SONY

CXD2457R

Timing Generator for Progressive Scan CCD Image Sensor

Description

The CXD2457R is an IC developed to generate the timing pulses required by Progressive Scan CCD image sensors as well as signal processing circuits.

Features

- Electronic shutter function
- Supports non-interlaced operation
- Base oscillation frequency 30.0MHz
- Horizontal drive frequency switchable between 15/10/5MHz
- Switchable between FINE (Progressive Scan) mode or DRAFT (high-frame rate readout) mode
- Vertical driver

Applications

Progressive Scan CCD cameras

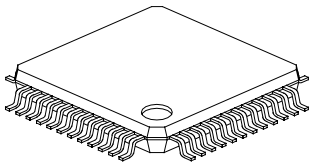
Structure

Silicon gate CMOS IC

Applicable CCD Image Sensor

ICX204AK

48 pin LQFP (Plastic)



Absolute Maximum Ratings

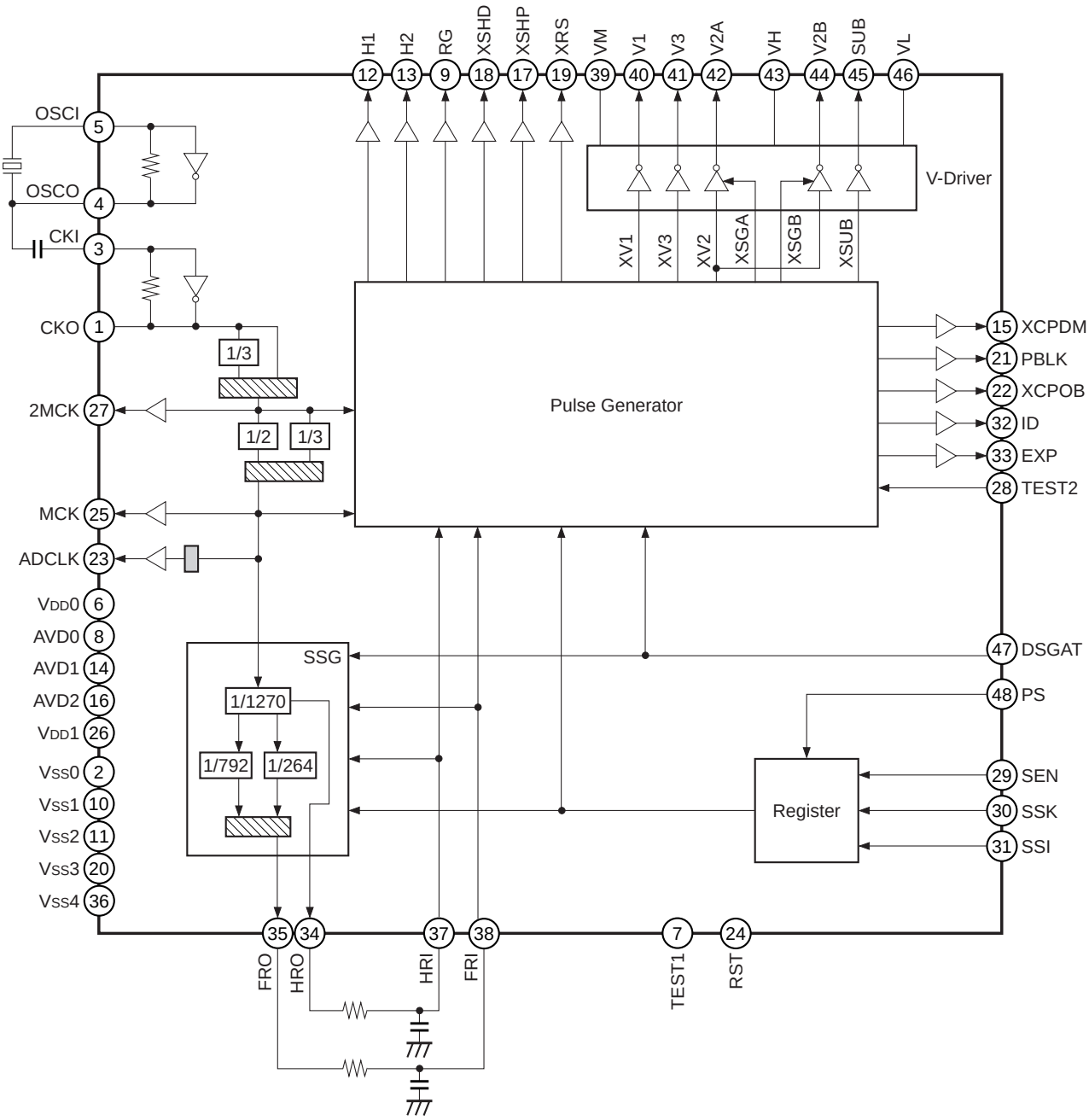
• Supply voltage	$V_{DD}a$, $V_{DD}b$, $V_{DD}c$, $V_{DD}d$	Vss – 0.5 to Vss + 7.0	V
• Supply voltage	V_{SS}	VL – 0.5 to VL + 10.0	V
• Supply voltage	VH	VL – 0.5 to VL + 26.0	V
• Supply voltage	VM	VL – 0.5 to VL + 26.0	V
• Input voltage	V_I	Vss – 0.5 to V_{DD} + 0.5	V
• Output voltage	V_O	Vss – 0.5 to V_{DD} + 0.5	V
• Operating temperature	Topr	–20 to +75	°C
• Storage temperature	Tstg	–55 to +150	°C

Recommended Operating Conditions

• Supply voltage 1	$V_{DD}a$, $V_{DD}b$, $V_{DD}c$	3.0 to 3.6	V
• Supply voltage 2	$V_{DD}d$	3.0 to 3.6	V
• Supply voltage 3	VH	14.25 to 15.75	V
• Supply voltage 4	VL	–9.0 to –5.0	V
• Supply voltage 5	VM	0	V
• Operating temperature	Topr	–20 to +75	°C

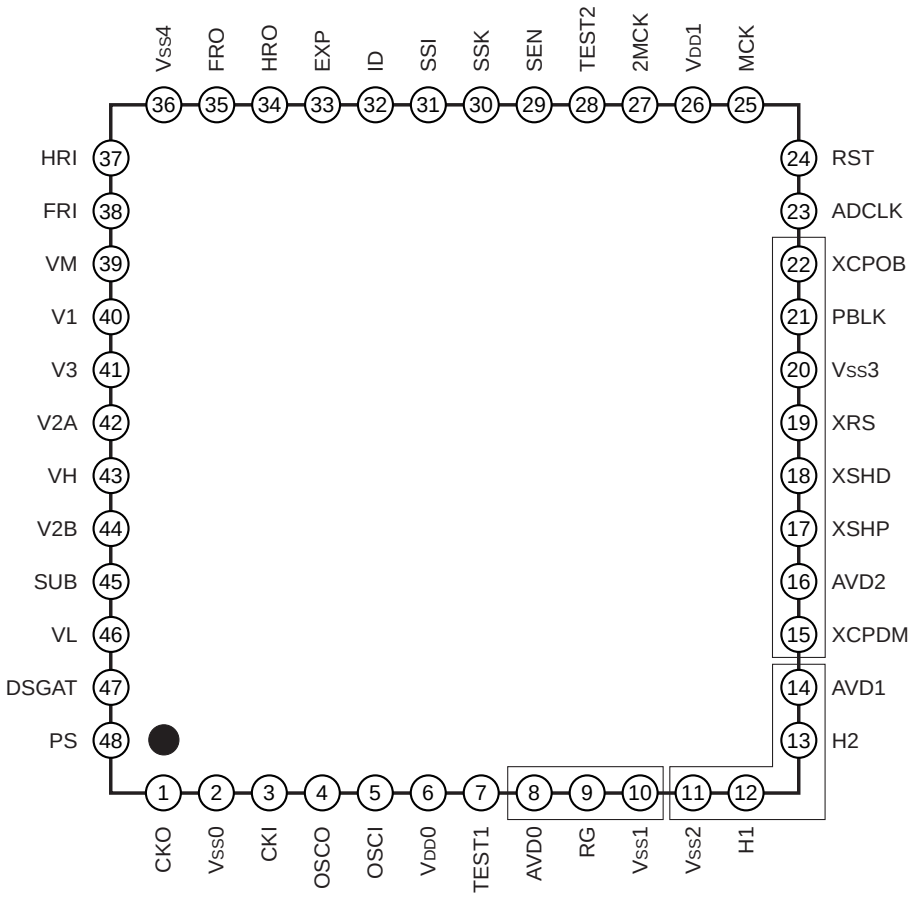
E98113A86-PS

Block Diagram



XSGA and XSGB are readout pulses that use V2A and V2B, respectively, as the VH value.

Pin Configuration (Top View)



The enclosed pins use separate power supplies.

Pin Description

Pin No.	Symbol	I/O	Description
1	CKO	O	Oscillator output. (30.0MHz)
2	Vss0	—	GND
3	CKI	I	Oscillator input. (30.0MHz)
4	OSCO	O	Inverter output for oscillation. (30.0MHz)
5	OSCI	I	Inverter input for oscillation. (30.0MHz)
6	$V_{DD}0$	—	Power supply.
7	TEST1	I	Test. With pull-down resistor. Fix to low.
8	AVD0	—	Power supply.
9	RG	O	Reset gate pulse output.
10	Vss1	—	GND
11	Vss2	—	GND
12	H1	O	Clock output for horizontal CCD drive.
13	H2	O	Clock output for horizontal CCD drive.
14	AVD1	—	Power supply.
15	XCPDM	O	Clamp pulse.
16	AVD2	—	Power supply.
17	XSHP	O	Sample-and-hold pulse.
18	XSHD	O	Sample-and-hold pulse.
19	XRS	O	Sample-and-hold pulse.
20	$V_{SS}3$	—	GND
21	PBLK	O	Blanking cleaning pulse.
22	XCPOB	O	Clamp pulse.
23	ADCLK	O	Clock output for AD conversion.
24	RST	I	Reset (Low: Reset, High: Normal operation). Always input one reset pulse during power-on.
25	MCK	O	Clock output for digital circuit.
26	$V_{DD}1$	—	Power supply.
27	2MCK	O	Clock output for digital circuit.
28	TEST2	I	Test. Fix to high.
29	SEN	I	PS = High: Drive frequency setting input. PS = Low: Serial setting strobe input.
30	SSK	I	PS = High: Readout method setting input. PS = Low: Serial setting clock input.
31	SSI	I	PS = High: Shutter speed setting input. PS = Low: Serial setting data input.
32	ID	O	Line identification signal output write enable pulse output or XSUB output.
33	EXP	O	Pulse output indicating exposure is underway or checksum result output.

Pin No.	Symbol	I/O	Description
34	HRO	O	Horizontal sync signal (HR) output or XSGB output.
35	FRO	O	Vertical sync signal (FR) output or XSGA output.
36	$V_{SS}4$	—	GND
37	HRI	I	Horizontal sync signal (HR) input.
38	FRI	I	Vertical sync signal (FR) input.
39	VM	—	GND (vertical clock driver GND).
40	V1	O	Clock output for vertical CCD drive.
41	V3	O	Clock output for vertical CCD drive.
42	V2A	O	Clock output for vertical CCD drive.
43	VH	—	15V power supply (vertical clock driver power supply).
44	V2B	O	Clock output for vertical CCD drive.
45	SUB	O	CCD electric charge sweep pulse output.
46	VL	—	–7.5V power supply (vertical clock driver power supply).
47	DSGAT	I	Output stop (Same operation control as SLP when low).
48	PS	I	Parallel/serial switching for mode setting input method. (High: Parallel, Low: Serial) With pull-down resistor.

