

Preliminary

TOSHIBA Bipolar Linear Integrated Circuit
Silicon Monolithic

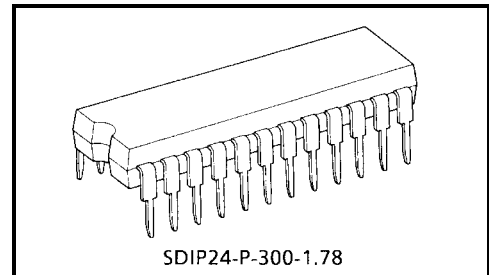
TA1318N

SYNC Processor, Frequency Counter IC for TV Component Signals

TA1318N is a sync processor for TV component signals.
TA1318N provides sync and frequency counter processing for external input signals.

These functions are integrated in a 24 pin dual-in-line shrink-type plastic package.

TA1318N provides I²C bus interface, so various functions and controls are adjustable via the bus.



Weight: 1.22 g (typ.)

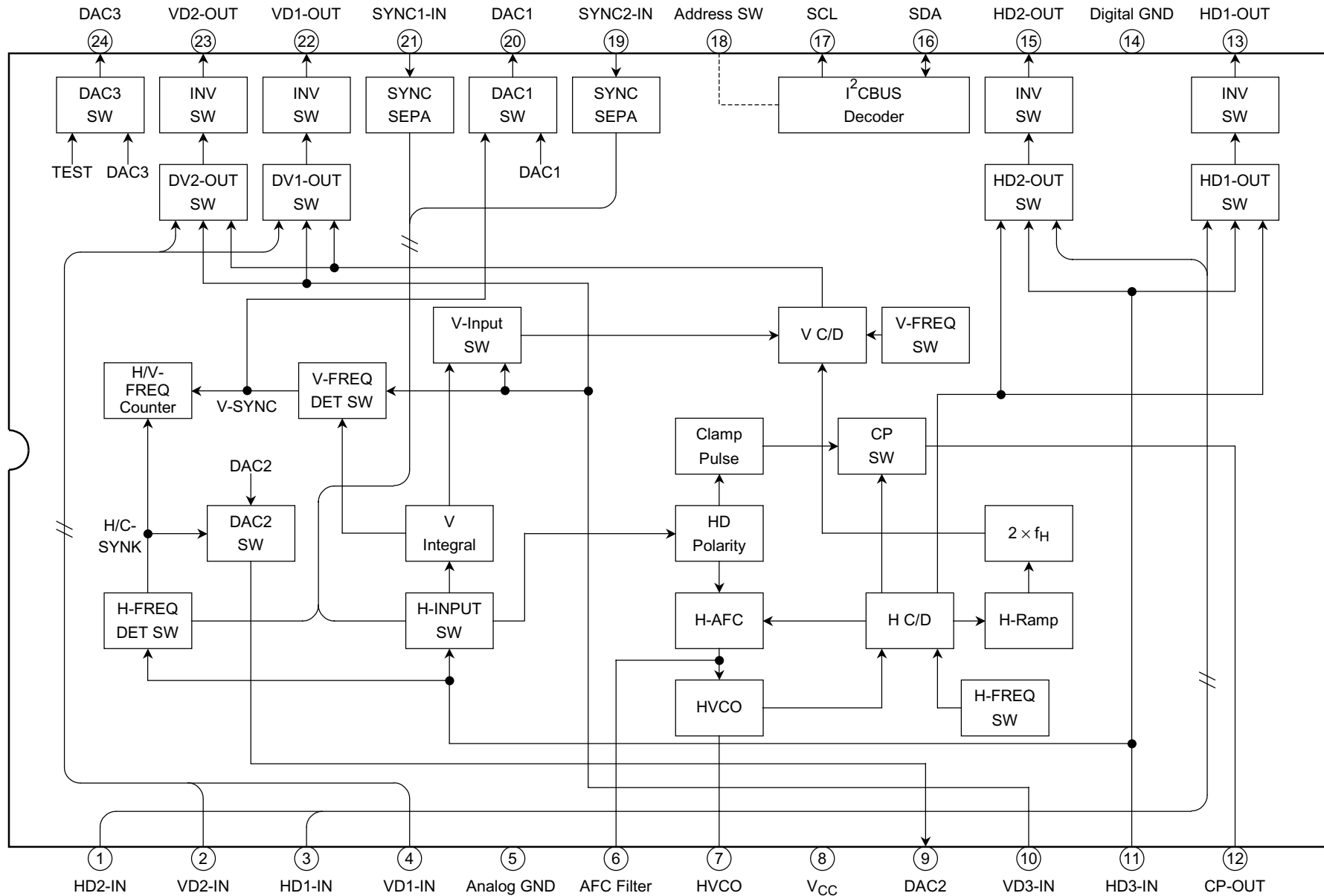
Features

- Horizontal synchronization circuit (15.75 kHz, 31.5 kHz, 33.75 kHz, 45 kHz)
- Vertical synchronization circuit (525I, 525P, 625I, 750P, 1125I, 1125P, PAL 100 Hz, NTSC 120 Hz)
- Horizontal and vertical frequency counter
- Horizontal PLL
- Accepts 2-level and 3-level sync
- Accepts both negative and positive HD and VD
- Clamp pulse output
- HD, VD output (polarity inverter)
- Separated sync output
- Mask for the copy guard signal

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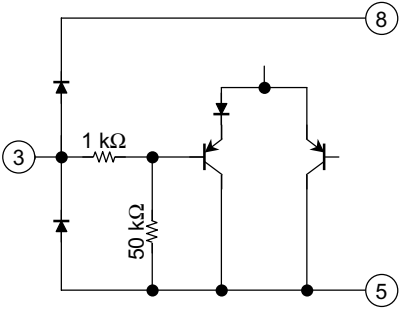
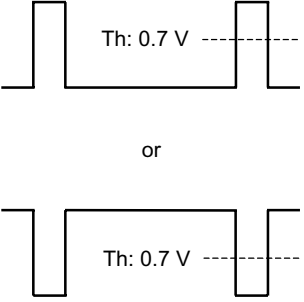
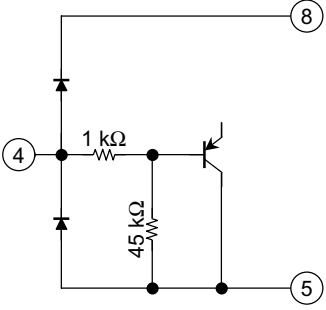
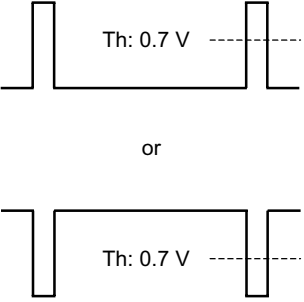
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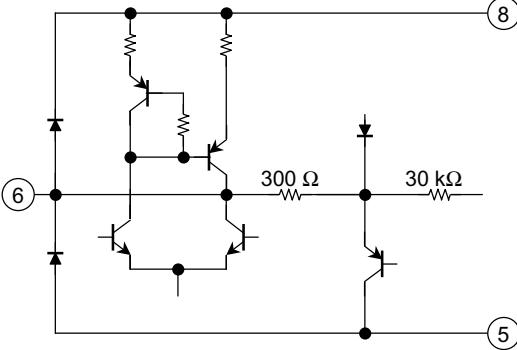
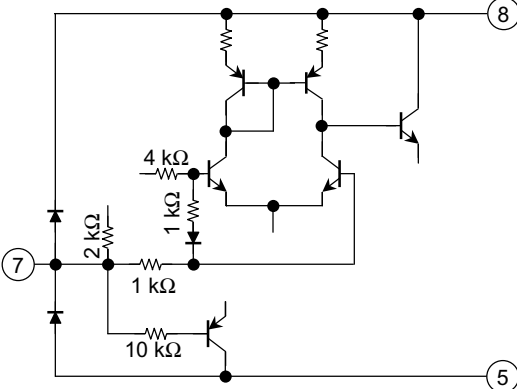
Block Diagram



Pin Functions

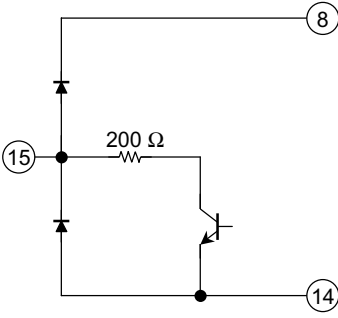
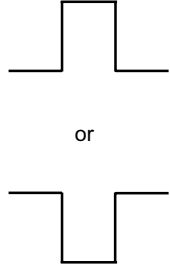
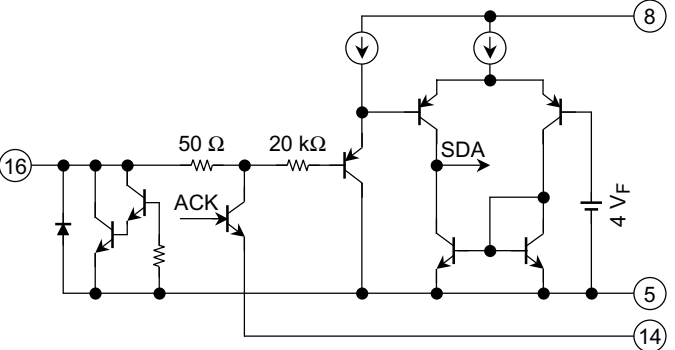
Pin No.	Pin Name	Function	Interface Circuit	Input Signal/Output Signal
1	HD2-IN	Inputs horizontal sync signal. Accepts input of both positive and negative polarity. Input signal from this pin is not synchronized.		
2	VD2-IN	Inputs vertical sync signal. Accepts input of both positive and negative polarity. Input signal from this pin is not synchronized.		

