Dokumentace SPI_NEWS

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Použité komponenty:

SPI_NEWS

Hlavní entita v projektu, v rámci které je instanciován ovladač SPI řadiče, tři čítače s různými frekvencemi pro změnu rychlosti posuvu textu a 8*16 instancí komponenty cell, reprezentujici jeden pixel na maticovém displeji. Komponenta také řeší přepínání rychlostí a výchozího stavu buněk.

Vstupy a výstupy komponenty:

CLK : in STD_LOGIC – Hodinový signál

RESET : in STD_LOGIC – Reset, pro resetování nutno přivést log. 1

SPI_IN : in STD_LOGIC – Vstup pro zadání příkazu

SPI_EN : in STD_LOGIC – Enable signál pro SPI

SPI_OUT : out STD_LOGIC – Výstup SPI, sloužící pro předání stavu buněk

Counter

Komponenta obdrží dva generické parametry, vstupní a požadovanou výstupní frekvenci. Komponenta zapne výstupní signál jednou za ožadovaný počet taktů, slouží pro posun textu na displeji. V rámci hlavní entity existují signály EN, EN1k,EN2k a EN3k. EN1k,EN2k a EN3k jsou výstupy z čítačů rozlišené pomocí výstupní frekvence, EN je signál podle kterého jsou řízeny buňky a tento signál je volen z výstupů čítačů pomocí SPI controleru.

Generické parametry:

CLK_FREQ : positive – Frekvence hodin

OUT_FREQ : positive – Požadovaná výstupní frekvence

Vstupy a výstupy komponenty:

CLK : in STD_LOGIC – Hodinový signál

RESET : in STD_LOGIC – Reset, pro resetování nutno přivést log. 1

EN : out STD_LOGIC – Enable signál sloužící pro posuv buněk.

spi_ctrl

Ovladač SPI řadiče, přes který jsou celé světelné noviny ovládány. Pro zahájení komunikace je třeba aktivní SPI_EN signál.

Vstupy a výstupy komponenty:

CLK : in STD_LOGIC – Hodinový signál

RESET : in STD_LOGIC – Reset, pro resetování nutno přivést log. 1

SPI_IN : in STD_LOGIC – Bit přes který je příjmán 8 bitový kód posílán od LSB

SPI_EN : in STD_LOGIC – Bit, který je nutný pro povolení komunikace, mezi každým příkazem musí dojít k nastavení bitu na 0

SPI_OUT : out STD_LOGIC – Bit přes který řadič posílá odpověď od LSB

DIRECTION : out DIRECTION_T – nastavení směru posuvu textu

INIT_STATE : out STD_LOGIC_VECTOR(1 downto 0) – Volba výchozího stavu displeje

CELL_RESET : out STD_LOGIC - Signál sloužící pro přechod buňek do výchozího stavu

SPEED : out STD_LOGIC_VECTOR(1 downto 0) – Volba rychlosti posuvu displeje

STATES : in STD_LOGIC_VECTOR(127 downto 0) – Vektor obsahující aktuální stav buněk

cell

Komponenta reprezentující jeden pixel, obsahuje svůj aktuální stav a stav svých sousedů, který přebírá v závislosti na směru posuvu.

Vstupy a výstupy komponenty:

CLK : in STD_LOGIC – Hodinový signál
RESET : in STD_LOGIC - Reset, pro resetování nutno přivést log. 1
STATE : out STD_LOGIC – bit reprezentující aktuální stav, provázán s konkrétním bitem ve vektoru STATES
INIT_STATE : in STD_LOGIC – bit reprezentující konkrétní bit v rámci vektoru, který je zvolen jako aktuální výchozí stav
NEIGH_LEFT : in STD_LOGIC – bit uchovávající stav souseda vlevo
NEIGH_RIGHT : in STD_LOGIC - bit uchovávající stav souseda vpravo
DIRECTION : in DIRECTION_T – informace ohledně směru posuvu
EN : in STD_LOGIC – Enable signál z aktuálně zvoleného čítače

Výchozí stavy buněk

Projekt obsahuje čtyři výchozí stavy, a a jeden signál pro aktuálně zvolený stav. Aktuální stav se volí pomocí SPI řadiče. Výchozí stavy a jednotlivé bity jsou znázorněny na obrázku pod názvem stavu:

INIT_STATE_00

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
1	9	17	25	33	41	49	57	65	73	81	89	97	105	113	121
2	10	18	26	34	42	50	58	66	74	82	90	98	106	114	122
3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123
4	12	20	28	36	44	52	60	68	76	84	92	100	108	116	124
5	13	21	29	37	45	53	61	69	77	85	93	101	109	117	125
6	14	22	30	38	46	54	62	70	78	86	94	102	110	118	126
7	15	23	31	39	47	55	63	71	79	87	95	103	111	119	127

INIT_STATE_01

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
1	1	9	17	25	33	41	49	57	65	73	81	89	97	105	113	121
2	2	10	18	26	34	42	50	58	66	74	82	90	98	106	114	122
3	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123
4	4	12	20	28	36	44	52	60	68	76	84	92	100	108	116	124
5	5	13	21	29	37	45	53	61	69	77	85	93	101	109	117	125
6	6	14	22	30	38	46	54	62	70	78	86	94	102	110	118	126
7	7	15	23	31	39	47	55	63	71	79	87	95	103	111	119	127

INIT_STATE_10

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
1	1	9	17	25	33	41	49	57	65	73	81	89	97	105	113	121
2	2	10	18	26	34	42	50	58	66	74	82	90	98	106	114	122
3	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123
4	4	12	20	28	36	44	52	60	68	76	84	92	100	108	116	124
5	5	13	21	29	37	45	53	61	69	77	85	93	101	109	117	125
6	6	14	22	30	38	46	54	62	70	78	86	94	102	110	118	126
7	7	15	23	31	39	47	55	63	71	79	87	95	103	111	119	127

INIT_STATE_11

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
1	1	9	17	25	33	41	49	57	65	73	81	89	97	105	113	121
2	2	10	18	26	34	42	50	58	66	74	82	90	98	106	114	122
3	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123
4	4	12	20	28	36	44	52	60	68	76	84	92	100	108	116	124
5	5	13	21	29	37	45	53	61	69	77	85	93	101	109	117	125
6	6	14	22	30	38	46	54	62	70	78	86	94	102	110	118	126
7	7	15	23	31	39	47	55	63	71	79	87	95	103	111	119	127

Testbench

K hlavní komponentě SPI_NEWS byl vytvořen testbench, jehož výstup bude následně popsán.

V rámci testbenche bylo zavedeno:

Konstanty:

*constant C1K_period : time := 1000*CLK_period - Perioda čítače s výstupní frekvencí 1K*

constant C2K_period : time := 500*CLK_period - Perioda čítače s výstupní frekvencí 2K

constant C5K_period : time := 200*CLK_period – Perioda čítače s výstupní frekvencí 5K

constant READING_MATRIX_TIME : time := 272*CLK_period - Doba nutná pro vypsání stavu displeje

Procedury:

PROCEDURE SendCommand(CMD : in STD_LOGIC_VECTOR(7 downto 0);

signal SPI_IN : out STD_LOGIC) is

Procedura slouží pro komunikaci s SPI controlerem pomocí 8 bitových příkazů.

Procedura bere dva parametry, první bere příkaz, který bude poslán SPI controleru, a druhý signál SPI_IN, na který bude posílat jednotlivé bity příkazu.

PROCEDURE ReadMatrix(signal SPI_IN : out STD_LOGIC;

signal SPI_OUT : in STD_LOGIC;

signal SPI_EN : out STD_LOGIC) is

Procedura slouží pro vyčtení aktuálního stavu buněk.

Procedura bere tři parametry, v prvním očekává signál SPI_IN přes který bude posílat příkazy pomocí procedury SendCommand. Druhý parametr vyžaduje SPI_OUT přes který bude zaznamenávat odpověď controleru a ukládát si stav do proměnné. Třetí parametr obsahuje signál SPI_EN aby bylo možné ovládat povolení komunikace s řadičem.

Výsledek je vypsán pomocí reportu do logu testování

Výstup simulace

Výstup

```
Version:1.0 StartHTML:0000000105 EndHTML:0000063503 StartFragment:0000000538
EndFragment:0000063467
ISim O.40d (signature 0x79f3f3a8)
WARNING: A WEBPACK license was found.
WARNING: Please use Xilinx License Configuration Manager to check out a full ISim license.
WARNING: ISim will run in Lite mode. Please refer to the ISim documentation for more
information on the differences between the Lite and the Full version.
This is a Lite version of ISim.
Time resolution is 1 ps
Simulator is doing circuit initialization process.
Finished circuit initialization process.
```