Electrical Characteristics

DC Characteristics

(Within the recommended operating conditions)

Item	Pins	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage 1	$V_{DD}0$, $V_{DD}1$,	$V_{DD}a$		3.0	3.3	3.6	V
Supply voltage 2	AVD0	$V_{DD}b$		3.0	3.3	3.6	V
Supply voltage 3	AVD1	$V_{DD}c$		3.0	3.3	3.6	V
Supply voltage 4	AVD2	$V_{DD}d$		3.0	3.3	3.6	V
Supply voltage 5	VH	VH		14.5	15.5	15.5	V
Supply voltage 6	VM	VM		—	0.0	—	V
Supply voltage 7	VL	VL		–9.0		–5.0	V
Input voltage 1	CKI	V_{IH1}		0.7V_{DD}a			V
		V_{IL1}				0.3V_{DD}a	V
Input voltage 2	TEST1, PS	V_{IH2}		0.7V_{DD}b			V
		V_{IL2}				0.3V_{DD}a	V
Input voltage 3	RST, TEST2, SEN, SSK, SSI, HRI, FRI, DSGAT	V_{t+1}		0.8V_{DD}a			V
		V_{t-1}				0.2V_{DD}a	V
Output voltage 1	CKO, MCK, 2MCK	V_{OH1}	Feed current where I_{OH} = –10.0mA	V_{DD}a – 0.8			V
		V_{OL1}	Pull-in current where I_{OL} = 7.2mA			0.4	V
Output voltage 2	RG	V_{OH2}	Feed current where I_{OH} = –3.3mA	V_{DD}b – 0.8			V
		V_{OL2}	Pull-in current where I_{OL} = 2.4mA			0.4	V
Output voltage 3	H1, H2	V_{OH3}	Feed current where I_{OH} = –22.0mA	V_{DD}c – 0.8			V
		V_{OL3}	Pull-in current where I_{OL} = 14.4mA			0.4	V
Output voltage 4	XCPDM, XSHP, XSHD, XRS, PBLK, XCPOB	V_{OH4}	Feed current where I_{OH} = –3.3mA	V_{DD}d – 0.8			V
		V_{OL4}	Pull-in current where I_{OL} = 2.4mA			0.4	V
Output voltage 5	ID, EXP, HRO, FRO	V_{OH5}	Feed current where I_{OH} = –2.4mA	V_{DD}a – 0.8			V
		V_{OL5}	Pull-in current where I_{OL} = 4.8mA			0.4	V
Output voltage 6	SUB	V_{OH6}	Feed current where I_{OH} = –4.0mA	VH – 0.25			V
		V_{OL6}	Pull-in current where I_{OL} = 5.4mA			VL + 0.25	V
Output voltage 7	V1, V3	V_{OM7}	Feed current where I_{OH} = –5.0mA	VM – 0.25			V
		V_{OL7}	Pull-in current where I_{OL} = 10.0mA			VL + 0.25	V
Output voltage 8	V2A, V2B	V_{OM101}	Feed current where I_{OH} = –7.2mA	VH – 0.25			V
		V_{OM102}	Pull-in current where I_{OL} = 5.0mA			VM + 0.25	V
		V_{OL8}	Feed current where I_{OH} = –5.0mA	VM – 0.25			V
		V_{OL8}	Pull-in current where I_{OL} = 10.0mA			VL + 0.25	V

Inverter I/O Characteristics for Oscillation (Within the recommended operating conditions)

Item	Pins	Symbol	Conditions	Min.	Typ.	Max.	Unit
Logical Vth	OSCI	LVth			$V_{DD}a/2$		V
Input voltage	OSCI	V_{IH}		$0.7V_{DD}d$			V
		V_{IL}				$0.3V_{DD}a$	V
Output voltage	OSCO	V_{OH}	Feed current where I_{OH} = –6.0mA	$V_{DD}a/2$			V
		V_{OL}	Pull-in current where I_{OL} = 6.0mA			$V_{DD}a/2$	V
Feedback resistor	OSCI, OSCO	RFB	V_{IN} = V_{DD}d or Vss	500k	2M	5M	Ω
Oscillator frequency	OSCI, OSCO	f		20		50	MHz

Base Oscillation Clock Input Characteristics (Within the recommended operating conditions)

Item	Pins	Symbol	Conditions	Min.	Typ.	Max.	Unit
Logical Vth	CKI	LVth			$V_{DD}a/2$		V
Input voltage		V_{IH}		$0.7V_{DD}a$			V
		V_{IL}				$0.3V_{DD}a$	V
Input amplification		V_{IN}	fmax 50MHz sine wave	0.3			Vp-p

*1 Input voltage is the input voltage characteristics for direct input from an external source. Input amplification is the input amplification characteristics for input through capacitor.

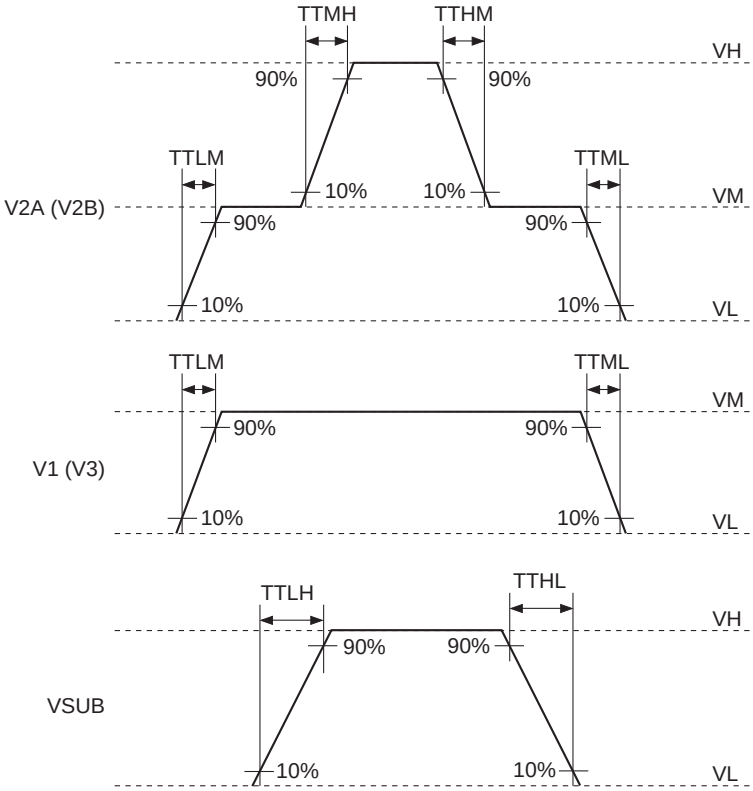
Switching Characteristics (VH = 15.0V, VM = GND, VL = –8.5V)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Rise time	TTLM	VL to VM		350	550	ns
	TTMH	VM to VH		450	700	ns
	TTLH	VL to VH		50	80	ns
Fall time	TTML	VM to VL		250	400	ns
	TTHM	VH to VM		300	450	ns
	TTHL	VH to VL		50	80	ns
Output noise voltage	VCLH				1.0	V
	VCLL				1.0	V
	VCMH				1.0	V
	VCML				1.0	V

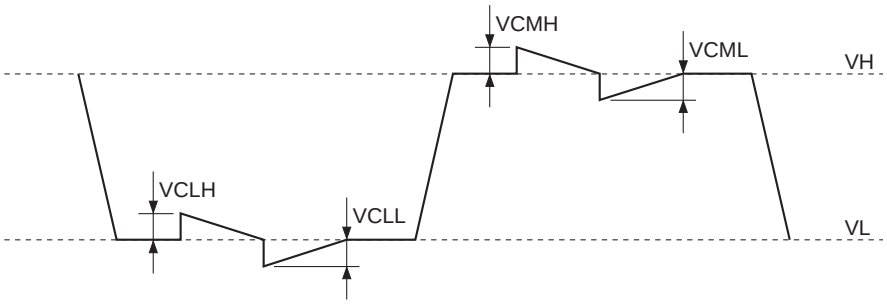
*1 The MOS structure of this IC has a low tolerance for static electricity, so full care should be given for measures to prevent electrostatic discharge.

*2 For noise and latch-up countermeasures, be sure to connect a bypass capacitor (0.1µF or more) between each power supply pin (VH, VL) and GND.

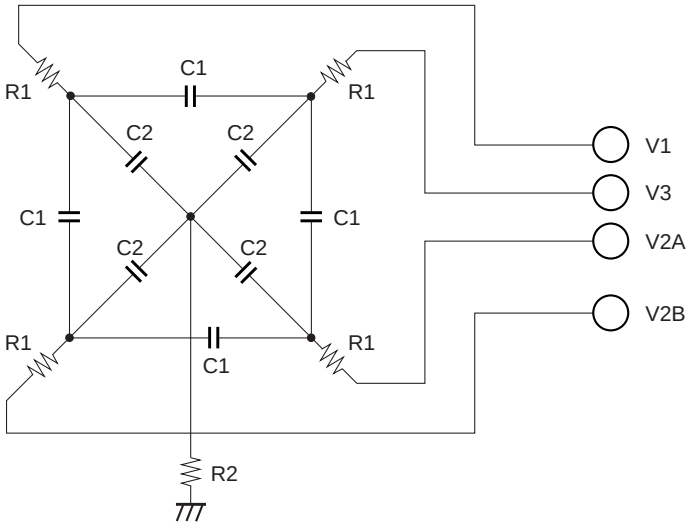
Switching Waveforms



Waveform Noise



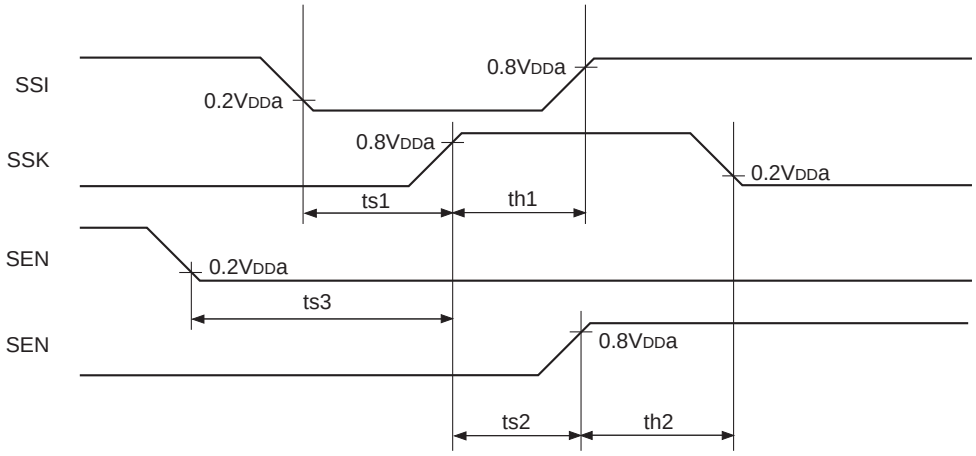
Measurement Circuit



R1: 27Ω
R2: 5Ω
C1: 1500pF
C2: 3300pF

AC Characteristics

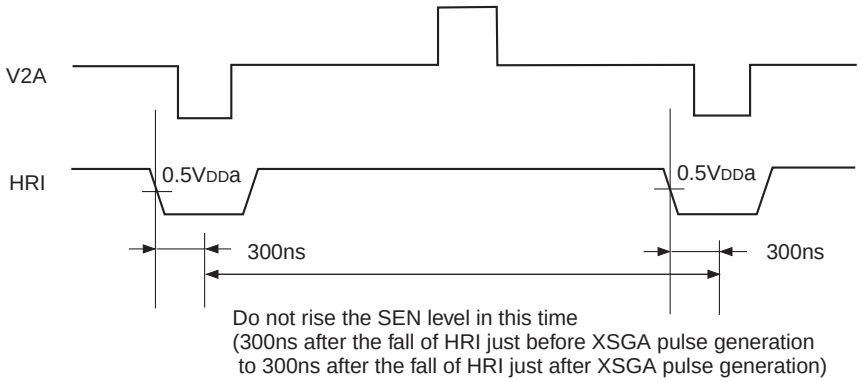
1) AC characteristics between the serial interface clocks



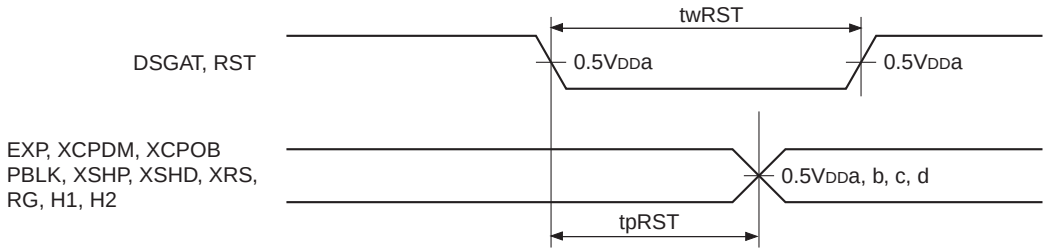
(Within the recommended operating conditions)

Symbol	Definition	Min.	Typ.	Max.	Unit
ts1	SSI setup time, activated by the rising edge of SSK	20			ns
th1	SSI hold time, activated by the rising edge of SSK	20			ns
ts2	SSK setup time, activated by the rising edge of SEN	20			ns
th2	SSK hold time, activated by the rising edge of SEN	20			ns
ts3	SEN setup time, activated by the rising edge of SSK	20			ns
fk	SSK frequency			7.5	MHz

2) Serial interface clock internal loading characteristics



3) Output timing characteristics using DSGAT and RST



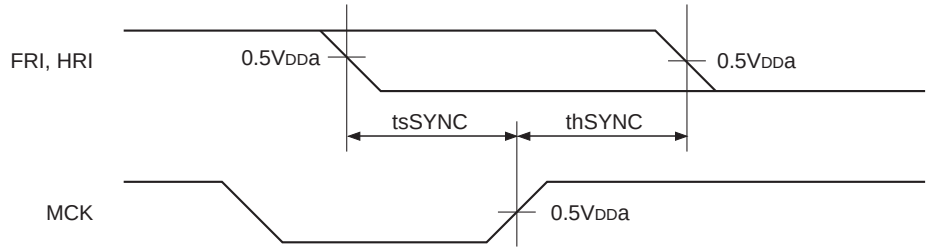
H1 and H2 load capacitance = 180pF

EXP, XCPDM, PBLK, XSHP, XSHD, XRS and RG load capacitance = 10pF

(Within the recommended operating conditions)

Symbol	Definition	Min.	Typ.	Max.	Unit
tpRST	Time until the above outputs reach the specified value after the fall of DSGAT and RST			75	ns
twRST	RST and DSGAT pulse width	10			ns

4) FRI and HRI loading characteristics

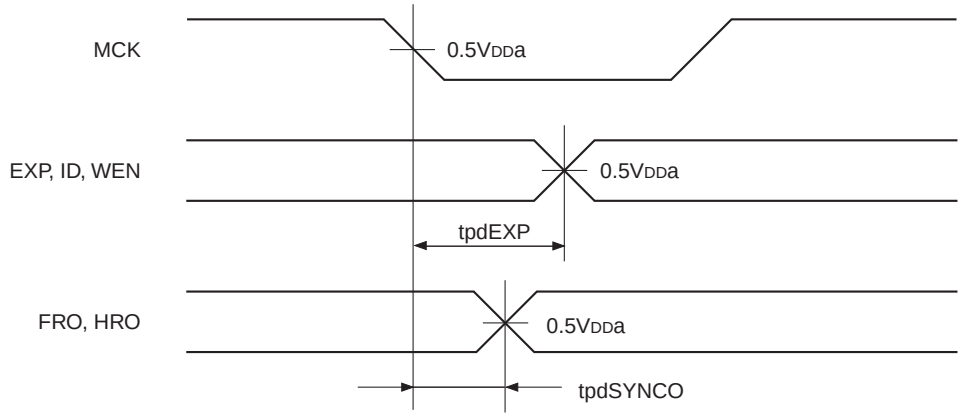


MCK load capacitance = 10pF

(Within the recommended operating conditions)