Pin No.	Pin Name	Function	Interface Circuit	Input Signal/Output Signal
3	HD1-IN	Inputs horizontal sync signal. Accepts input of both positive and negative polarity. Input signal from this pin is not synchronized.		
4	VD1-IN	Inputs vertical sync signal. Accepts input of both positive and negative polarity. Input signal from this pin is not synchronized.		
5	Analog GND	GND pin for analog circuit blocks.	—	—

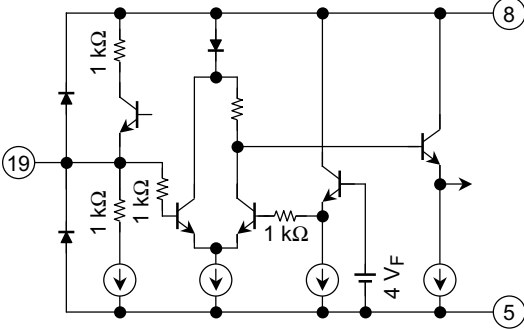
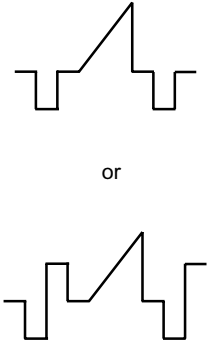
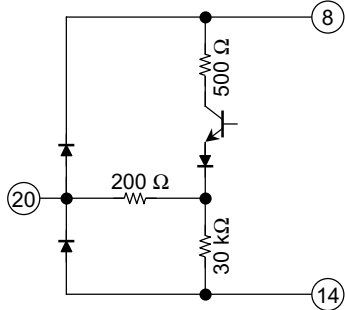
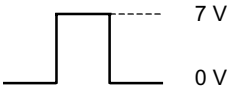
Pin No.	Pin Name	Function	Interface Circuit	Input Signal/Output Signal
6	AFC Filter	Connects filter for horizontal AFC. Voltage on this pin determines horizontal output frequency.		DC
7	HVCO	Connects ceramic oscillator for horizontal oscillation. Use Murata CSB503F30.		—
8	V _{CC}	VCC pin. Connects 9 V (typ.).	—	—

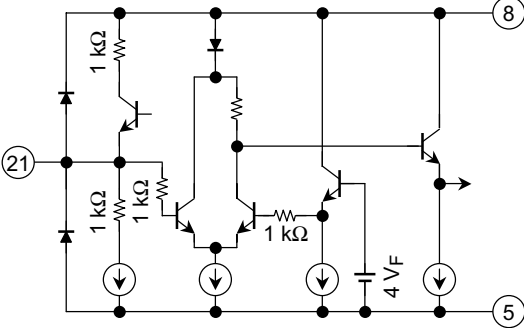
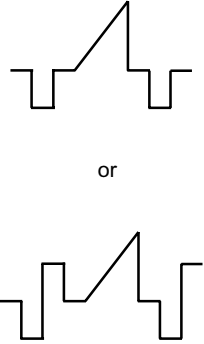
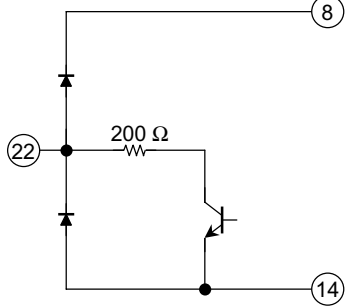
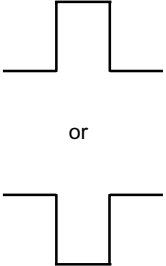
Pin No.	Pin Name	Function	Interface Circuit	Input Signal/Output Signal
9	DAC2 (H/C. SYNC output)	<p>DAC2 output pin.</p> <p>In Test mode, outputs HD or composite sync signal to frequency counter.</p>		<p>DC or H/C SYNC</p>
10	VD3-IN	<p>Inputs vertical sync signal.</p> <p>Accepts input of both positive and negative polarity.</p>		
11	HD3-IN	<p>Inputs horizontal sync signal.</p> <p>Accepts input of both positive and negative polarity.</p>		

Pin No.	Pin Name	Function	Interface Circuit	Input Signal/Output Signal
12	CP-OUT	Clamp pulse (CP) output pin. Outputs CP generated by sync circuit.		
13	HD1-OUT	HD output pin. Open collector output. HD1/HD2 input signal is output from this pin without synchronization. Polarity is switched by BUS write function.		
14	Digital GND	GND pin for logic blocks.	—	—

Pin No.	Pin Name	Function	Interface Circuit	Input Signal/Output Signal
15	HD2-OUT	<p>HD output pin. Open collector output. HD1/HD2 input signal is output from this pin without synchronization. Polarity is switched by BUS write function.</p>		
16	SDA	<p>SDA pin for I²C bus.</p>		<p>—</p>

Pin No.	Pin Name	Function	Interface Circuit	Input Signal/Output Signal														
17	SCL	SCL pin for I ² C bus.		—														
18	Address SW	Slave address switch pin. When this pin is connected to V _{CC} (GND), used for DC/DD _H (D8/D9 _H); when left open, DA/DB _H .		<table border="0"> <tr> <td>—————</td> <td>9 V</td> </tr> <tr> <td>—————</td> <td>DC/DD</td> </tr> <tr> <td>—————</td> <td>7.5 V</td> </tr> <tr> <td>—————</td> <td>DA/DB</td> </tr> <tr> <td>—————</td> <td>1.5 V</td> </tr> <tr> <td>—————</td> <td>D8/D9</td> </tr> <tr> <td>—————</td> <td>0 V</td> </tr> </table>	—————	9 V	—————	DC/DD	—————	7.5 V	—————	DA/DB	—————	1.5 V	—————	D8/D9	—————	0 V
—————	9 V																	
—————	DC/DD																	
—————	7.5 V																	
—————	DA/DB																	
—————	1.5 V																	
—————	D8/D9																	
—————	0 V																	

Pin No.	Pin Name	Function	Interface Circuit	Input Signal/Output Signal
19	SYNC2-IN	Inputs signal for sync separation circuit. Input via clamp capacitor.		<p>White 100% = 1 V_{p-p}</p> 
20	DAC1 (V SYNC output)	DAC1 output pin. In Test mode, outputs VD or composite sync signal to frequency counter.		<p>DC or V SYNC</p> 

Pin No.	Pin Name	Function	Interface Circuit	Input Signal/Output Signal
21	SYNC1-IN	Inputs signal for sync separation circuit. Input via clamp capacitor.		White 100% = 1 V _{p-p} 
22	VD1-OUT	VD output pin. Open collector output. VD1/VD2 input signal is output from this pin without synchronization. Polarity is switched by BUS write function.		