Test inicializace konstant

Test zkouší nastavit defaultní konstanty a následně je vypíše.

```
at 1120 ps: Note: setting init_state_01 with text TECH (/spi_news_tb/).
at 1210 ps: Note: Reading matrix (/spi_news_tb/).
at 3930 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 3930 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 3930 ps: Note: '1''1''1''0''1''1''1''0''1''1''1''0''1''0''1''0' (/spi_news_tb/).
at 3930 ps: Note: '0''1''0''0''1''0''0''0''1''0''0''0''1''0''1''0' (/spi_news_tb/).
at 3930 ps: Note: '0''1''0''0''1''1''0''0''1''0''0''0''1''1''1''0' (/spi_news_tb/).
at 3930 ps: Note: '0''1''0''0''1''0''0''0''1''0''0''0''1''0''1''0' (/spi_news_tb/).
at 3930 ps: Note: '0''1''0''0''1''1''1''0''1''1''1''0''1''0''1''0' (/spi_news_tb/).
at 3930 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).

at 3930 ps: Note: setting init_state_11 with text JPN (/spi_news_tb/).
at 4020 ps: Note: Reading matrix (/spi_news_tb/).
at 6740 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 6740 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 6740 ps: Note: '1''1''1''0''1''1''1''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 6740 ps: Note: '0''0''1''0''1''0''1''0''1''1''0''0''1''0''0''0' (/spi_news_tb/).
at 6740 ps: Note: '0''0''1''0''1''1''1''0''1''0''1''0''1''0''0''0' (/spi_news_tb/).
at 6740 ps: Note: '1''0''1''0''1''0''0''0''1''0''0''1''1''0''0''0' (/spi_news_tb/).
at 6740 ps: Note: '1''1''1''0''1''0''0''0''1''0''0''0''1''0''0''0' (/spi_news_tb/).
at 6740 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).

at 6740 ps: Note: setting init_state_10 with text FPGA (/spi_news_tb/).
at 6830 ps: Note: Reading matrix (/spi_news_tb/).
at 9550 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 9550 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 9550 ps: Note: '1''1''1''0''1''1''1''0''1''1''1''1''0''1''1''1' (/spi_news_tb/).
at 9550 ps: Note: '1''0''0''0''1''0''1''0''1''0''0''0''0''1''0''1' (/spi_news_tb/).
at 9550 ps: Note: '1''1''1''0''1''1''1''0''1''0''1''1''0''1''1''1' (/spi_news_tb/).
at 9550 ps: Note: '1''0''0''0''1''0''1''0''1''0''0''1''0''1''0''1' (/spi_news_tb/).
at 9550 ps: Note: '1''0''0''0''1''0''0''0''1''1''1''1''0''1''0''1' (/spi_news_tb/).
at 9550 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).

at 9580 ps: Note: Reading matrix (/spi_news_tb/).
at 12300 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 12300 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 12300 ps: Note: '0''0''1''1''1''0''1''0''1''1''1''0''0''0''0''0' (/spi_news_tb/).
at 12300 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 12300 ps: Note: '0''0''1''1''1''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 12300 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 12300 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 12300 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
```

Test posuvu displeje vlevo

Frekvence 1k

```
at 12310 ps: Note: setting speed to 00 (/spi_news_tb/).
at 12390 ps: Note: Reading matrix (/spi_news_tb/).
at 15110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 15110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 15110 ps: Note: '0''0''1''1''1''0''1''0''1''1''1''0''0''0''0''0' (/spi_news_tb/).
at 15110 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 15110 ps: Note: '0''0''1''1''1''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 15110 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 15110 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 15110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 22390 ps: Note: Reading matrix (/spi_news_tb/).
at 25110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 25110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 25110 ps: Note: '0''1''1''1''0''1''0''1''1''1''0''0''0''0''0''0' (/spi_news_tb/).
at 25110 ps: Note: '0''1''0''0''0''1''0''0''1''0''0''0''0''0''0''0' (/spi_news_tb/).
at 25110 ps: Note: '0''1''1''1''0''1''0''0''1''0''0''0''0''0''0''0' (/spi_news_tb/).
at 25110 ps: Note: '0''1''0''0''0''1''0''0''1''0''0''0''0''0''0''0' (/spi_news_tb/).
at 25110 ps: Note: '0''1''0''0''0''1''0''0''1''0''0''0''0''0''0''0' (/spi_news_tb/).
at 25110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 32390 ps: Note: Reading matrix (/spi_news_tb/).
at 35110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 35110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 35110 ps: Note: '1''1''1''0''1''0''1''1''1''0''0''0''0''0''0''0' (/spi_news_tb/).
at 35110 ps: Note: '1''0''0''0''1''0''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 35110 ps: Note: '1''1''1''0''1''0''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 35110 ps: Note: '1''0''0''0''1''0''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 35110 ps: Note: '1''0''0''0''1''0''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 35110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 42390 ps: Note: Reading matrix (/spi_news_tb/).
at 45110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 45110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 45110 ps: Note: '1''1''0''1''0''1''1''1''0''0''0''0''0''0''0''1' (/spi_news_tb/).
at 45110 ps: Note: '0''0''0''1''0''0''1''0''0''0''0''0''0''0''0''1' (/spi_news_tb/).
at 45110 ps: Note: '1''1''0''1''0''0''1''0''0''0''0''0''0''0''0''1' (/spi_news_tb/).
at 45110 ps: Note: '0''0''0''1''0''0''1''0''0''0''0''0''0''0''0''1' (/spi_news_tb/).
at 45110 ps: Note: '0''0''0''1''0''0''1''0''0''0''0''0''0''0''0''1' (/spi_news_tb/).
at 45110 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
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Frekvence 2k