Symbol	Definition	Min.	Typ.	Max.	Unit
tsSYNC	FRI and HRI setup time, activated by the rising edge of MCK	5			ns
thSYNC	FRI and HRI hold time, activated by the rising edge of MCK	5			ns

5) Output variation characteristics of ID, WEN, EXP, FRO and HRO



EXP, ID and WEN load capacitance = 10pF (Within the recommended operating conditions)

Symbol	Definition	Min.	Typ.	Max.	Unit
tpdEXP	Time until the WEN, ID and EXP outputs change after the fall of MCK	0.5		8.5	ns
tpdSYNCO	Time until the FRO and HRO outputs change after the fall of MCK	1.0		11.5	ns

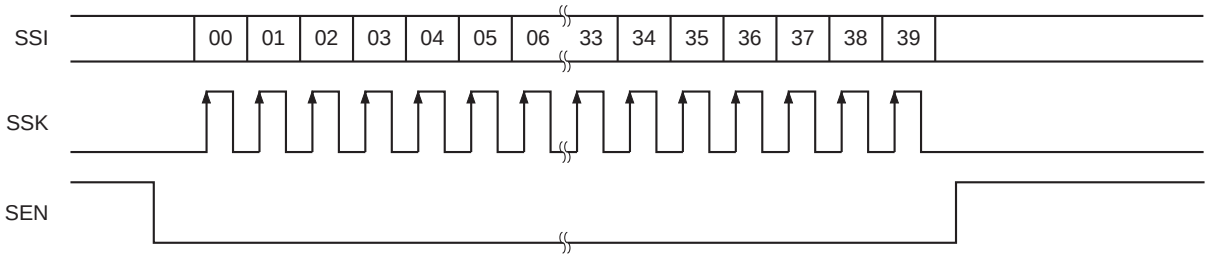
Description of Operation

1. Progressive Scan CCD drive pulse generation

- Combining this IC with a crystal oscillator generates a fundamental frequency of 30.0MHz.
- CCD drive pulse generation is synchronized with HRI and FRI.
- The CCD drive method can be changed to various modes by inputting serial data or parallel data to the CXD2457R.
- The various drive methods possessed by the CXD2457R are shown in the Timing Charts A-1 to 4 (V rate) and B-1 to 6 (H rate).

2. Serial data input method

- All CXD2457R operations can be controlled via the serial interface. The serial data format is as follows.



Serial data format

Serial data

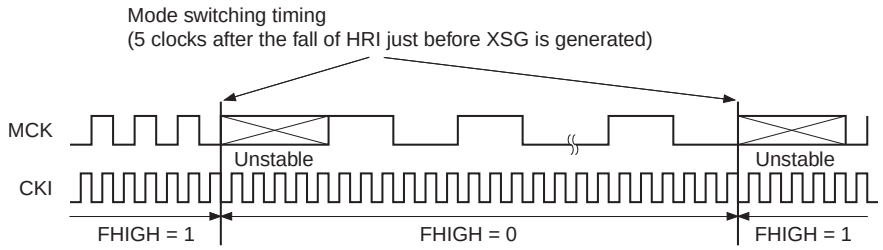
Data	Symbol	Function		When reset
D00 to D07	CHIP	Chip switching	See D00 to D07 CHIP.	All 0
D08 to D10	CTGRY	Category switching	See D08 to D10 CTGRY.	All 0
D11 to D31	DATA	Control data for each category The meaning of this CTGRY control data differs according to the category set by D08 to D10.	See D11 to D31 DATA.	All 0
D32 to D39	Checksum bits	Checksum bits	See D32 to D39 CHKSUM.	All 0

3. Serial data and description of functions

<table>
<tr><th></th><th>Detailed description</th></tr>
<tr><td>D00
to
D07
CHIP</td><td>The serial interface data is loaded to the CXD2457R when D00 and D07 are 1. However, this assumes that D32 to D39 CHKSUM is satisfied.
<table>
<tr><th>D07</th><th>D06</th><th>D05</th><th>D04</th><th>D03</th><th>D02</th><th>D01</th><th>D00</th><th>Function</th></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>Loading to the CXD2457R</td></tr>
</table></td></tr>
<tr><td>D08
to
D10
CTGRY</td><td>This CTGRY data indicates the functions that the serial interface data controls.
<table>
<tr><th>D10</th><th>D09</th><th>D08</th><th>Function</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Mode control data</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Electronic shutter control data</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>High-speed phase adjustment data (Set all of D11 to D31 to 0.)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>System setting data</td></tr>
</table>
Input of values other than those listed above is prohibited.</td></tr>
</table>

CTGRY: Mode control data

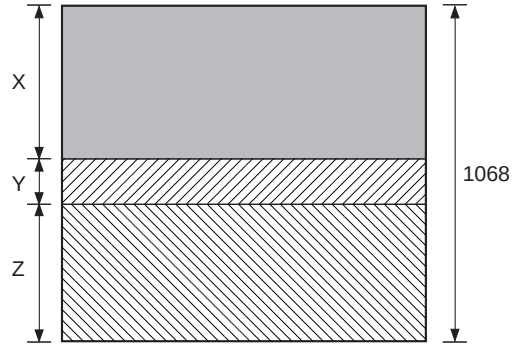
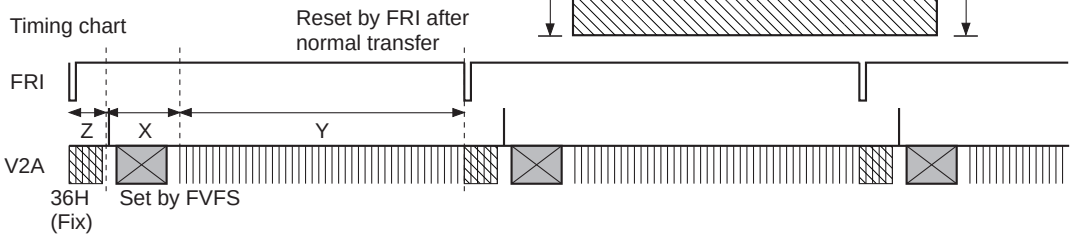
<table>
<tr><th></th><th>Detailed description</th></tr>
<tr><td>D11
FHIGH</td><td>0: Power saving drive mode
1: High-speed drive mode

When FHIGH = 0, the clock input to CKI is immediately frequency divided by 1/3 and loaded internally.
 

The high-speed phases of H1, H2, RG, XSHP, XSHD, XRS, ADCLK and other pulses are always logically the same phase with respect to MCK.</td></tr>
<tr><td>D12
FINE</td><td>0: DRAFT mode
1: FINE mode

In FINE mode, image data is taken by the normal Progressive Scan method.
In DRAFT mode, image data is taken by pulse elimination readout. This enables a frame rate three times that during FINE mode. The mode is switched at the fall of HRI just before XSGA.
Note that the FRO output is also switched accordingly. (DRAFT mode: 264H, FINE mode: 792H)</td></tr>
<tr><td>D13
NSG</td><td>0: Normal operation
1: Readout prohibited mode

In readout prohibited mode, a readout pulse is not added to V2A and V2B (V2A or V2B takes a VH value). (V1, V2 and V3 are not modulated.)
The mode is normally switched at the fall of HRI just before the position where the readout pulse is added.</td></tr>
</table>

	Detailed description
D14 FS	0: Normal operation 1: FS mode In order to increase the frame rate, a certain portion of the captured image of CCD can be cut out by performing high-speed sweep. In FS mode, high-speed sweep is performed for the V registers of the entire image (period Z) after FRI input. Next, high-speed sweep is performed again for only the desired period (period X) after generating the XSGA pulse. Then, after performing normal V transfer and outputting the effective signal (period Y), high-speed sweep is performed for the entire image again by inputting FRI at the desired timing. This makes it possible to take only the desired portion in the V direction, thus effectively increasing the frame rate. Operation is fixed during period Z, with 22 lines swept every 1H and repeating over a 36H period. During period X, first XSGA is generated, then sweep operation starts. This period is set in serial data FVFS (system setting data: D21 to D26) in HRI units. Be sure to set FINE = 0 in this mode. • When the frame rate is increased as the vertical effective signal Y line (example) Sweep variable period (period X) Effective signal period (period Y) Sweep fixed period (period Z)  
D15 to D16	Set to 0.

	Detailed description
D17 to D18 STB	Operation control settings The operating mode control bits are loaded to the CXD2457R at the rise timing of the SEN input, and control is applied immediately.

D18	D17	Symbol	Control mode
0	0	CAM	Normal operation mode
0	1	SLP	Sleep mode (mode for the status where CCD drive is not required)
1	X	STN	Standby mode

Pin status during operation control

Pin No.	Symbol	CAM	SLP	STN	RST*	Pin No.	Symbol	CAM	SLP	STN	RST*
1	CKO	ACT	ACT	ACT	ACT	25	MCK	ACT	ACT	ACT	ACT
2	$V_{SS}0$	—	—	—	—	26	$V_{DD}1$	—	—	—	—
3	CKI	ACT	ACT	ACT	ACT	27	2MCK	ACT	ACT	ACT	ACT
4	OSCO	ACT	ACT	ACT	ACT	28	TEST2	—	—	—	—
5	OSCI	ACT	ACT	ACT	ACT	29	SEN	ACT	ACT	—	—
6	$V_{DD}0$	—	—	—	—	30	SSK	ACT	ACT	—	—
7	TEST1	—	—	—	—	31	SSI	ACT	ACT	—	—
8	AVD0	—	—	—	—	32	ID	ACT	L	L	L
9	RG	ACT	L	L	L	33	EXP	ACT	L	L	L
10	$V_{SS}1$	—	—	—	—	34	HRO	ACT	ACT	L	L
11	$V_{SS}2$	—	—	—	—	35	FRO	ACT	ACT	L	L
12	H1	ACT	L	L	L	36	$V_{SS}4$	—	—	—	—
13	H2	ACT	L	L	L	37	HRI	ACT	ACT	—	—
14	AVD1	—	—	—	—	38	FRI	ACT	ACT	—	—
15	XCPDM	ACT	L	L	L	39	VM	—	—	—	—
16	AVD2	—	—	—	—	40	V1	ACT	VM	VM	VM
17	XSHP	ACT	L	L	L	41	V3	ACT	VM	VM	VM
18	XSHD	ACT	L	L	L	42	V2A	ACT	VH	VH	VH
19	XRS	ACT	L	L	L	43	VH	—	—	—	—
20	$V_{SS}3$	—	—	—	—	44	V2B	ACT	VH	VH	VH
21	PBLK	ACT	L	L	L	45	SUB	ACT	VH	VH	VH
22	XCPOB	ACT	L	L	L	46	VL	—	—	—	—
23	ADCLK	ACT	L	L	L	47	DSGAT	ACT	ACT	L	L
24	RST	ACT	ACT	ACT	ACT	48	PS	ACT	ACT	ACT	ACT

* See "6. RST pulse" for a detailed description of RST.

Note) ACT indicates circuit operation, and L indicates "low" output level in the controlled status. For sleep mode or standby mode, stop supplying VH and VL power supplies with CCD image sensor.

<table>
<tr><th></th><th>Detailed description</th></tr>
<tr><td>D19
EXPXEN</td><td>0: The EXP pulse indicating the exposure period is generated.
1: The EXP pulse indicating the exposure period is not generated, and is constantly fixed to low.

This bit is invalid when STATUS = 1.
Note that the STB setting has priority.
The data is reflected at the rise of XSGA.</td></tr>
<tr><td>D20
3MCK</td><td>0: 2MCK clock system
1: 3MCK clock system

This bit switches how MCK is comprised from the clock selected by FHIGH. Note that the waveform is unstable for 5 clocks before and after switching.</td></tr>
<tr><td>D21
to
D23</td><td>Invalid data</td></tr>
<tr><td>D24
to
D28
VSHUT</td><td>Low-speed electronic shutter setting.
The value set here is the number of FR during which readout operation is not performed even if there is input. The setting range is from 0 to 31. When set to 0, readout operation is performed at the first VR.
When FS = 1, this bit is invalid.

<table>
<tr><th>MSB</th><th></th><th></th><th></th><th>LSB</th><th>Function</th></tr>
<tr><td>D28</td><td>D27</td><td>D26</td><td>D25</td><td>D24</td><td>Number of FR during which readout operation is not performed</td></tr>
</table>
</td></tr>
<tr><td>D29
to
D31</td><td>Invalid data</td></tr>
</table>

CXD2457R clock system

When using a 30MHz crystal

	FHIGH	3MCK	FINE	MCK frequency	2MCK pin output	Frame rate
Mode1	1	0	1	15MHz	30MHz	15Frame/s
Mode2	1	1	0	10MHz	15MHz	30Frame/s
Mode3	0	0	0	5MHz	10MHz	15Frame/s
Mode4	1	0	0	15MHz	30MHz	45Frame/s
Mode5	1	1	1	10MHz	15MHz	10Frame/s

Note) Combinations of FHIGH, 3MCK and FINE other than those listed above are prohibited.