Pin No.	Pin Name	Function	Interface Circuit	Input Signal/Output Signal
23	VD2-OUT	VD output pin. Open collector output. VD1/VD2 input signal is output from this pin without synchronization. Polarity is switched by BUS write function.		
24	DAC3	DAC3 output pin. Open collector output. In Test mode, outputs test pulse for shipping.		DC or test pulse for shipping

Bus Control Map

Write Mode

Slave Address: D8/DA/DC_H

Sub-Add	D7 MSB	D6	D5	D4	D3	D2	D1	D0 LSB	Preset	
									MSB	LSB
00	H-FREQUENCY		HD1/VD1-OUT SW		HD2/VD2-OUT SW		SEPA LEVEL		1000	0000
01	DAC1		DAC2		DAC3	TEST	HD1-INV	HD2-INV	1000	0000
02	V-FREQUENCY			CLP-PHS	FREQ DET SW		INPUT SW		1000	0000
03	HD PHASE						VD1-INV	VD2-INV	1000	0000

Read Mode

Slave Address: D9/DB/DD_H

	D7 MSB	D6	D5	D4	D3	D2	D1	D0 LSB
0	POR	V FREQUENCY DET						
1	HD-IN	H FREQUENCY DET						

Bus Control Functions

Write Mode (*: Preset)

- H-FREQUENCY** (Horizontal oscillation frequency)
 Switches horizontal frequency.
 (00): 15.75 kHz (01): 31.5 kHz *(10): 33.75 kHz (11): 45 kHz
- HD1/VD1-OUT SW** (HD1/VD1 output switch)
 Switches output from pin 13/22. When set to 00, 01, or 10, outputs HD/VD without synchronization. When set to 11, outputs HD/VD from the sync circuit.
 *(00): HD1/VD1 (01): HD2/VD2 (10): HD3/VD3 (11): Synchronized HD/VD
- HD2/VD2-OUT SW** (HD2/VD2 output switch)
 Switches output from pin 15/23. When set to 00, 01, or 10, outputs HD/VD without synchronization. When set to 11, outputs HD/VD from the sync circuit.
 *(00): HD1/VD1 (01): HD2/VD2 (10): HD3/VD3 (11): Synchronized HD/VD
- SEPA LEVEL** (Sync separation level switch)
 Switches sync separation level of pin 19/21. Set values are the levels from sync tip.
 *(00): 15IRE (01): 20IRE (10): 25IRE (11): 30IRE
- DAC1** (DAC1 control)
 Controls 2-bit DAC (pin 9).
 (00): 1 V (01): 3 V *(10): 5 V (11): 7 V
- DAC2** (DAC2 control)
 Controls 2-bit DAC (pin 20).
 *(00): 1 V (01): 3 V (10): 5 V (11): 7 V
- DAC3** (DAC3 control)
 Controls open collector 1-bit DAC (pin 24).
 *(0): OPEN (HIGH) (1): ON (LOW)
- TEST** (Test mode)
 Switches DAC1, 2, and 3 outputs. Also used to test IC for shipping.
 *(0): DAC outputs are used as DAC.
 (1): DAC1 outputs V. SYNC to the frequency counter.
 : DAC2 outputs H. SYNC or C. SYNC to the frequency counter.
 DAC3 outputs IC test pulse for shipping.

- **HD1-INV (HD1 output polarity switch)**
Switches HD1 output (pin 13) polarity. When set to 0, positive HD input is output as negative HD. When set to 0, output from the sync circuit is output as negative HD.
*(0): Normal (1): Inverse
- **HD2-INV (HD2 output polarity switch)**
Switches HD1 output (pin 15) polarity. When set to 0, positive HD input is output as negative HD. When set to 0, output from the sync circuit is output as negative HD.
*(0): Normal (1): Inverse
- **V-FREQUENCY (Vertical frequency switch (pull-in range))**
Sets vertical frequency pull-in range, VD-STOP, or free-running frequency.
Free-running frequency is controlled by H-FREQUENCY.

	Pull-in Range	Format/H (V) Frequency
*(000)	48~1281 H	1125P/30 Hz (33.75 kHz)
(001)	48~849 H	750P/60 Hz (45 kHz)
(010)	FREE-RUN	Free-running frequency is controlled by H-FREQUENCY. (00): 262 H (01): 525 H (10): 562 H (11): 750 H
(011)	48~637 H	1125I/60 Hz (33.75 kHz)
(100)	48~613 H	525P/60 Hz (31.5 kHz)
(101)	48~363 H	PAL/SECAM/50 Hz (15.625 kHz) PAL/SECAM double scan/100 Hz (31.5 kHz)
(110)	48~307 H	NTSC/60 Hz (15.734 kHz) NTSC double scan /120 Hz (31.5 kHz)
(111)	VP STOP	VD output is HIGH

- **CLP PHS (Clamp pulse phase switch)**
Switches clamp pulse phase.
If no signal input, 0.9 μ s pulse is output from the H-C/D circuit.
*(0): 1 μ s (3.4%) delay following HD stop phase, 0.8 μ s (2.7%) pulse
(1): 0.5 μ s (1.7%) delay following HD stop phase, 0.8 μ s (2.7%) pulse
- **FREQ DET SW (Horizontal/vertical frequency counter switch)**
Switches input signal used for horizontal/vertical frequency counter. This switch is controlled independently from INPUT SW. The detection result is output as read BUS data.
*(00): SYNC1 input (01): SYNC2 input (10)/(11): HD3/VD3 inputs
- **INPUT SW (Input signal switch for synchronization)**
Switches input signal used for synchronization.
*(00): SYNC1 input (01): SYNC2 input (10)/(11): HD3/VD3 inputs
- **HD PHASE (HD phase adjustment)**
Adjusts phase of HD output from the sync circuit. The phase of the adjustment center value is the same as that of input H-SYNC or input HD.
(000000): -5% (H periodically)
*(100000): 0%
(111111) : 5%
- **VD1-INV (VD1 output polarity switch)**
Switches VD1 output (pin 22) polarity. When set to 0, negative VD input is output as negative VD. When set to 0, output from the sync circuit is output as negative VD.
*(0): Normal (1): Inverse
- **VD2-INV (VD2 output polarity switch)**
Switches VD2 output (pin 23) polarity. When set to 0, negative VD input is output as negative VD. When set to 0, output from the sync circuit is output as negative VD.
*(0): Normal (1): Inverse

Read Mode

- POR (Power on reset)
 - (0): Status read (at second data read and subsequent)
 - (1): Power on (at first data read)
- HD-IN (Input signal self-check result)
 - Detects HD or H-SYNC input signal selected by INPUT SW.
 - (0): No signal input (1): Signal input
- V FREQ DET (Vertical frequency of SYNC or VD input selected by FREQ DET SW)
 - (0000000)~(0001100): No-VD
 - (0001101): Vicinity of 162 Hz
 - (1111111) : 16.5 Hz

How to calculate vertical frequency (X):

Convert V-FREQ DET read data into decimal and define the resulting value as Y.

Where H-FREQUENCY is 15.75 kHz/31.5 kHz, Z = 476.2 μs

Where H-FREQUENCY is 33.75 kHz/45 kHz, Z = 474.1 μs

$$\text{Vertical frequency (X)} = 1 \div (Y \times Z) \text{ [Hz]}$$

Error of Y is +1, -0. If vertical frequency is 162 Hz or more, the frequency cannot be accurately measured. Time constant used to separate V.SYNC from integrated C.SYNC is 9 μs (error: ±1 μs).

- H FREQ DET (Horizontal frequency of SYNC or HD input selected by FREQ DET SW)
 - (0000000): No signal input (1111111): 53 kHz or more

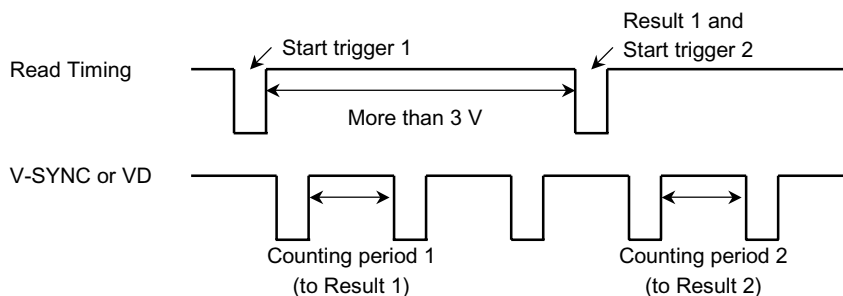
How to calculate horizontal frequency (X):

X, Y, and Z are defined same as for V FREQ.

$$\text{Horizontal frequency (X)} = Y \div (5 \times Z) \text{ [kHz]}$$

Error of Y is +1, -0. If horizontal frequency is 53 kHz or more, the frequency cannot be accurately measured. When V-SYNC or VD is not input, horizontal frequency cannot be measured, resulting in data = (0000000).

Note: Counting horizontal/vertical frequency is triggered by ACK in the second byte in Bus Read mode. Frequency is counted from the first V-SYNC/VD input to the second V-SYNC/VD input. For data to stabilize, interval between bus read must be 3 V or more.