```
at 45140 ps: Note: setting speed to 01 (/spi_news_tb/).
at 45220 ps: Note: Reading matrix (/spi_news_tb/).
at 47940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 47940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 47940 ps: Note: '0''0''1''1''1''0''1''0''1''1''1''0''0''0''0''0' (/spi_news_tb/).
at 47940 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 47940 ps: Note: '0''0''1''1''1''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 47940 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 47940 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 47940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 50220 ps: Note: Reading matrix (/spi_news_tb/).
at 52940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 52940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 52940 ps: Note: '0''1''1''1''0''1''0''1''1''1''0''0''0''0''0''0' (/spi_news_tb/).
at 52940 ps: Note: '0''1''0''0''0''1''0''0''1''0''0''0''0''0''0''0' (/spi_news_tb/).
at 52940 ps: Note: '0''1''1''1''0''1''0''0''1''0''0''0''0''0''0''0' (/spi_news_tb/).
at 52940 ps: Note: '0''1''0''0''0''1''0''0''1''0''0''0''0''0''0''0' (/spi_news_tb/).
at 52940 ps: Note: '0''1''0''0''0''1''0''0''1''0''0''0''0''0''0''0' (/spi_news_tb/).
at 52940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 55220 ps: Note: Reading matrix (/spi_news_tb/).
at 57940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 57940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 57940 ps: Note: '1''1''1''0''1''0''1''1''1''0''0''0''0''0''0''0' (/spi_news_tb/).
at 57940 ps: Note: '1''0''0''0''1''0''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 57940 ps: Note: '1''1''1''0''1''0''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 57940 ps: Note: '1''0''0''0''1''0''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 57940 ps: Note: '1''0''0''0''1''0''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 57940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 60220 ps: Note: Reading matrix (/spi_news_tb/).
at 62940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 62940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 62940 ps: Note: '1''1''0''1''0''1''1''1''0''0''0''0''0''0''0''1' (/spi_news_tb/).
at 62940 ps: Note: '0''0''0''1''0''0''1''0''0''0''0''0''0''0''0''1' (/spi_news_tb/).
at 62940 ps: Note: '1''1''0''1''0''0''1''0''0''0''0''0''0''0''0''1' (/spi_news_tb/).
at 62940 ps: Note: '0''0''0''1''0''0''1''0''0''0''0''0''0''0''0''1' (/spi_news_tb/).
at 62940 ps: Note: '0''0''0''1''0''0''1''0''0''0''0''0''0''0''0''1' (/spi_news_tb/).
at 62940 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
```

Frekvence 5k

U testování maximální frekvence dochází k problému, že doba na vyčtení a vypsání maticového displeje (272*CLK_period) pomocí SPI je delší než frekvence posuvu (200*CLK_period).