CTGRY: Electronic shutter control data

<table>
<tr><th></th><th>Detailed description</th></tr>
<tr><td>D11
to
D20
HSHUT</td><td>High-speed electronic shutter setting.
The value set here is the number of SUB pulses from FR to the next FR.
<table>
<tr><th colspan="10">MSB LSB</th><th>Function</th></tr>
<tr><td>D20</td><td>D19</td><td>D18</td><td>D17</td><td>D16</td><td>D15</td><td>D14</td><td>D13</td><td>D12</td><td>D11</td><td>Number of SUB pulses setting</td></tr>
</table></td></tr>
<tr><td>D21
to
D31</td><td>Input 0.</td></tr>
</table>

High-speed and low-speed electronic shutter can be used together. Therefore, the exposure time is as follows:

FR cycle × VSHUT + (fv – HSHUT) × HR cycle + 745/MCK frequency [Hz] = Exposure time [s]

(fv: Number of HR in 1FR)

CTGRY: System setting data

<table>
<tr><th></th><th>Detailed description</th></tr>
<tr><td>D11
SGXEN</td><td>0: Internal SSG (Sync Signal Generator) functions operate to generate FRO and HRO.
1: Internal SSG functions are stopped, and the FRO and HRO pulses are fixed to low.
Note that the STB setting has priority. When the sync signal is input from external CXD2457R, use it at SGXEN = 1.</td></tr>
<tr><td>D12
EXSG</td><td>0: Normal operation
1: XSGA and XSGB are output from the FRO and HRO pins.
Note that the amplitude of the output pulses are V_{SS} to V_{DD}a.</td></tr>
<tr><td>D13
to
D14
IDSEL</td><td>These bits select the pulse output from the ID pin.
<table>
<tr><td colspan="2"></td><td>D14</td></tr>
<tr><td colspan="2"></td><td>0</td><td>1</td></tr>
<tr><td rowspan="2">D13</td><td>0</td><td>ID pulse output</td><td>WEN pulse output</td></tr>
<tr><td>1</td><td>XSUB pulse output</td><td>ID pulse output</td></tr>
</table>
XSUB: Inverted SUB pulse output at the amplitude of V_{SS} to V_{DD}a</td></tr>
<tr><td>D15
VTXEN</td><td>0: VT (readout clock) is added to V2A, V2B and V3 as normal.
1: VT is not added to V2A, V2B and V3.
During readout, only the modulation necessary for readout is performed.
Note that this setting has priority over mode control data NSG (D13).</td></tr>
<tr><td>D16
CHKSUM</td><td>0: Checksum is not performed and the checksum data is invalid. (However, dummy data must be set in the CHKSUM register.)
1: Checksum is performed. This data is reflected even if the checksum results are NG.</td></tr>
<tr><td>D17
STATUS</td><td>0: The EXP pulse is output from the EXP pin.
1: High is indicated if the checksum results are OK, and low if the results are NG.
This pulse is output at the rise of SEN, and reset high at the fall of SEN. This pulse has priority over mode control data EXP.</td></tr>
<tr><td>D18
to
D20</td><td>Input 0.</td></tr>
<tr><td>D21
to
D26
FVFS</td><td>These bits set the high-speed sweep period (unit: H) in FS mode.
<table>
<tr><td>MSB</td><td></td><td></td><td></td><td></td><td>LSB</td></tr>
<tr><td>D26</td><td>D25</td><td>D24</td><td>D23</td><td>D22</td><td>D21</td></tr>
</table>
The high-speed sweep is performed 22 times every 1H.</td></tr>
</table>

	Detailed description
D27 XVCK	0: Normal operation 1: V1, V2 and V3 are inverted and output as XV1, XV2 and XV3. The amplitude is from VL to VM.
D28 to D31	Invalid data

CHKSUM

	Detailed description
D32 to D39	These are the checksum bits. MSB LSB D07 D06 D05 D04 D03 D02 D01 D00 D15 D14 D13 D12 D11 D10 D09 D08 D23 D22 D21 D20 D19 D18 D17 D16 D31 D30 D29 D28 D27 D26 D25 D24 +) D39 D38 D37 D36 D35 D34 D33 D32 → CHKSUM If the total = 0, the checksum results are OK. Serial data is loaded to the internal registers only when checksum is OK. Data is not reflected to the registers if checksum is NG. Also, when CHKSUM = 0, the checksum results are always OK and the data is reflected to the registers.

4. Shutter speed setting specifications when PS = H

When PS = H, the CXD2457R can be controlled without inputting serial data by using the SEN, SSK and SSI pins.

<table>
<tr><th>Pin</th><th></th><th>When L</th><th>When H</th></tr>
<tr><td>SEN</td><td>FHIGH
(horizontal CCD drive frequency)</td><td>Serial registers FHIGH and 3MCK = 0.</td><td>Serial registers FHIGH = 1 and 3MCK = 0.</td></tr>
<tr><td>SSK</td><td>FINE
(readout method)</td><td>Serial register FINE = 0 and the CXD2457R operates in DRAFT mode.</td><td>Serial register FINE = 1 and the CXD2457R operates in FINE mode.</td></tr>
<tr><td>SSI</td><td>HSHUT,
VSHUT
(exposure time)</td><td colspan="2">Number of SUB pulses when PS = H
<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="2">SSK</th></tr>
<tr><th>L</th><th>H</th></tr>
<tr><td rowspan="2">SEN</td><td>L</td><td>249
199</td><td>777
727</td></tr>
<tr><td>H</td><td>217
68</td><td>745
596</td></tr>
</table>
Upper number: When SSI = H (1/250)
Lower number: When SSI = L (1/60)</td></tr>
</table>

Other registers hold the value input when PS = L, and assume the status indicated by STB when the RST pulse is input.

5. Reflective position of each data

Each serial data is reflected at the timing shown in the table below. The reflection position is the same when PS = H. When using the low-speed electronic shutter, the data is not reflected at FR where XSGA is not generated (a readout pulse is not added to V2A).

Table 5-1. Serial data reflection timing

Data	Reflection position
Mode control data (STB)	SEN rise
Mode control data (EXPXEN)	XSGA pulse rise
Mode control data (other than STB and EXPXEN)	HRI*1 fall just before XSGA pulse generation
Electronic shutter control data	HRI*2 fall just after XSGA pulse generation
High-speed phase adjustment data	HRI*1 fall just before XSGA pulse generation
System setting data (SGXEN)	SEN rise
System setting data (other than SGXEN)	HRI*1 fall just before XSGA pulse generation

*1 For FS mode, 7HRI later from FRI fall

*2 For FS mode, 8HRI later from FRI fall

6. RST pulse

Setting Pin 30 to low resets the system. The serial data values after reset are as shown in the "Serial data" table.
Also, some internal circuits stop operating when RST = L. For a description of the pin status when RST = L, see the "Pin status during operation control" table given in the detailed description of STB under "3. Serial data and description of functions".

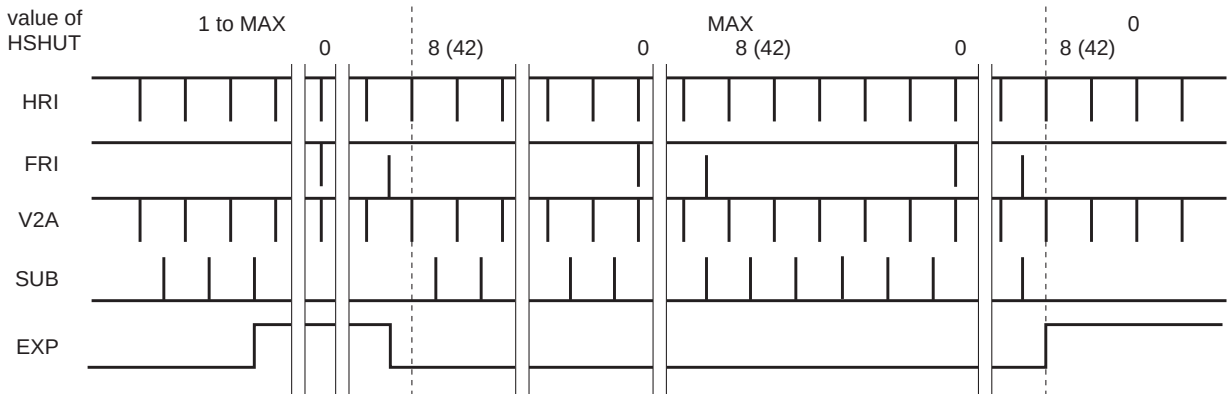
7. DSGAT

DSGAT is ON when low and the CXD2457R is set to sleep mode as with SLP of STB.
Note that control is applied when either or both of DSGAT and SLP are ON. Also, when STN is ON, the CXD2457R is set to standby mode regardless of the DSGAT status.

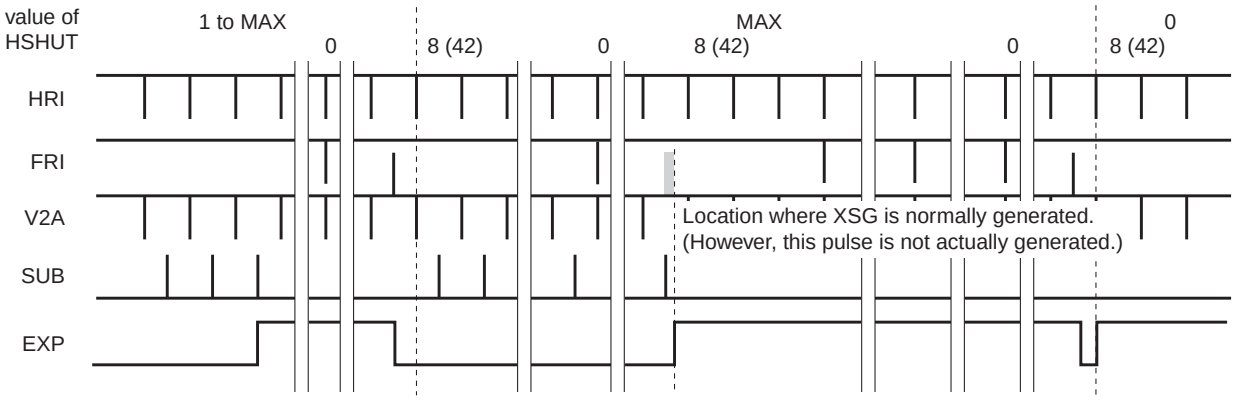
8. EXP pulse

The EXP pulse indicates the exposure period.
The details are shown on the following pages.

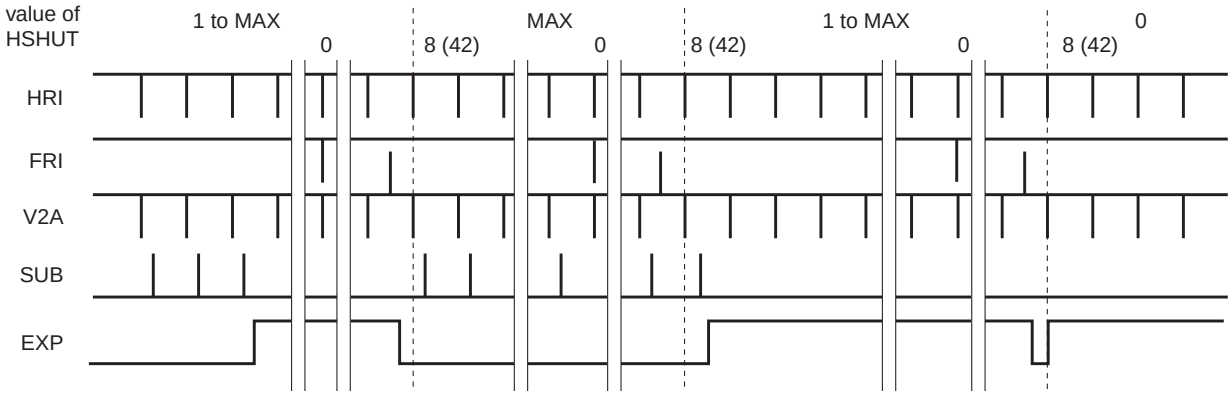
(1) HSHUT ≥ MAX



(2)HSHUT ≥ MAX (with low-speed erectronic shutter)