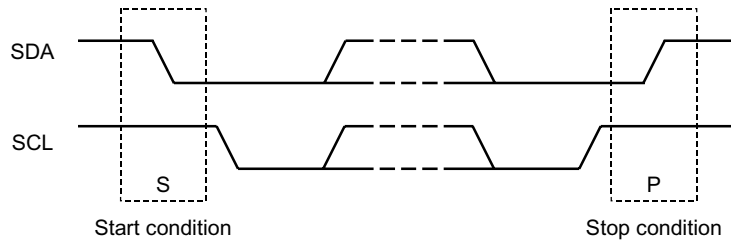


Data Transfer Format via I²C BUS

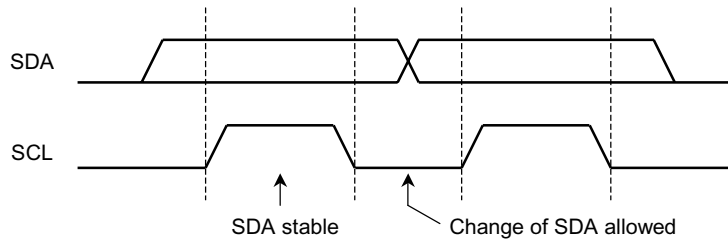
Slave Address: D8/DA/DC_H

A6	A5	A4	A3	A2	A1	A0	W/R
1	1	0	1	1	0/1	0/1	0/1

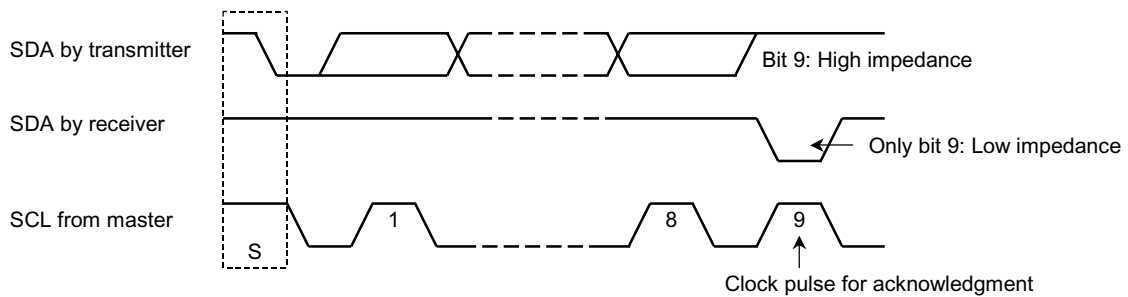
Start and Stop Condition



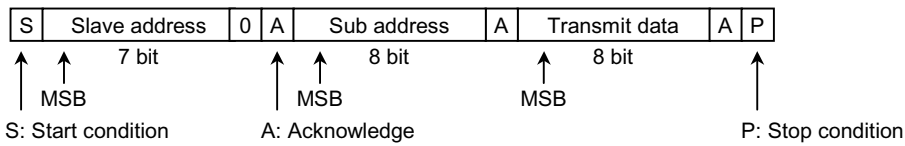
Bit Transfer



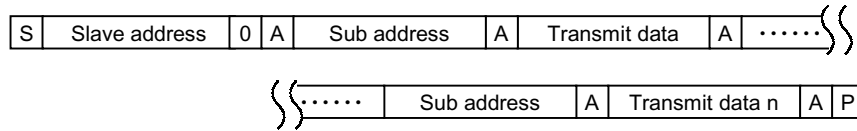
Acknowledge



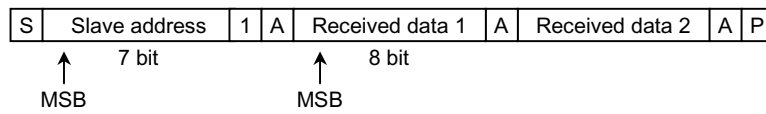
Data Transmit Format 1



Data Transmit Format 2



Data Receive Format



At the moment of the first acknowledge, the master transmitter becomes a master receiver and the slave transmitter. This acknowledge is still generated by this slave.

The Stop condition is generated by the master.

Details are provided in the Philips I²C specifications.

Optional Data Transmit Format: Automatic Increment Mode



In this transmission method, data is set on automatically incremented sub-address from the specified sub-address.

Purchase of TOSHIBA I²C components conveys a license under the Philips I²C Patent Rights to use these components in an I²C system, provided that the system conforms to the I²C Standard Specification as defined by Philips.

Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage	V _{CCmax}	12	V
Input pin signal voltage	e _{inmax}	9	V _{p-p}
Power dissipation	P _D (*1)	1250	mW
Power dissipation reduction rate	1/Q _{ja}	-10	mW/°C
Operating temperature	T _{opr}	-20~65	°C
Storage temperature	T _{stg}	-55~150	°C

Note: Refer to the figure below.

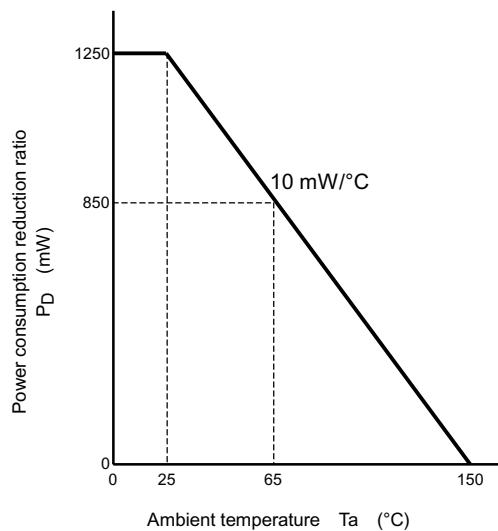


Figure P_D - T_a Curve

Recommended Operating Condition

Characteristics	Description	Min	Typ.	Max	Unit	
Power supply voltage (V _{CC})	Pin 8	8.5	9.0	9.5	V	
HD1, HD2, HD3 Input level	Pin 3, 1, 11	2.0	5.0	9.0	V _{p-p}	
VD1, VD2, VD3 Input level	Pin 4, 2, 10	2.0	5.0	9.0		
SYNC1, SYNC2 Input level	Pin 21, 19, white 100% with negative sync	0.9	1.0	1.1		
HD1, HD2, VD1, VD2-OUT Input current	Pin 13, 15, 22, 23	—	0.9	1.5	mA	
DAC3 Input current	Pin 24	—	0.5	1.0		
Address switching voltage	Pin 18	D8/D9 _H	0	0	1.0	V
		DC/DD _H	8.0	9.0	9.0	

Electrical Characteristics (V_{CC} = 9 V, Ta = 25°C, unless otherwise specified)

Current Dissipation

Pin Name	Symbol	Test Circuit	Min	Typ.	Max	Unit
V _{CC}	I _{CC}	—	32	38	44	mA

AC Characteristics

Horizontal Block

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Sync1/2 input horizontal sync phase	S _{1PH}	—	(Note HA01)	0.6	0.7	0.8	μs
	S _{2PH}	—		0.6	0.7	0.8	
HD3 input horizontal sync phase	HD _{3PH}	—	(Note HA02)	0.6	0.7	0.8	μs
Polarity distinction active range	HD-DUTY1	—	(Note HA03)	61	66	71	%
	HD-DUTY2	—		48	53	58	
Sync1 input threshold amplitude Sync2 input threshold amplitude	V _{thS10}	—	(Note HA04)	0.040	0.070	0.100	V _{p-p}
	V _{thS11}	—		0.060	0.106	0.152	
	V _{thS12}	—		0.081	0.142	0.203	
	V _{thS13}	—		0.102	0.178	0.255	
	V _{thS20}	—		0.040	0.070	0.100	
	V _{thS21}	—		0.060	0.106	0.152	
	V _{thS22}	—		0.081	0.142	0.203	
	V _{thS23}	—		0.102	0.178	0.255	
HD3 input threshold amplitude (Synchronization block)	V _{thHD3}	—	(Note HA05)	0.65	0.75	0.85	V _{p-p}
HD1 input threshold voltage HD2 input threshold voltage HD3 input threshold voltage (SW block)	V _{thHD1}	—	(Note HA06)	0.65	0.75	0.85	V _{p-p}
	V _{thHD2}	—		0.65	0.75	0.85	
	V _{thHD3}	—		0.65	0.75	0.85	
HD output phase adjustment variable range	ΔHP0-	—	(Note HA07)	2.86	3.18	3.49	μs
	ΔHP0+	—		2.86	3.18	3.49	
	ΔHP1-	—		1.43	1.59	1.75	
	ΔHP1+	—		1.43	1.59	1.75	
	ΔHP2-	—		1.33	1.48	1.63	
	ΔHP2+	—		1.33	1.48	1.63	
	ΔHP3-	—		1.00	1.11	1.22	
	ΔHP3+	—		1.00	1.11	1.22	
Clamp pulse phase/width/level	CP _{S0}	—	(Note HA08)	0.85	1.00	1.15	μs
	CP _{W0}	—		0.65	0.80	0.95	
	CP _{V0}	—		4.7	5.0	5.3	V
	CP _{S1}	—		0.35	0.50	0.65	
	CP _{W1}	—		0.65	0.80	0.95	
	CP _{V1}	—		4.7	5.0	5.3	V
	CP _{S3}	—		1.00	—	0	
	CP _{W3}	—		0.50	0.90	1.30	
	CP _{V3}	—		4.7	5.0	5.3	V
Delayed HD pulse width	W _{d-HD}	—	(Note HA09)	1.0	1.2	1.4	μs