```
at 62970 ps: Note: setting speed to 10 (/spi_news_tb/).
at 63050 ps: Note: Reading matrix (/spi_news_tb/).
at 65770 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 65770 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 65770 ps: Note: '0''0''1''1''1''0''1''0''1''1''1''0''0''0''0''0' (/spi_news_tb/).
at 65770 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 65770 ps: Note: '0''0''1''1''1''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 65770 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 65770 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 65770 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 65770 ps: Note: Reading matrix (/spi_news_tb/).
at 68490 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 68490 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 68490 ps: Note: '0''1''1''1''0''1''0''1''1''0''0''0''0''0''0''0' (/spi_news_tb/).
at 68490 ps: Note: '0''1''0''0''0''1''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 68490 ps: Note: '0''1''1''1''0''1''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 68490 ps: Note: '0''1''0''0''0''1''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 68490 ps: Note: '0''1''0''0''0''1''0''1''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 68490 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 68490 ps: Note: Reading matrix (/spi_news_tb/).
at 71210 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 71210 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 71210 ps: Note: '1''1''1''1''0''1''1''1''0''0''0''0''0''0''0''1' (/spi_news_tb/).
at 71210 ps: Note: '1''0''0''1''0''0''1''0''0''0''0''0''0''0''1''0' (/spi_news_tb/).
at 71210 ps: Note: '1''1''1''1''0''0''1''0''0''0''0''0''0''0''1''1' (/spi_news_tb/).
at 71210 ps: Note: '1''0''0''1''0''0''1''0''0''0''0''0''0''0''1''0' (/spi_news_tb/).
at 71210 ps: Note: '1''0''0''1''0''0''1''0''0''0''0''0''0''0''1''0' (/spi_news_tb/).
at 71210 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
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Test posuvu displeje vpravo

Frekvence 1k

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at 71240 ps: Note: setting Direction to RIGHT (/spi_news_tb/).
at 71340 ps: Note: setting speed to 00 (/spi_news_tb/).
at 71420 ps: Note: Reading matrix (/spi_news_tb/).
at 74140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 74140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 74140 ps: Note: '0''0''1''1''1''0''1''0''1''1''1''0''0''0''0''0' (/spi_news_tb/).
at 74140 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 74140 ps: Note: '0''0''1''1''1''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 74140 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 74140 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 74140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 81420 ps: Note: Reading matrix (/spi_news_tb/).
at 84140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 84140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 84140 ps: Note: '0''0''0''1''1''1''0''1''0''1''1''1''0''0''0''0' (/spi_news_tb/).
at 84140 ps: Note: '0''0''0''1''0''0''0''1''0''0''1''0''0''0''0''0' (/spi_news_tb/).
at 84140 ps: Note: '0''0''0''1''1''1''0''1''0''0''1''0''0''0''0''0' (/spi_news_tb/).
at 84140 ps: Note: '0''0''0''1''0''0''0''1''0''0''1''0''0''0''0''0' (/spi_news_tb/).
at 84140 ps: Note: '0''0''0''1''0''0''0''1''0''0''1''0''0''0''0''0' (/spi_news_tb/).
at 84140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 91420 ps: Note: Reading matrix (/spi_news_tb/).
at 94140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 94140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 94140 ps: Note: '0''0''0''0''1''1''1''0''1''0''1''1''1''0''0''0' (/spi_news_tb/).
at 94140 ps: Note: '0''0''0''0''1''0''0''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 94140 ps: Note: '0''0''0''0''1''1''1''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 94140 ps: Note: '0''0''0''0''1''0''0''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 94140 ps: Note: '0''0''0''0''1''0''0''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 94140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 101420 ps: Note: Reading matrix (/spi_news_tb/).
at 104140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 104140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 104140 ps: Note: '0''0''0''0''0''1''1''1''0''1''0''1''1''1''0''0' (/spi_news_tb/).
at 104140 ps: Note: '0''0''0''0''0''1''0''0''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 104140 ps: Note: '0''0''0''0''0''1''1''1''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 104140 ps: Note: '0''0''0''0''0''1''0''0''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 104140 ps: Note: '0''0''0''0''0''1''0''0''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 104140 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
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Frekvence 2k