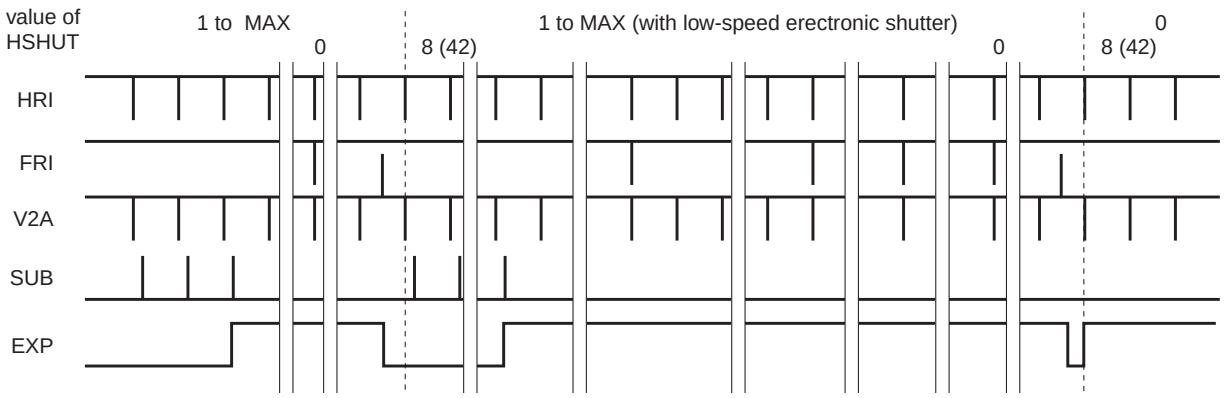


(3) 1 ≤ HSHUT < MAX

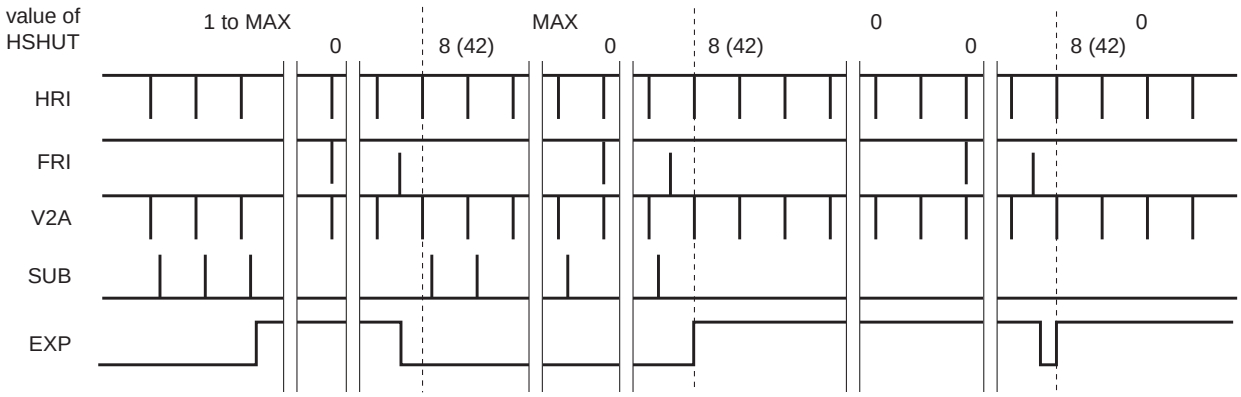


Numbers in parentheses are for FS mode.

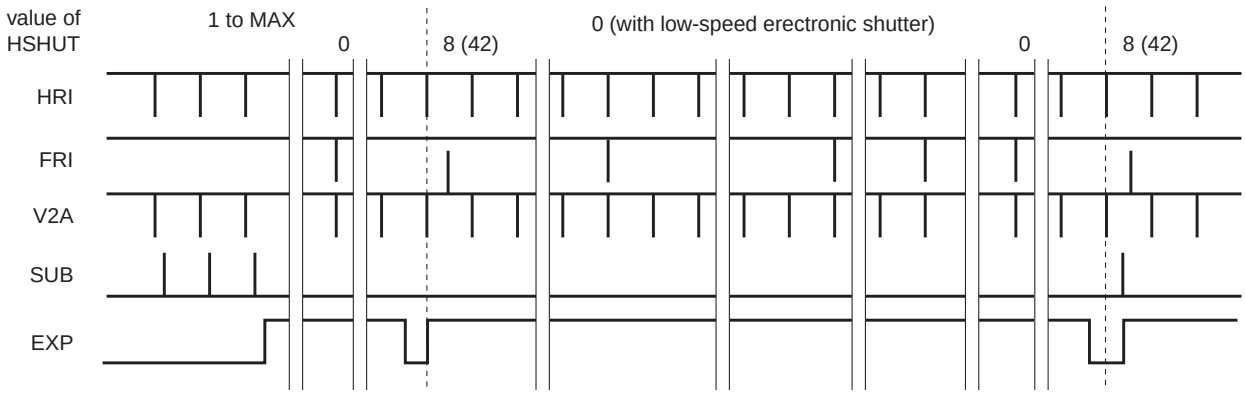
(4) 1 ≤ HSHUT < MAX (with low-speed erectronic shutter)



(5) HSHUT = 0



(6) HSHUT = 0 (with low-speed erecyronic shutter)



Numbers in parentheses are for FS mode.

Chart A-1. FINE Mode (Vertical synchronization)

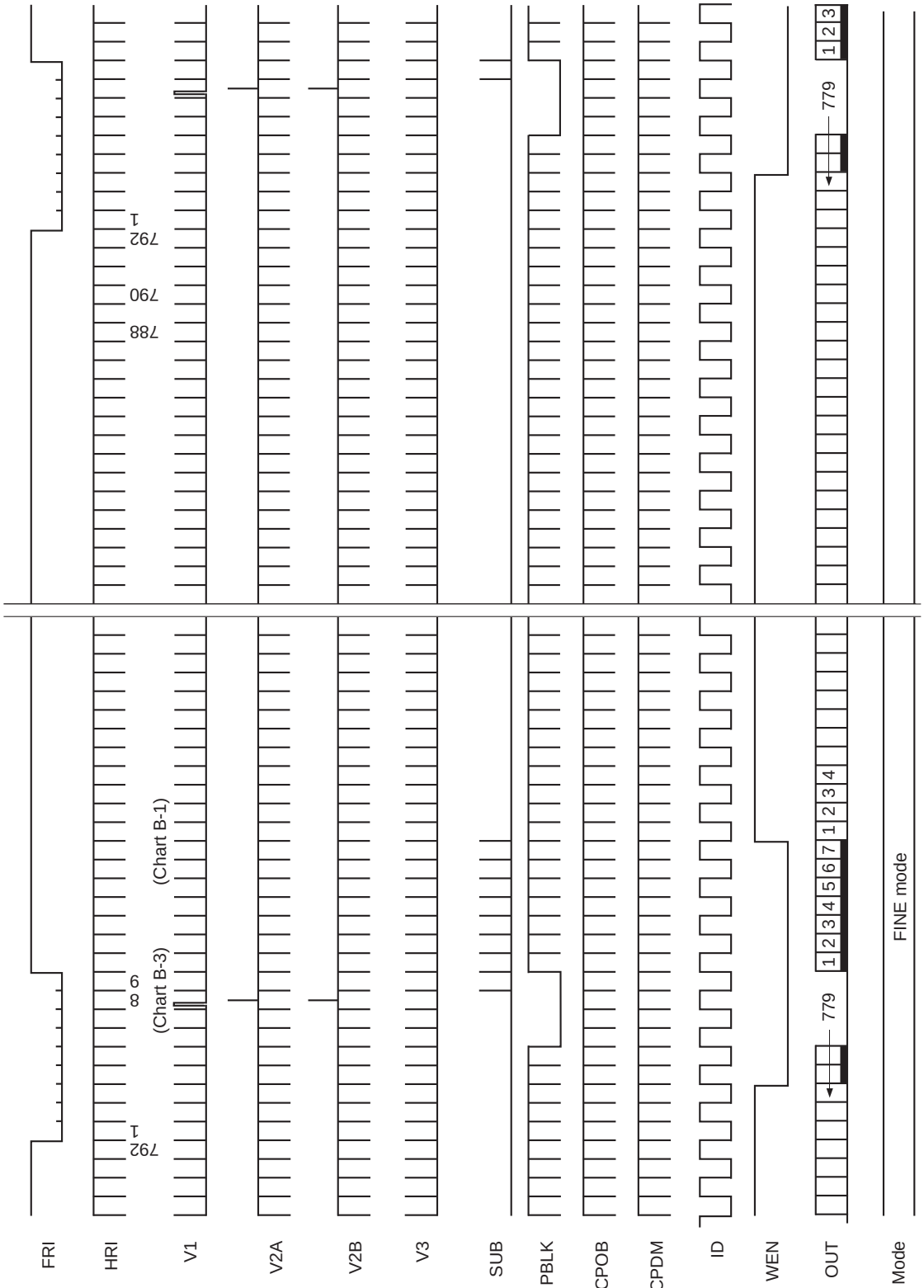


Chart A-2. DRAFT Mode (Vertical synchronization)

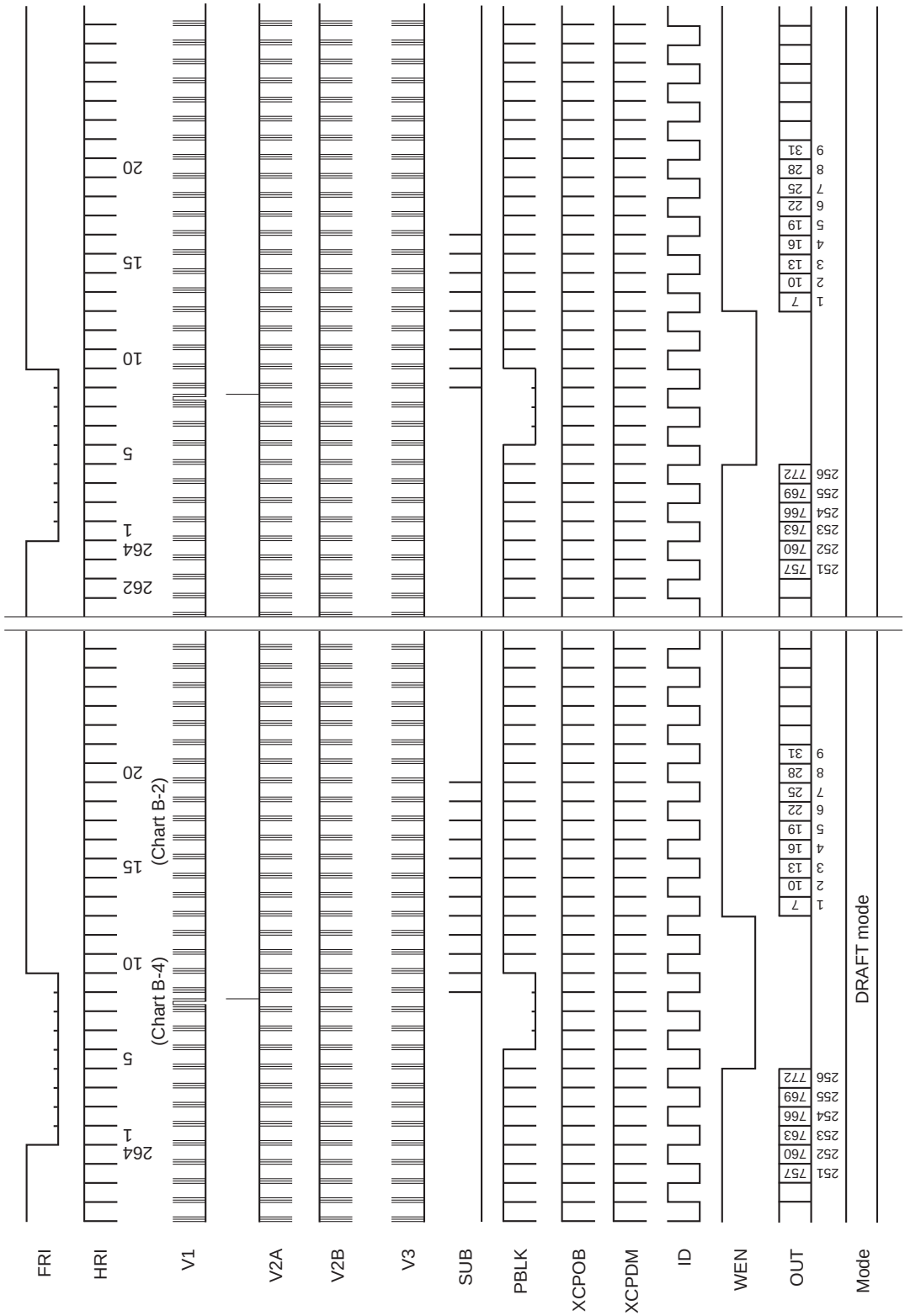
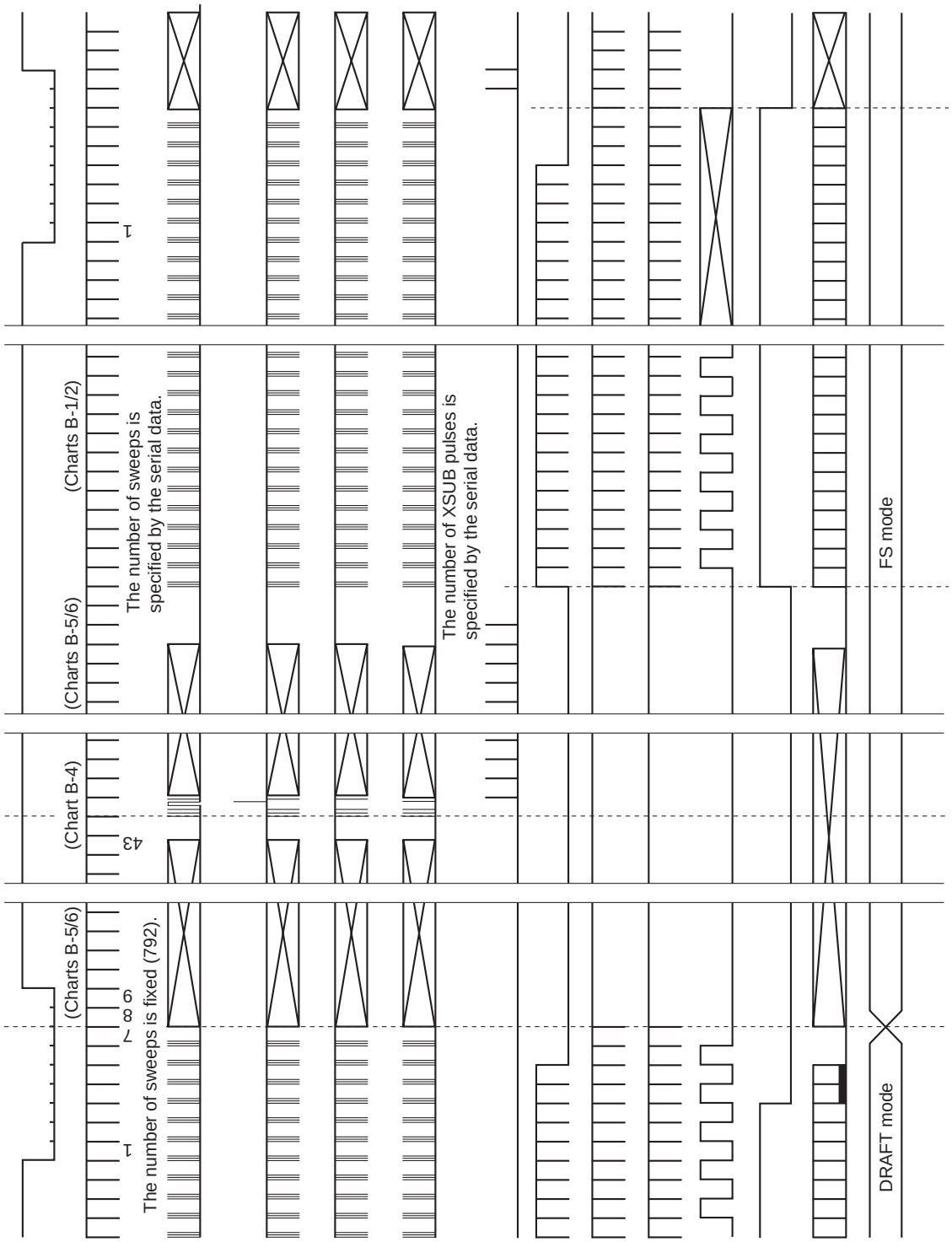


Chart A-3. FS Mode (Vertical synchronization)



The mode is switched at the point where XSG is normally generated.