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
HD1 output voltage	V13TH0	—	—	4.5	5.0	5.5	V
	V13TL0	—		—	0.1	0.5	
	V13TH1	—		4.5	5.0	5.5	
	V13TL1	—		—	0.1	0.5	
	V13TH2	—		4.5	5.0	5.5	
	V13TL2	—		—	0.1	0.5	
	V13TH3	—		4.5	5.0	5.5	
	V13TL3	—		—	0.1	0.5	
HD2 output voltage	V15TH0	—	—	4.5	5.0	5.5	V
	V15TL0	—		—	0.1	0.5	
	V15TH1	—		4.5	5.0	5.5	
	V15TL1	—		—	0.1	0.5	
	V15TH2	—		4.5	5.0	5.5	
	V15TL2	—		—	0.1	0.5	
	V15TH3	—		4.5	5.0	5.5	
	V15TL3	—		—	0.1	0.5	
HD1 output voltage (polarity inverse)	V13IH0	—	—	4.5	5.0	5.5	V
	V13IL0	—		—	0.1	0.5	
	V13IH1	—		4.5	5.0	5.5	
	V13IL1	—		—	0.1	0.5	
	V13IH2	—		4.5	5.0	5.5	
	V13IL2	—		—	0.1	0.5	
	V13IH3	—		4.5	5.0	5.5	
	V13IL3	—		—	0.1	0.5	
HD2 output voltage (polarity inverse)	V15IH0	—	—	4.5	5.0	5.5	V
	V15IL0	—		—	0.1	0.5	
	V15IH1	—		4.5	5.0	5.5	
	V15IL1	—		—	0.1	0.5	
	V15IH2	—		4.5	5.0	5.5	
	V15IL2	—		—	0.1	0.5	
	V15IH3	—		4.5	5.0	5.5	
	V15IL3	—		—	0.1	0.5	
AFC phase detection current	ID1	—	(Note HB01)	310	385	460	μA
	ID2	—		310	385	460	
	ID3	—		520	650	780	
	ID4	—		520	650	780	
VCO oscillation start voltage	V _{VCO}	—	(Note HB02)	3.9	4.2	4.5	V
HD output pulse width (free-run)	TH00	—	(Note HB03)	1.4	1.8	2.2	μs
	TH01	—		1.4	1.8	2.2	
	TH10	—		1.4	1.8	2.2	
	TH11	—		1.4	1.8	2.2	

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Horizontal free-run frequency	F00	—	(Note HB04)	15.59	15.75	15.91	kHz
	F01	—		31.19	31.5	31.82	
	F10	—		33.41	33.75	34.09	
	F11	—		44.55	45	45.45	
	F50	—		15.47	15.625	15.78	
Horizontal oscillation control sensitivity	BH00	—	(Note HB05)	24	30	36	kHz/V
	BH01	—		48	60	72	
	BH10	—		48	60	72	
	BH10	—		71	89	107	
DAC1 output voltage	VDAC ₁₀	—	—	0.5	1.0	1.5	V
	VDAC ₁₁	—		2.7	3.0	3.3	
	VDAC ₁₂	—		4.7	5.0	5.3	
	VDAC ₁₃	—		6.5	7.0	7.5	
DAC2 output voltage	VDAC ₂₀	—	—	0.5	1.0	1.5	V
	VDAC ₂₁	—		2.7	3.0	3.3	
	VDAC ₂₂	—		4.7	5.0	5.3	
	VDAC ₂₃	—		6.5	7.0	7.5	
DAC3 output voltage	VDAC ₃₀	—	—	0.3	0.5	0.7	V
	VDAC ₃₁	—		8.5	8.8	9.0	

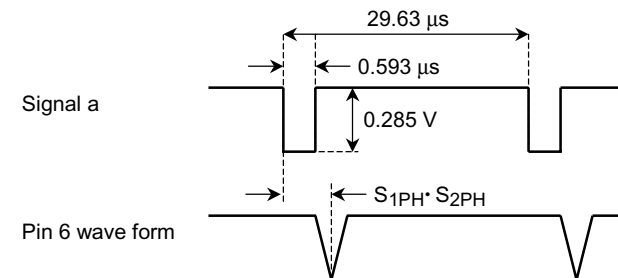
Vertical Block

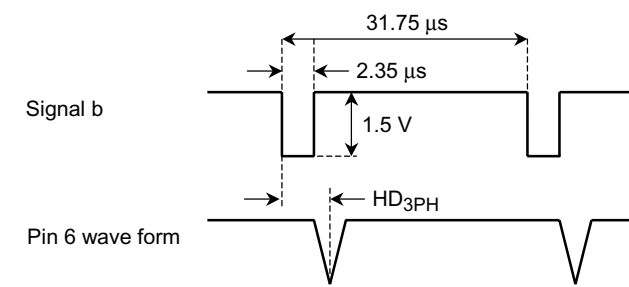
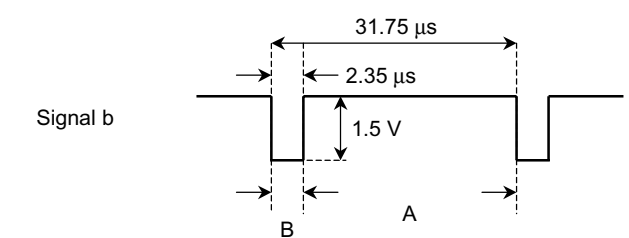
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
VD1 input threshold voltage VD2 input threshold voltage VD3 input threshold voltage (SW block)	V _{th} VD1	—	(Note VA01)	0.65	0.75	0.85	V _{p-p}
	V _{th} VD2	—		0.65	0.75	0.85	
	V _{th} VD3	—		0.65	0.75	0.85	
VD3 input threshold voltage (synchronization block)	V _{th} VD3	—	(Note VA02)	0.65	0.75	0.85	V _{p-p}
VD1 output voltage	V22TH0	—	—	4.5	5.0	5.5	V
	V22TL0	—		—	0.1	0.5	
	V22TH1	—		4.5	5.0	5.5	
	V22TL1	—		—	0.1	0.5	
	V22TH2	—		4.5	5.0	5.5	
	V22TL2	—		—	0.1	0.5	
	V22TH3	—		4.5	5.0	5.5	
VD2 output voltage	V23TH0	—	—	4.5	5.0	5.5	V
	V23TL0	—		—	0.1	0.5	
	V23TH1	—		4.5	5.0	5.5	
	V23TL1	—		—	0.1	0.5	
	V23TH2	—		4.5	5.0	5.5	
	V23TL2	—		—	0.1	0.5	
	V23TH3	—		4.5	5.0	5.5	
VD1 output voltage (polarity inverse)	V22IH0	—	—	4.5	5.0	5.5	V
	V22IL0	—		—	0.1	0.5	
	V22IH1	—		4.5	5.0	5.5	
	V22IL1	—		—	0.1	0.5	
	V22IH2	—		4.5	5.0	5.5	
	V22IL2	—		—	0.1	0.5	
	V22IH3	—		4.5	5.0	5.5	
VD2 output voltage (polarity inverse)	V23IH0	—	—	4.5	5.0	5.5	V
	V23IL0	—		—	0.1	0.5	
	V23IH1	—		4.5	5.0	5.5	
	V23IL1	—		—	0.1	0.5	
	V23IH2	—		4.5	5.0	5.5	
	V23IL2	—		—	0.1	0.5	
	V23IH3	—		4.5	5.0	5.5	
Vertical output pulse width	VP _{W0}	—	(Note VA03)	251	286	321	μs
	VP _{W1}	—		126	143	160	
	VP _{W2}	—		117	133	150	
	VP _{W3}	—		88	100	112	

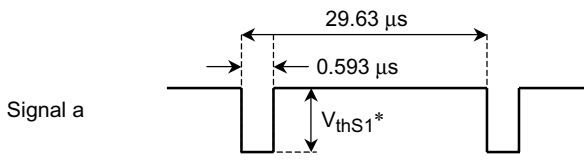
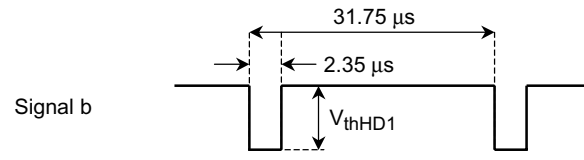
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Vertical free-run frequency	FV0	—	(Note VA04)	26.02	26.35	26.67	Hz
	FV1	—		39.21	39.75	40.30	
	FV3	—		52.20	52.98	53.77	
	FV4	—		54.24	55.06	55.89	
	FV5	—		91.28	92.98	94.69	
	FV6	—		107.8	109.9	112.1	
	FV20	—		57.0	60.0	63.0	
	FV21	—		57.0	60.0	63.0	
	FV22	—		57.0	60.0	63.0	
	FV23	—		57.0	60.0	63.0	
Vertical pull-in range	FVPL0	—	(Note VA05)	311	321	332	Hz
	FVPL1	—		624	643	663	
	FVPL2	—		668	689	710	
	FVPL3	—		891	918	947	
Sync input-VD output phase difference	15.75 kHz	—	—	9.6	11.8	14.0	μs
	31.50 kHz	—		5.7	6.8	7.9	
	33.75 kHz	—		5.3	6.4	7.5	
	45.00 kHz	—		4.4	5.2	6.0	

