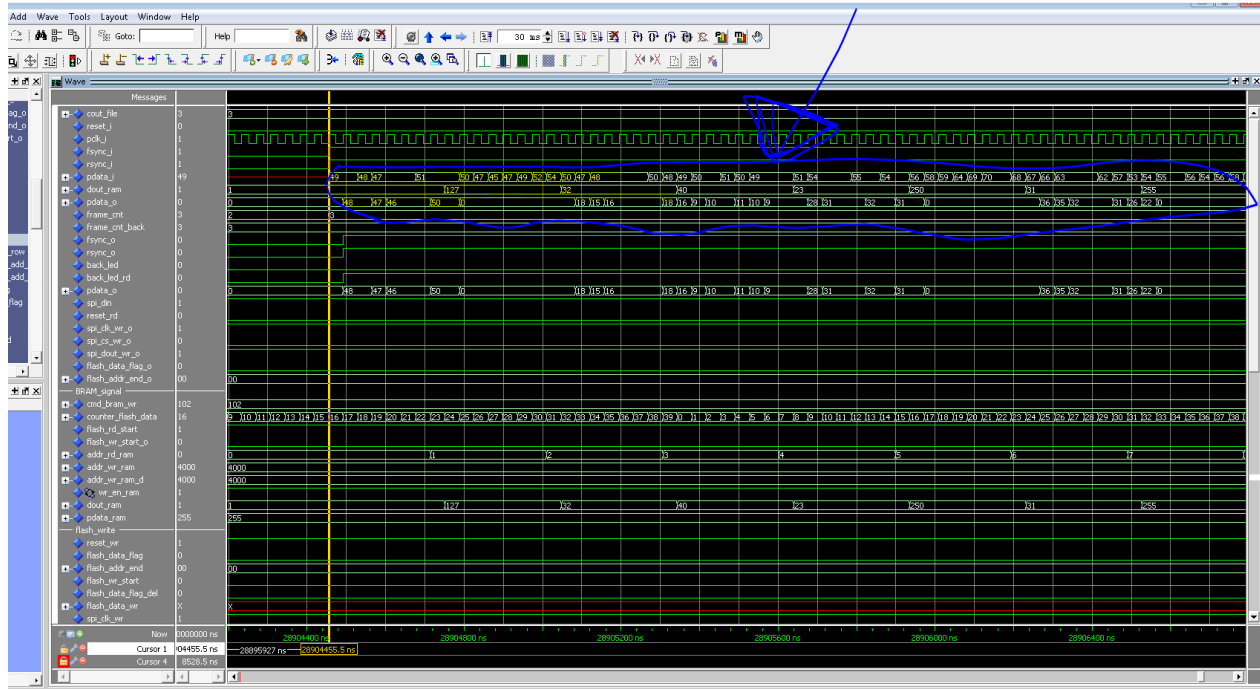
FLASH reading with commands from PC



See the contents from emulated FLASH storing in BRAMs. 1, 127 32.



Finally subtraction operation



Verification with MATLAB script

For verification of VHDL simulation, following MATLAB script can be run to generate images which can be compared with images produced by RTL simulation.

Image file name

background_subtraction_v1.m

input images

p_back.bmp, p_objets

MATLAB script

```
%%% Image scaling/ Zoom out and Zoom in
%%% Background image subtraction
clc;
clear all;
wind_col=1;
sum=0;
cols=640;
rows=400;
avg=0;
row_new=1;
```

muhammad.imran@miun.se

```

min_img=zeros((rows/8),(cols/8));
zoom_img=zeros(rows,cols);
im_orig=imread('p_back.bmp');
% im1 = im2double(im_orig);
im1=uint16(im_orig);
min_img=uint16(min_img);
% im1=im_orig;

figure(1)
imshow(im_orig)

% sum=typecast(sum,'uint16');
% min_img=typecast(min_img,'uint16');

wind_size=8;
wind_row=1;
for row=1:rows,
    col_new=1;
    sum=0;
    avg=0;
    wind_col=1;
    for col=1:cols,
        if wind_col<=wind_size
            sum=sum+im1(row,col);
%             avg=sum/wind_col;
            wind_col=wind_col+1;
        end;
        if wind_col==(wind_size+1)
            min_img(row_new, col_new)=min_img(row_new, col_new)+sum;
            if wind_row==8
                min_img(row_new, col_new)=floor((min_img(row_new,
col_new))/(wind_size*wind_size));
            end
            sum=0;
            wind_col=1;
            col_new=col_new+1;
        end;

        end;
        wind_row=wind_row+1;
        if wind_row==(wind_size+1)
            row_new=row_new+1;
            wind_row=1;
        end;
    end;

min_img=uint8(min_img);
img_nearest = imresize(min_img, [rows cols], 'nearest');
img_info = sprintf('img_gen.bmp');
imwrite(img_nearest,img_info);
figure(3)
imshow(img_nearest)
title('Nearest Neigh. Image')

```

```
%%%checking for subtraction%%%  
im_ob=imread('p_objets.bmp');  
im_back=imread('img_gen.bmp');  
im_diff=im_ob-im_back;  
imwrite(im_diff,'img_diff.bmp');  
figure(4)  
imshow(im_diff)  
title('im_diff Image')
```