Chart A-4. FINE Mode (Vertical synchronization) Low-speed electronic shutter

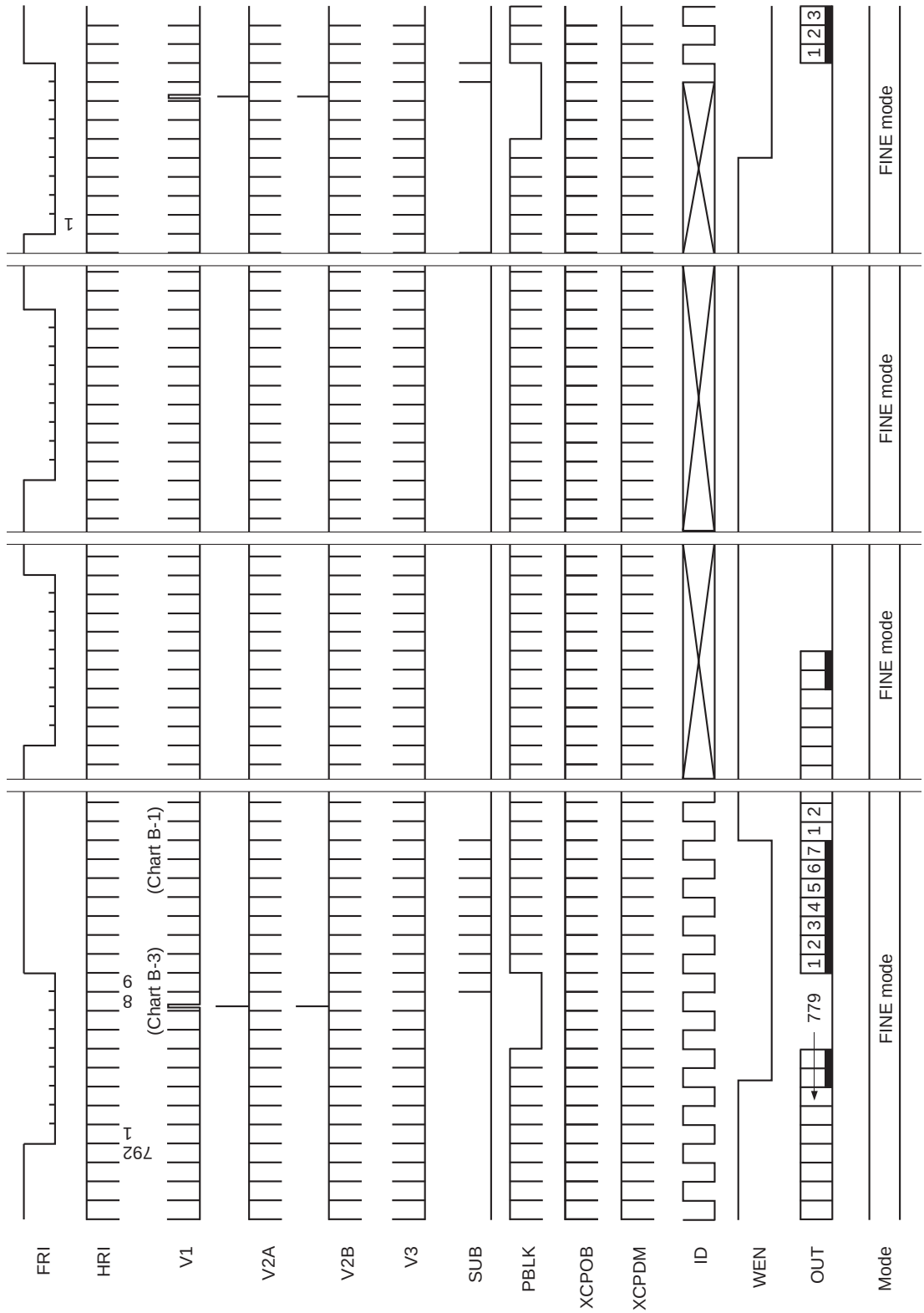


Chart B-1. FINE Mode (Horizontal synchronization)

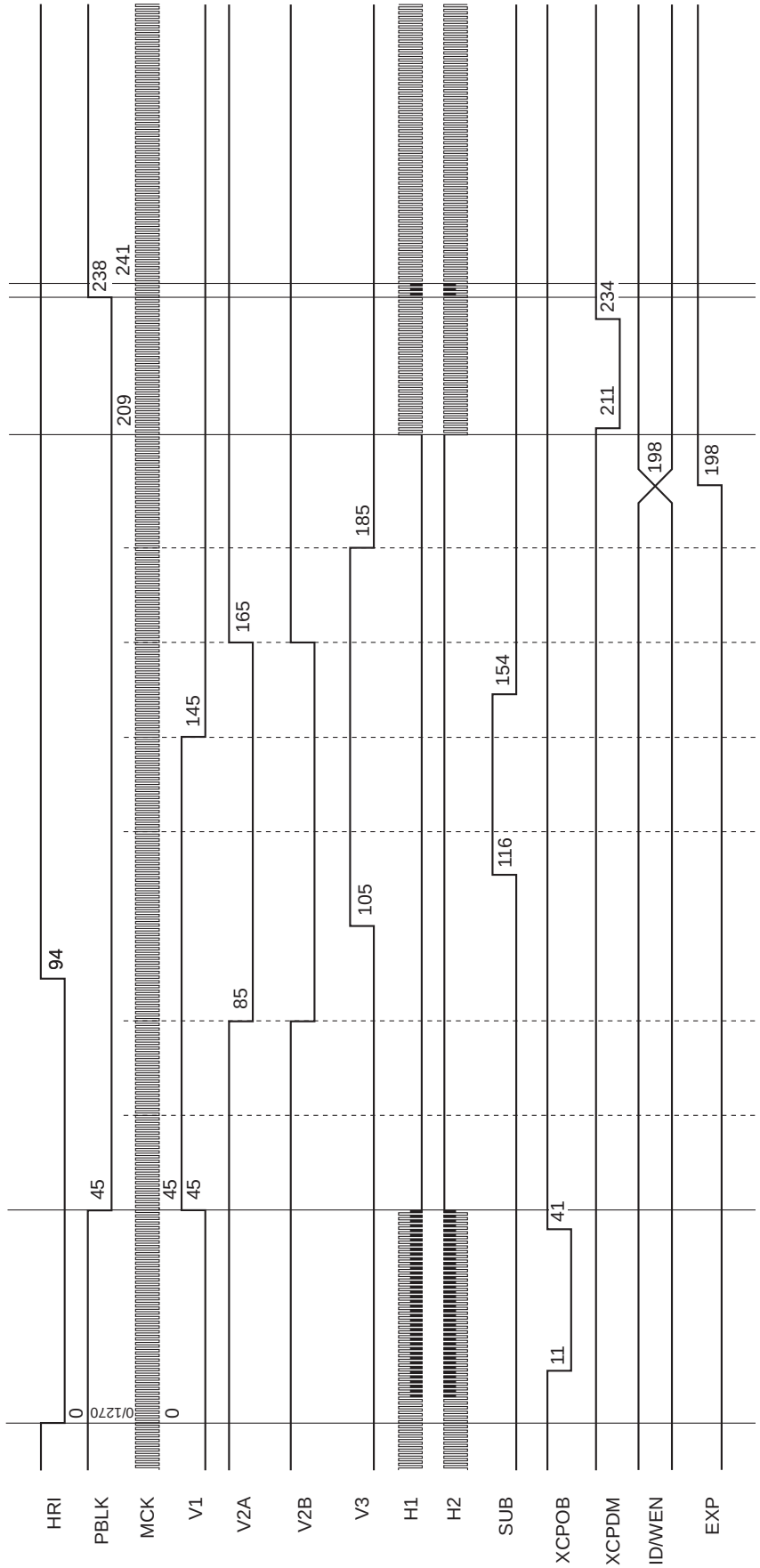


Chart B-2. DRAFT Mode (Horizontal synchronization)

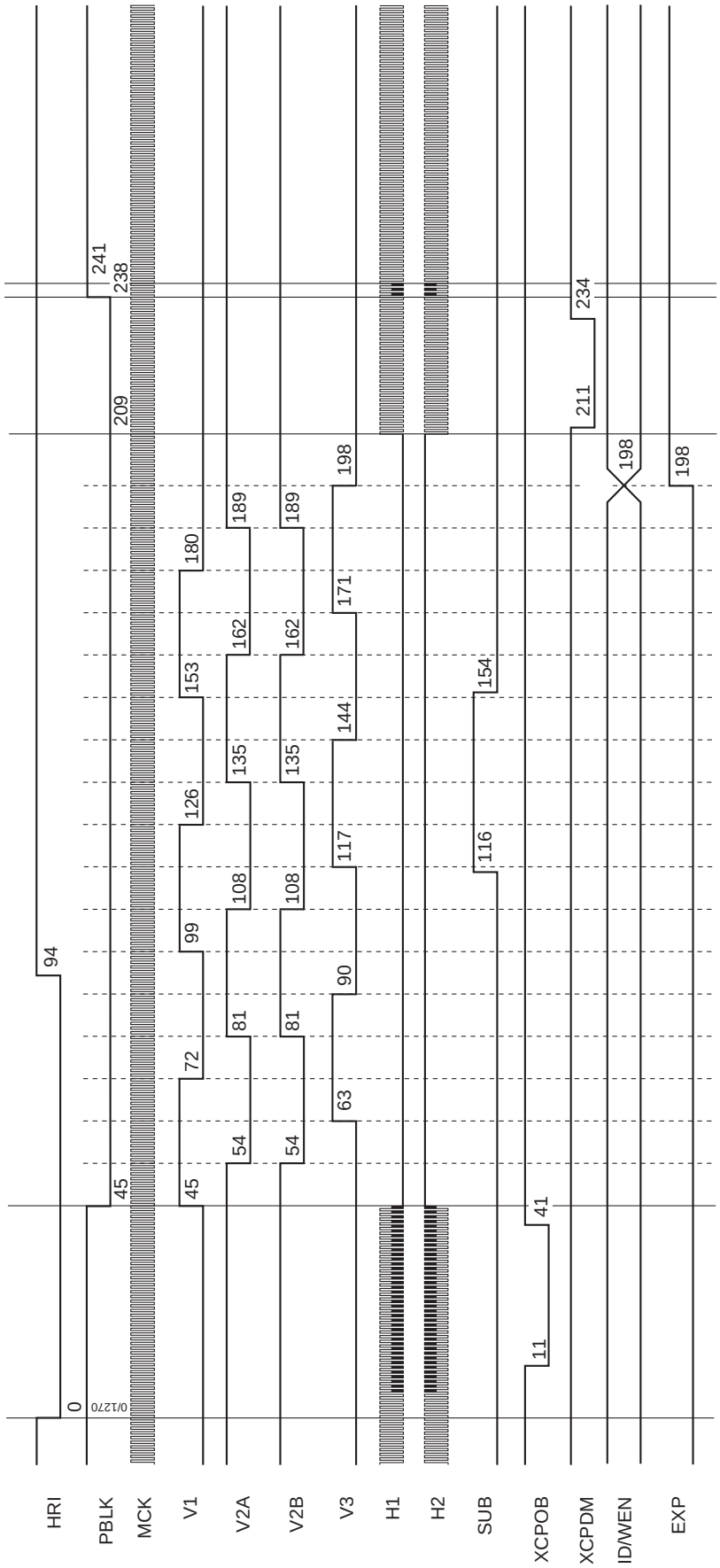


Chart B-3. Readout Timing (FINE mode)