Test Conditions and Measuring Method

Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
HA01	Sync1/2 input horizontal sync phase	c	b	a ↓ b	b ↓ a	<p>(1) Set sub-address (02) 60.</p> <p>(2) SW19-a and SW21-b.</p> <p>(3) Input Signal a (horizontal 33.75 kHz) to pin 21 (SYNC1-IN).</p> <p>(4) Set sub-address (02) 61.</p> <p>(5) Measure the phase difference S_{1PH} between pin 21 and pin 6 (AFC filter) wave form.</p> <p>(6) SW19-b and SW21-a.</p> <p>(7) Input Signal a (33.75 kHz) to pin 19 (SYNC2-IN).</p> <p>(8) Set sub-address (02) 01.</p> <p>(9) Measure the phase difference S_{2PH} between pin 19 and pin 6 (AFC filter) wave form.</p>

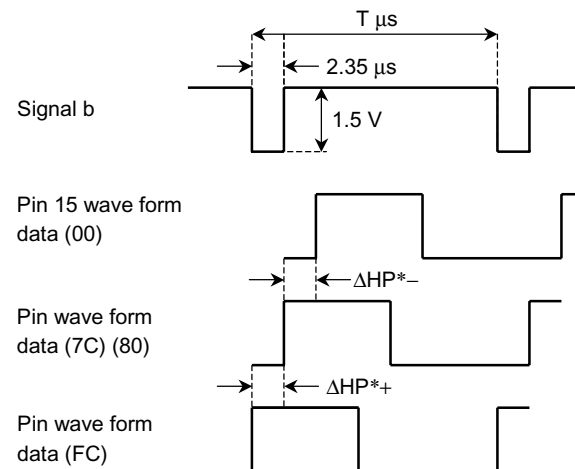


Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
HA02	HD3 input horizontal sync phase	c	b	—	—	<p>(1) Set sub-address (00) 40 and (02) 82.</p> <p>(2) Input signal b (horizontal 31.5 kHz) to pin 11 (HD3-IN).</p> <p>(3) Measure the phase difference HD_{3PH} between pin 11 and pin 6 (AFC filter) wave form.</p> 
HA03	Polarity distinction active range	c	b	—	—	<p>(1) Set sub-address (00) 70 and (02) 82.</p> <p>(2) Input signal b ((horizontal 31.5 kHz) to pin 11 (HD3-IN).</p> <p>(3) Decreasing the duty of signal b to 0% (get negative period shorter), measure the duty of Signal b ($HD-DUTY1$) when the phase between pin 11 and pin 13 ($HD1-OUT$) change.</p> <p>(4) Increasing the duty of Signal b to 100% (get negative period longer), measure the duty of Signal b ($HD-DUTY2$) when the phase between pin 11 and pin 13 ($HD1OUT$) change.</p>  <p style="text-align: center;">* duty = $A/(A + B) \times 100$ (%)</p>

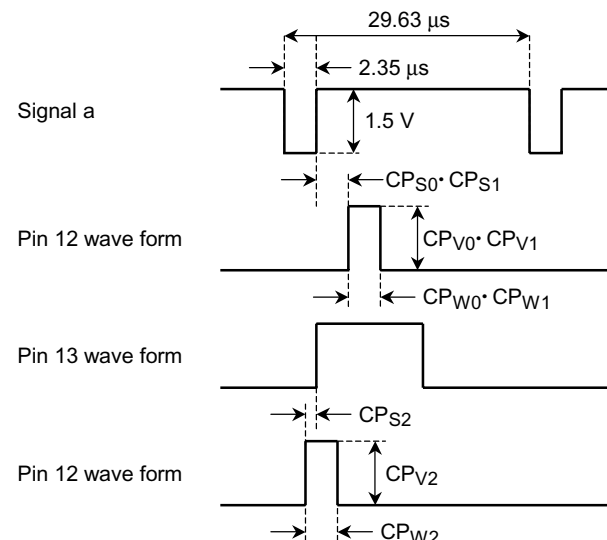
Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
HA04	Sync1 input threshold amplitude Sync2 input threshold amplitude	c	b	a ↓ b	b ↓ a	<p>(1) Set sub-address (00) 0B and (02) 60.</p> <p>(2) Input Signal a (33.75 kHz) to pin 21 (SYNC1-IN)</p> <p>(3) Increasing the voltage of signal a from 0 V, measure the voltage of Signal a V_{thS10} when HD-OUT lock.</p> <p>(4) Set sub-address (00) B1, B2, B3 and (02) 60. Increasing the voltage of Signal a from 0 V, measure V_{thS11}, V_{thS12}, V_{thS13} when HD1-OUT lock.</p> <p>(5) Measure the voltage of pin 19 (SYNC2-IN) V_{thS20}, V_{thS21}, V_{thS22} or V_{thS23} as well.</p> 
HA05	HD3 input threshold amplitude (synchronization block)	c	b	—	—	<p>(1) Set sub-address (00) 70 and (02) 62.</p> <p>(2) Input Signal b (31.5 kHz) to pin 11 (HD3-IN).</p> <p>(3) Increasing the voltage of Signal b from 0 V, measure the voltage of Signal b V_{thHD3} when HD1-OUT lock.</p> 

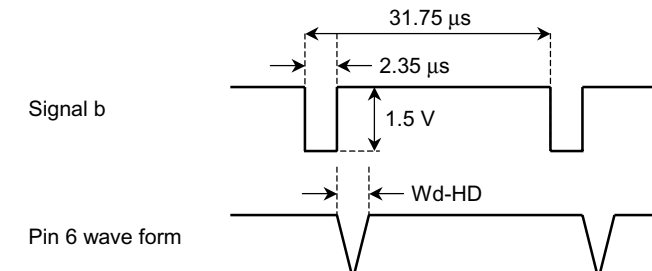
Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
HA06	HD1 input threshold voltage HD2 input threshold voltage HD3 input threshold voltage (SW block)	c	b	—	—	<p>(1) Set sub-address (00) 40.</p> <p>(2) Input Signal b (31.5 kHz) to pin 3 (HD1-IN).</p> <p>(3) Increasing the voltage of Signal b from 0 V, measure the voltage of Signal b V_{thHD1} when HD1-OUT lock.</p> <p>(4) Measure the voltage of pin 1 V_{thHD2}. Measure the voltage of pin 11 V_{thHD3} as well.</p> <div style="text-align: center;"> <p>Signal b</p> </div>

Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
HA07	HD output phase adjustment variable range	c	b	—	—	<p>(1) Set sub-address (00) 30.</p> <p>(2) Input Signal b (horizontal period $T = 63.5\ \mu\text{s}$) to pin 11 (HD3-IN).</p> <p>(3) Set sub-address (02) 02.</p> <p>(4) Change form 00 to 7C sub-address (03), then measure the phase change quantity ($\Delta\text{HP}0-$) of pin 13 (HD1-OUT) wave form.</p> <p>(5) Change form 80 to FC sub-address (03), then measure the phase change quantity ($\Delta\text{HP}0+$) of pin 13 (HD1-OUT) wave form.</p> <p>(6) When horizontal period of Signal b is $T = 31.75\ \mu\text{s}$ measure $\Delta\text{HP}1-$ and $\Delta\text{HP}1+$ as well.</p> <p>(7) When horizontal period of Signal b is $T = 29.63\ \mu\text{s}$ measure $\Delta\text{HP}2-$ and $\Delta\text{HP}2+$ as well.</p> <p>(8) When horizontal period of Signal b is $T = 22.22\ \mu\text{s}$ measure $\Delta\text{HP}3-$ and $\Delta\text{HP}3+$ as well.</p>

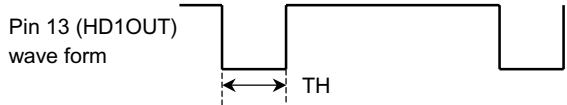


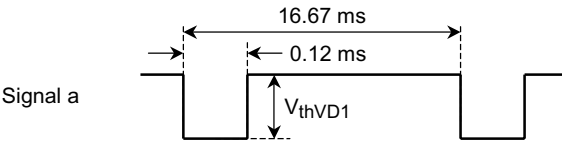
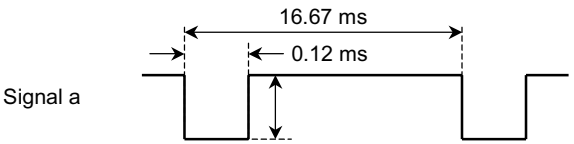
Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
HA08	Clamp pulse phase/width/level	c	b	—	—	<p>(1) Set sub-address (00) B0.</p> <p>(2) Input Signal a (horizontal 33.75 kHz) to pin 11 (HD3-IN).</p> <p>(3) Set sub-address (02) 02.</p> <p>(4) Measure the clamp pulse phase (CP_{S0}), width (CP_{W0}), output level (CP_{V0}) of pin 12 (CLP-OUT) against Signal a.</p> <p>(5) Set sub-address (02) 12.</p> <p>(6) Measure the clamp pulse phase (CP_{S1}), width (CP_{W1}), output level (CP_{V1}) of pin 12 (SCP-OUT) against Signal a.</p> <p>(7) Input no-signal to pin 11.</p> <p>(8) Measure the clamp pulse phase (CP_{S2}), width (CP_{W2}), output level (CP_{V2}) of pin 12 (SCP-OUT) against pin 13 (HD-OUT).</p>



Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
HA09	Delayed HD pulse width	c	b	—	—	<p>(1) Set sub-address (00) 70. (2) Input Signal b (horizontal 31.5 kHz) to pin 11 (HD3-IN). (3) Set sub-address (02) 62. (4) Measure the pulse width (WdHD) of pin 6 (AFC filter) wave form.</p> 

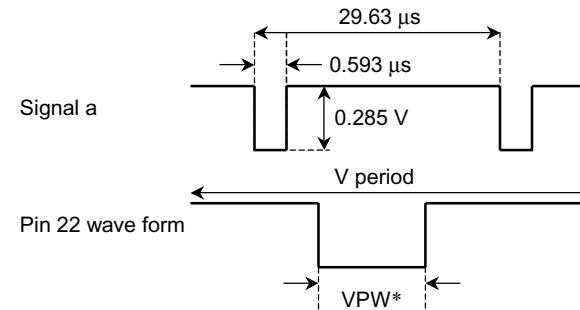
Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
HB01	AFC phase detection current	OPEN	b	a	b	<p>(1) BUS control data preset.</p> <p>(2) Horizontal oscillation frequency is 15.75 kHz (00).</p> <p>(3) SW6 open. Measure the Voltage of pin 6 V6 (no external supply).</p> <p>(4) Connect external supply with pin 6, and supply the voltage (V6).</p> <p>(5) Input signal (below figure) to pin 21 (SYNC1-IN). When INPUT SW is SYNC1-IN, measure V1 and V2 of pin 6 wave form.</p> <p>(6) Supply $V6 - 0.1\text{ V}$ and $V6 + 0.1\text{ V}$ to pin 6, then measure V3 and V4.</p> <p>(7) Calculate by following equations.</p> $ID1 [\mu\text{A}] = (V1 [\text{V}] + 1 [\text{k}\Omega]) \times 1000$ $ID2 [\mu\text{A}] = (V2 [\text{V}] + 1 [\text{k}\Omega]) \times 1000$ $ID3 [\mu\text{A}] = (V3 [\text{V}] + 1 [\text{k}\Omega]) \times 1000$ $ID4 [\mu\text{A}] = (V4 [\text{V}] + 1 [\text{k}\Omega]) \times 1000$
						<p>Pin 21 wave form</p> <p>Pin 6 wave form</p> <p>63.5 μs</p> <p>0.25 V</p> <p>V1, V3</p> <p>V2, V4</p>
HB02	VCO oscillation start voltage	—	—	—	—	<p>(1) Increasing the voltage of pin 8 V_{CC} form 2.5V, measure the voltage V_{VCO} when pin 7 appear oscillation wave form.</p>

Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
HB03	HD output pulse width (free-run)	c	b	—	—	(1) BUS control data preset. (2) When horizontal oscillation frequency is 15.75 kHz (00), measure the output pulse width TH00 of pin 13 (HD1-OUT) wave form. (3) When horizontal oscillation frequency is 31.5 kHz (01), 33.75 kHz (10), 45 kHz (11), measure the output pulse width TH01, TH02, TH03 as well. <div style="text-align: center;">  <p>Pin 13 (HD1OUT) wave form</p> </div>
HB04	Horizontal free-run frequency	OPEN	b	—	—	(1) BUS control data preset. (2) SW6 open. When horizontal oscillation frequency is 15.75 kHz (00), measure the oscillation frequency F00 of pin 13 (HD1-OUT) wave form. (3) When horizontal oscillation frequency is 31.5 kHz (01), 33.75 kHz (10), 45 kHz (11), measure the oscillation frequency F01, F10, F11 as well. (4) When horizontal oscillation frequency is 15.75 kHz (00) and vertical free-run frequency is (101), measure the oscillation frequency F50 of pin 15 wave form.
HB05	Horizontal oscillation control sensitivity	OPEN	b	—	—	(1) BUS control data preset. (2) SW6 open. (3) Connect external voltage with pin 6 . Horizontal oscillation frequency is 15.75 kHz (00). Supply V_6 (about 6.3 V) + 0.05 V or $V_6 - 0.05\text{ V}$ to pin 6, then measure the frequency F_A , F_B of pin 13 (HD1-OUT) wave form. Calculate frequency changing ratio (BH00). $BH00 = (F_B - F_A)/0.1$ (4) When horizontal oscillation frequency is 31.5 kHz (01), 33.75 kHz (10), 45 kHz (11), calculate BH01, BH10, BH11 as wall.

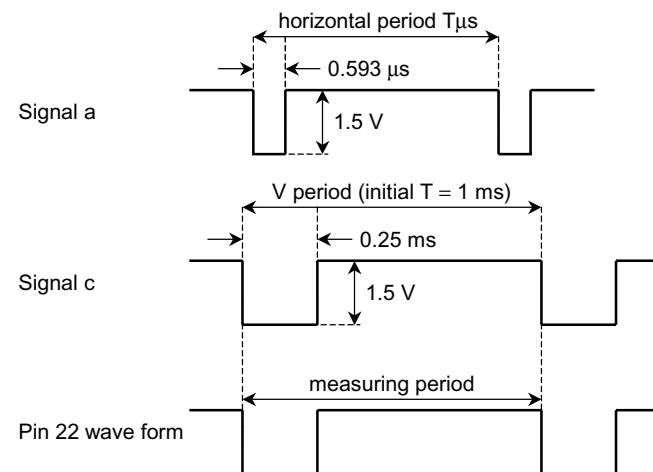
Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
VA01	VD1 input threshold voltage VD2 input threshold voltage VD3 input threshold voltage (SW block)	c	b	—	—	<ol style="list-style-type: none"> (1) Set sub-address (00) 80. (2) Input Signal a (vertical 60 Hz) to pin 4 (VD1-IN). (3) Set sub-address (02) 00. (4) Increasing the voltage of Signal a from 0 V, measure the voltage of Signal b V_{thVD1} when VD1-OUT lock. (5) Measure V_{thVD2} and V_{thVD3} against pin 2 and pin 10 as well. 
VA02	VD3 input threshold voltage (synchronization block)	c	b	—	—	<ol style="list-style-type: none"> (1) Set sub-address (00) 70. (2) Input Signal b (vertical 60 Hz) to pin 10 (VD3-IN). (3) Set sub-address (02) 03. (4) Increasing the voltage of Signal b from 0 V, measure the voltage of Signal a V_{thVD3} when VD1-OUT lock. 

Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
VA03	Vertical output pulse width	c	b	—	—	<p>(1) Input Signal a (horizontal 33.75 kHz) to pin 11 (HD3-IN).</p> <p>(2) Set sub-address (02) 02.</p> <p>(3) When sub-address (00) is B0, measure the pulse width VPW2 of pin 22 (VD1-OUT) wave form.</p> <p>(4) When sub-address (00) is 30, 70, F0, measure the pulse width VPW0, VPW1, VPW3 of pin 22 (VD1-OUT) wave form as well.</p> <div style="text-align: center;"> <p>The diagram shows two waveforms. The top waveform, labeled 'Signal a', is a square wave with a period of 29.63 μs and a pulse width of 0.593 μs. The bottom waveform, labeled 'Pin 22 wave form', is a square wave with a period of V period and a pulse width of VPW*.</p> </div>