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at 104170 ps: Note: setting Direction to RIGHT (/spi_news_tb/).
at 104270 ps: Note: setting speed to 01 (/spi_news_tb/).
at 104350 ps: Note: Reading matrix (/spi_news_tb/).
at 107070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 107070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 107070 ps: Note: '0''0''1''1''1''0''1''0''1''1''1''0''0''0''0''0' (/spi_news_tb/).
at 107070 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 107070 ps: Note: '0''0''1''1''1''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 107070 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 107070 ps: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 107070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 109350 ps: Note: Reading matrix (/spi_news_tb/).
at 112070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 112070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 112070 ps: Note: '0''0''0''1''1''1''0''1''0''1''1''1''0''0''0''0' (/spi_news_tb/).
at 112070 ps: Note: '0''0''0''1''0''0''0''1''0''0''1''0''0''0''0''0' (/spi_news_tb/).
at 112070 ps: Note: '0''0''0''1''1''1''0''1''0''0''1''0''0''0''0''0' (/spi_news_tb/).
at 112070 ps: Note: '0''0''0''1''0''0''0''1''0''0''1''0''0''0''0''0' (/spi_news_tb/).
at 112070 ps: Note: '0''0''0''1''0''0''0''1''0''0''1''0''0''0''0''0' (/spi_news_tb/).
at 112070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 114350 ps: Note: Reading matrix (/spi_news_tb/).
at 117070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 117070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 117070 ps: Note: '0''0''0''0''1''1''1''0''1''0''1''1''1''0''0''0' (/spi_news_tb/).
at 117070 ps: Note: '0''0''0''0''1''0''0''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 117070 ps: Note: '0''0''0''0''1''1''1''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 117070 ps: Note: '0''0''0''0''1''0''0''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 117070 ps: Note: '0''0''0''0''1''0''0''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 117070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 119350 ps: Note: Reading matrix (/spi_news_tb/).
at 122070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 122070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 122070 ps: Note: '0''0''0''0''0''1''1''1''0''1''0''1''1''1''0''0' (/spi_news_tb/).
at 122070 ps: Note: '0''0''0''0''0''1''0''0''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 122070 ps: Note: '0''0''0''0''0''1''1''1''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 122070 ps: Note: '0''0''0''0''0''1''0''0''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 122070 ps: Note: '0''0''0''0''0''1''0''0''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 122070 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
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Frekvence 5k

Vzniká zde stejný problém, který je popsaný u posuvu vlevo.

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at 122100 ps: Note: setting Direction to RIGHT (/spi_news_tb/).
at 122200 ps: Note: setting speed to 10 (/spi_news_tb/).
at 122280 ps: Note: Reading matrix (/spi_news_tb/).
at 125 ns: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 125 ns: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 125 ns: Note: '0''0''1''1''1''0''1''0''1''1''1''1''0''0''0''0' (/spi_news_tb/).
at 125 ns: Note: '0''0''1''0''0''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 125 ns: Note: '0''0''1''1''1''0''1''0''0''1''0''0''0''0''0''0' (/spi_news_tb/).
at 125 ns: Note: '0''0''1''0''0''0''1''0''0''1''1''0''0''0''0''0' (/spi_news_tb/).
at 125 ns: Note: '0''0''1''0''0''0''1''0''0''1''1''0''0''0''0''0' (/spi_news_tb/).
at 125 ns: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 125 ns: Note: Reading matrix (/spi_news_tb/).
at 127720 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 127720 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 127720 ps: Note: '0''0''0''1''1''1''1''0''1''0''1''1''1''0''0''0' (/spi_news_tb/).
at 127720 ps: Note: '0''0''0''1''0''0''0''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 127720 ps: Note: '0''0''0''1''1''1''1''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 127720 ps: Note: '0''0''0''1''0''0''0''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 127720 ps: Note: '0''0''0''1''0''0''0''0''1''0''0''1''0''0''0''0' (/spi_news_tb/).
at 127720 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 127720 ps: Note: Reading matrix (/spi_news_tb/).
at 130440 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 130440 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 130440 ps: Note: '0''0''0''0''0''1''1''1''0''1''0''1''1''1''1''0' (/spi_news_tb/).
at 130440 ps: Note: '0''0''0''0''0''1''0''0''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 130440 ps: Note: '0''0''0''0''0''1''1''1''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 130440 ps: Note: '0''0''0''0''0''1''0''0''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 130440 ps: Note: '0''0''0''0''0''1''0''0''0''1''0''0''1''0''0''0' (/spi_news_tb/).
at 130440 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 130440 ps: Note: Reading matrix (/spi_news_tb/).
at 133160 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 133160 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
at 133160 ps: Note: '0''0''0''0''0''0''1''1''1''0''0''1''0''1''1''1' (/spi_news_tb/).
at 133160 ps: Note: '0''0''0''0''0''0''1''0''0''0''0''1''0''0''1''0' (/spi_news_tb/).
at 133160 ps: Note: '0''0''0''0''0''0''1''1''1''0''0''1''0''0''1''0' (/spi_news_tb/).
at 133160 ps: Note: '0''0''0''0''0''0''1''0''0''0''0''1''0''0''1''0' (/spi_news_tb/).
at 133160 ps: Note: '0''0''0''0''0''0''1''0''0''0''0''1''0''0''1''0' (/spi_news_tb/).
at 133160 ps: Note: '0''0''0''0''0''0''0''0''0''0''0''0''0''0''0''0' (/spi_news_tb/).
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