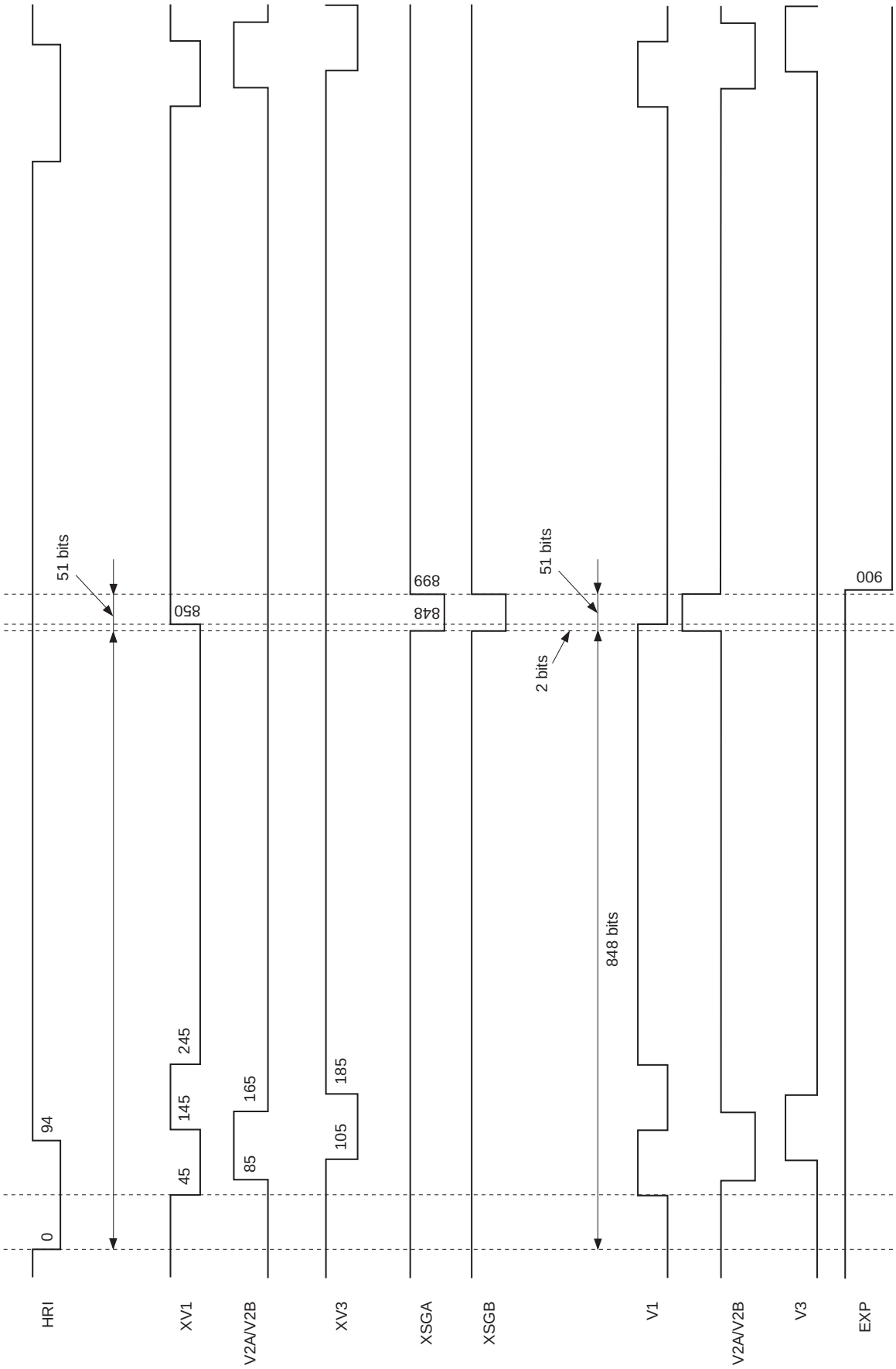


Chart B-4. Readout Timing (DRAFT mode)

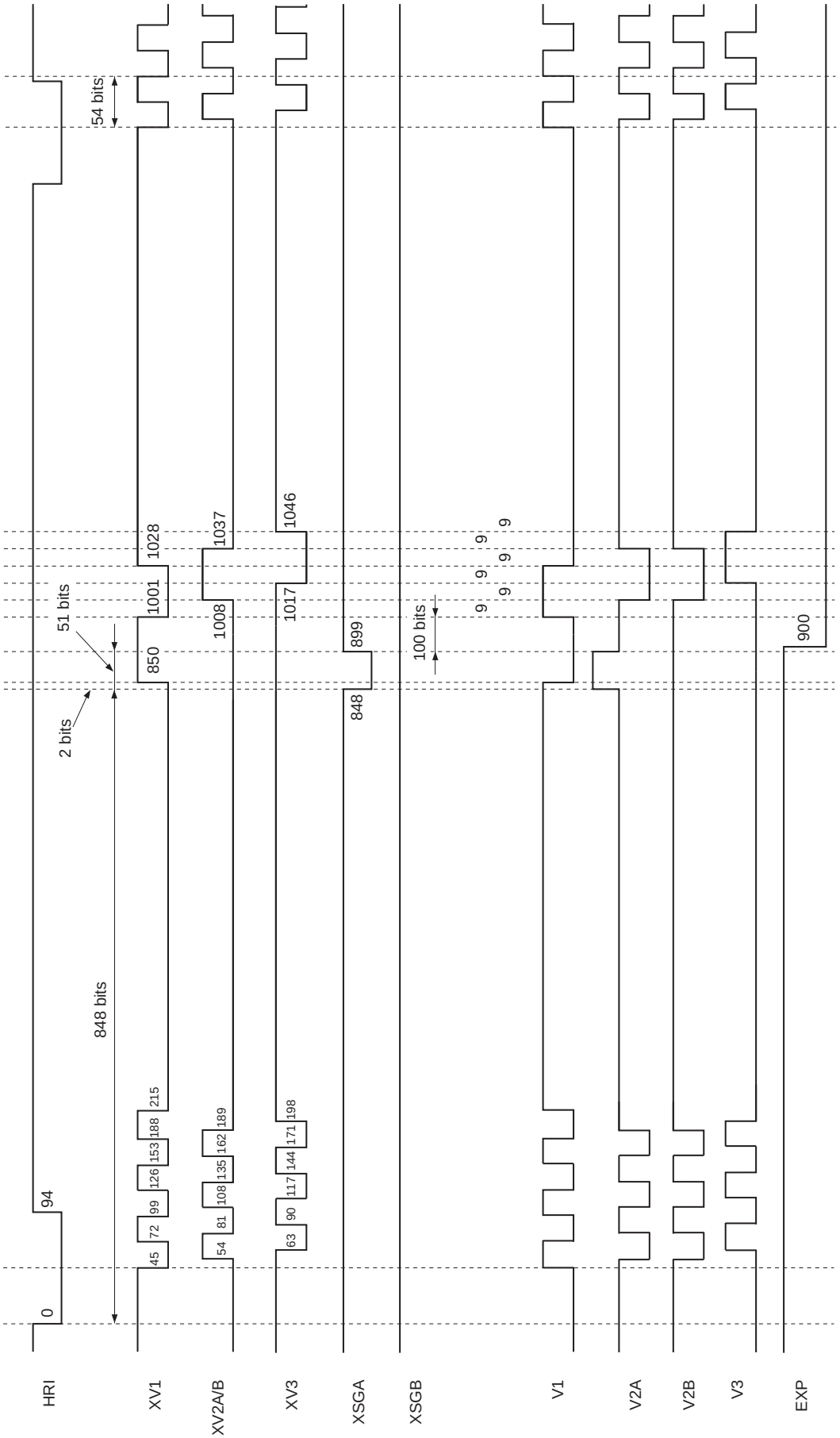


Chart B-5. FS Mode: V clock continuous drive start (Horizontal synchronization)

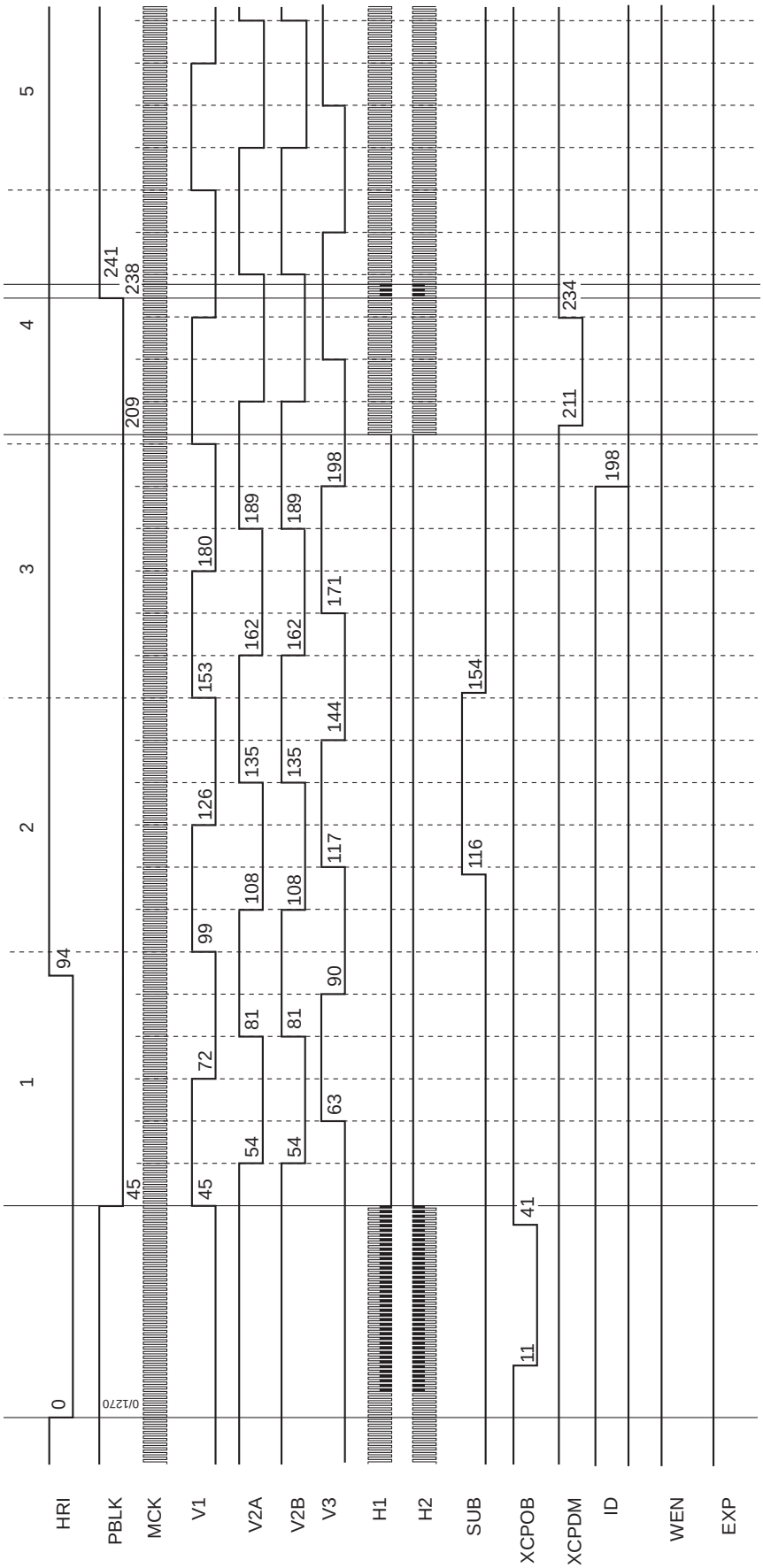
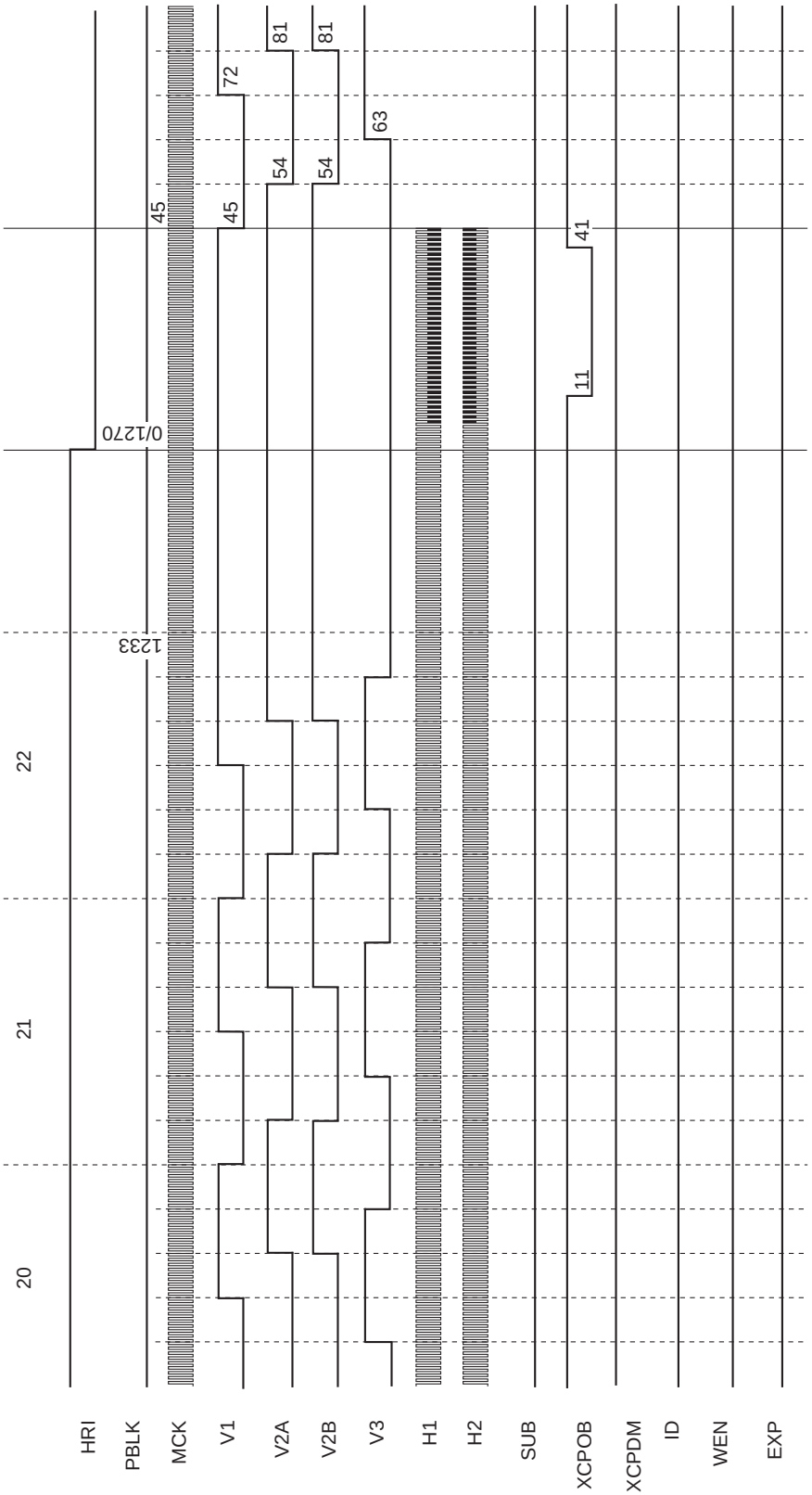
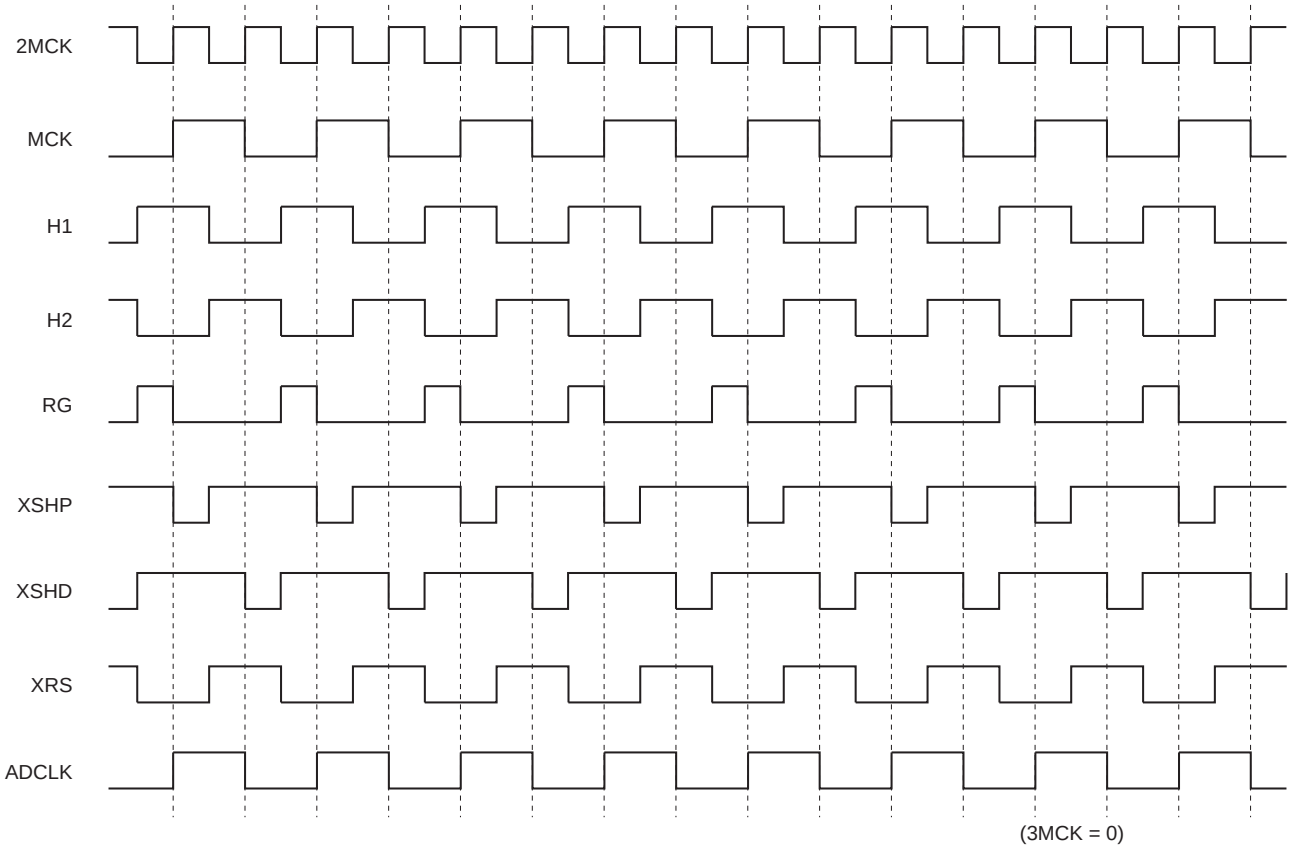


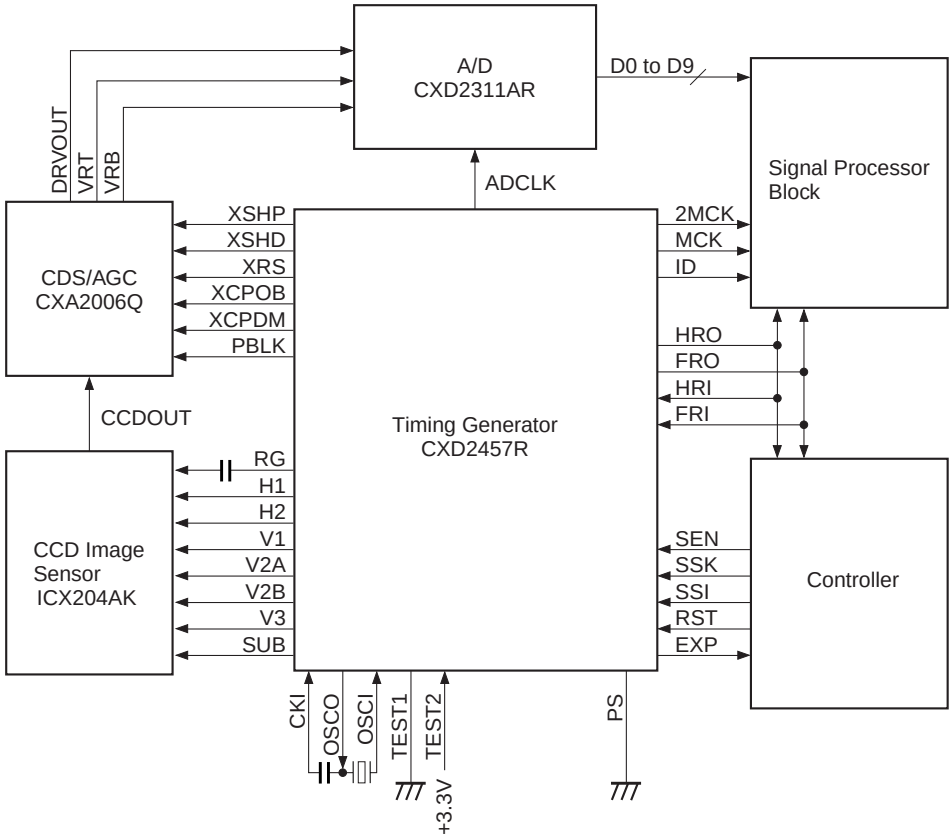
Chart B-6. FS Mode: V clock continuous drive end (Horizontal synchronization)



Logical Phase



Application Circuit

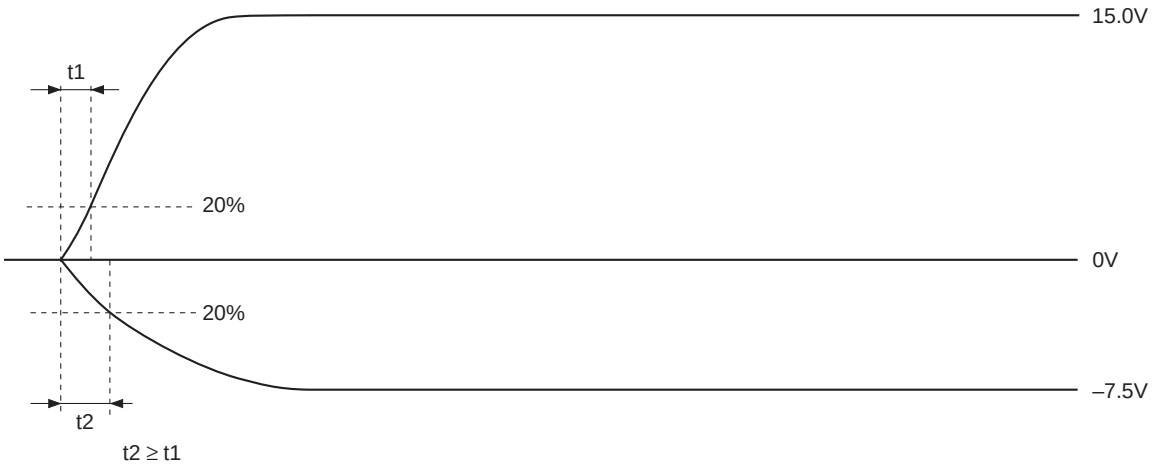


For making FR and HR outside the CXD2457R, configure a circuit that counts MCK. (Using 2MCK, CKO, etc. is not recommended.) Also, set system setting data, SGXEN (D11) to "1" and stop a built-in SSG.

Use crystal oscillator (fundamental wave) as base oscillation. Be sure to input duty 50% pulse when crystal oscillator is used.

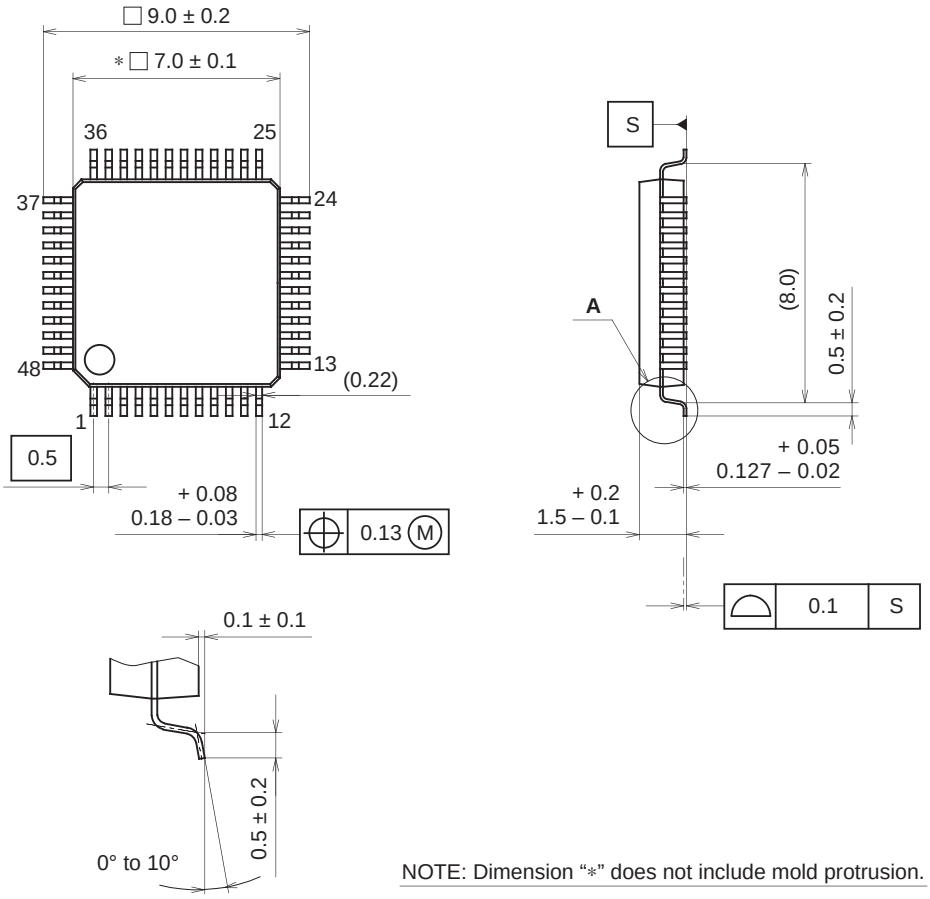
Notes on Turning Power ON

To avoid setting VSUB pin of the CCD image sensor negative potential, the former two power supplies should be raised by the following order among three power supplies, –7.5V, +15.0V and +3.3V.



Package Outline Unit: mm

48PIN LQFP (PLASTIC)



NOTE: Dimension "∗" does not include mold protrusion.

DETAIL **A**

SONY CODE	LQFP-48P-L01
EIAJ CODE	LQFP048-P-0707
JEDEC CODE	————

PACKAGE STRUCTURE

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER/PALLADIUM PLATING
LEAD MATERIAL	42/COPPER ALLOY
PACKAGE MASS	0.2g