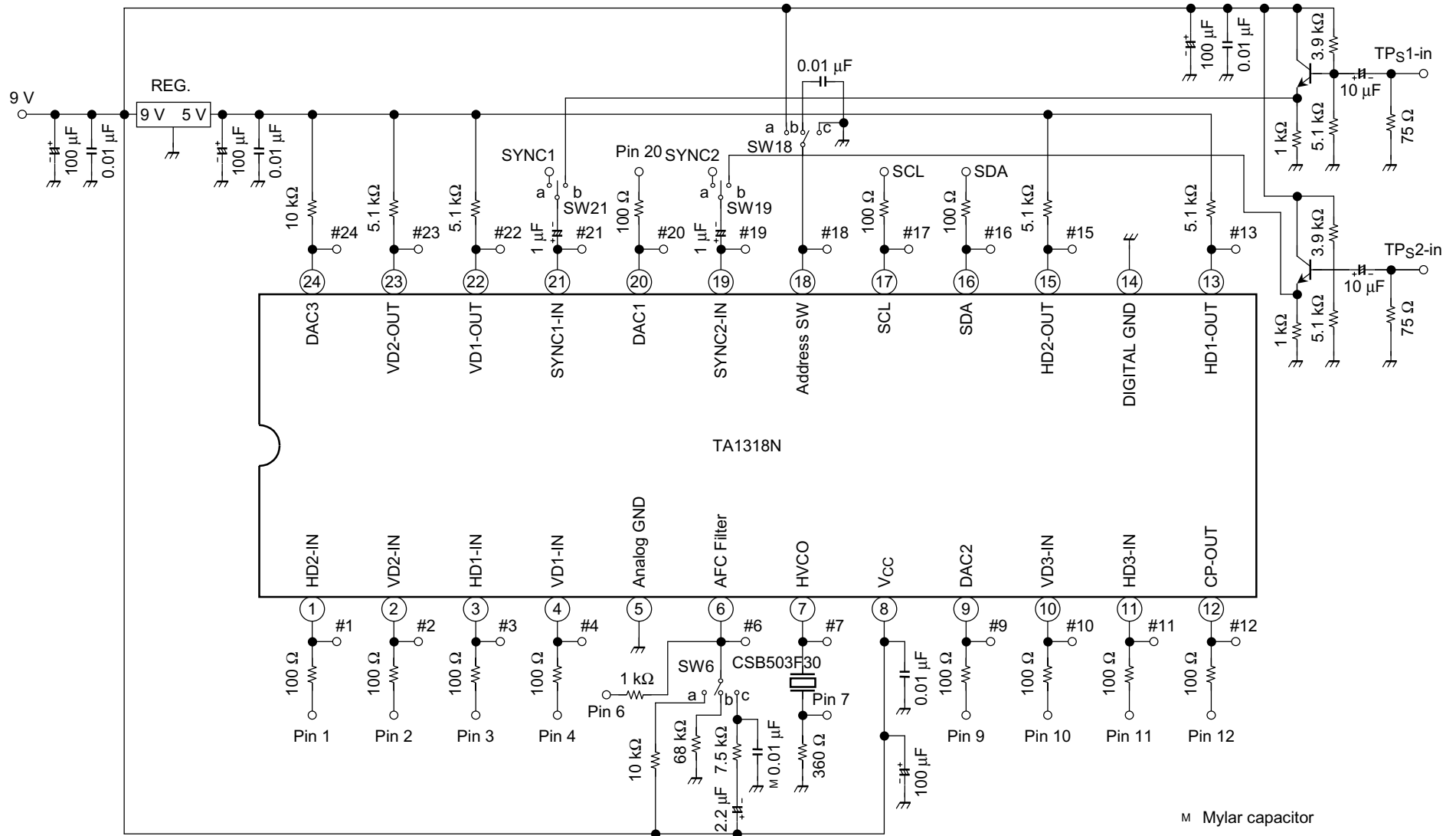
Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
VA04	Vertical free-run frequency	c	b	—	—	<p>(1) Input Signal a (horizontal 33.75 kHz) to pin 11 (HD3-IN).</p> <p>(2) Set sub-address (00) B0.</p> <p>(3) When sub-address (02) is 02, 22, 62, 82, A2 or C2, measure the frequency FV0, FV1, FV3, FV4, FV5 or FV6 of pin 22 (VD1-OUT) wave form.</p> <p>(4) Input no-signal to pin 3 (HD1-IN).</p> <p>(5) Set sub-address (02) 42.</p> <p>(6) When sub-address (00) is 30, 70, B0 or F0, measure the frequency FV20, FV21, FV22 or FV23 of pin 22 (VD1-OUT) wave form.</p>



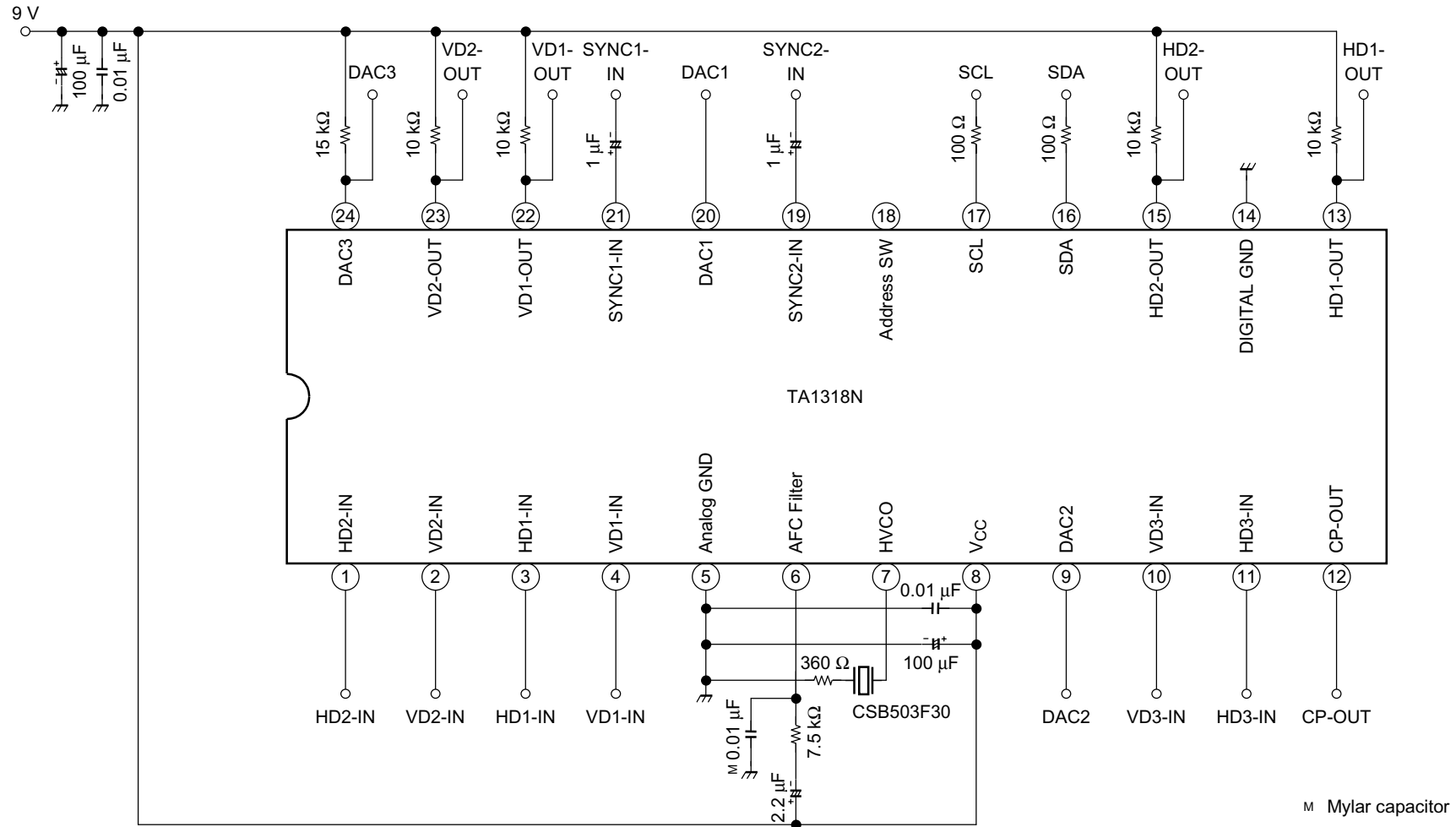
Note	Item	SW Mode				Test Conditions and Measuring Method ($V_{CC} = 9\text{ V}$, $T_a = 25 \pm 3^\circ\text{C}$, unless otherwise specified)
		S06	S18	S19	S21	
VA05	Vertical pull-in range	c	b	—	—	<p>(1) Input Signal a (horizontal period $T = 63.5\ \mu\text{s}$) to pin 11 (HD3-IN).</p> <p>(2) Set sub-address (02) 02.</p> <p>(3) Set sub-address (00) 30.</p> <p>(4) Input Signal C (vertical period initial $T = 1\text{ ms}$) to pin 10 (VD3-IN). Increasing vertical period of Signal C, measure the frequency FVPL0 when pin 22 (VD1-OUT) wave form synchronize with Signal C.</p> <p>(5) Input Signal a (horizontal period $T = 31.75\ \mu\text{s}$) to pin 11 (HD3-IN).</p> <p>(6) Set sub-address (00) 70.</p> <p>(7) Measure FVPL1 as well.</p> <p>(8) Input Signal a (horizontal period $T = 29.63\ \mu\text{s}$) to pin 11 (HD3-IN).</p> <p>(9) Set sub-address (00) B0.</p> <p>(10) Measure FVPL2 as well.</p> <p>(11) Input Signal a (horizontal period $T = 22.22\ \mu\text{s}$) to pin 11 (HD3-IN).</p> <p>(12) Set sub-address (00) F0.</p> <p>(13) Measure FVPL3 as well.</p>



Test Circuit



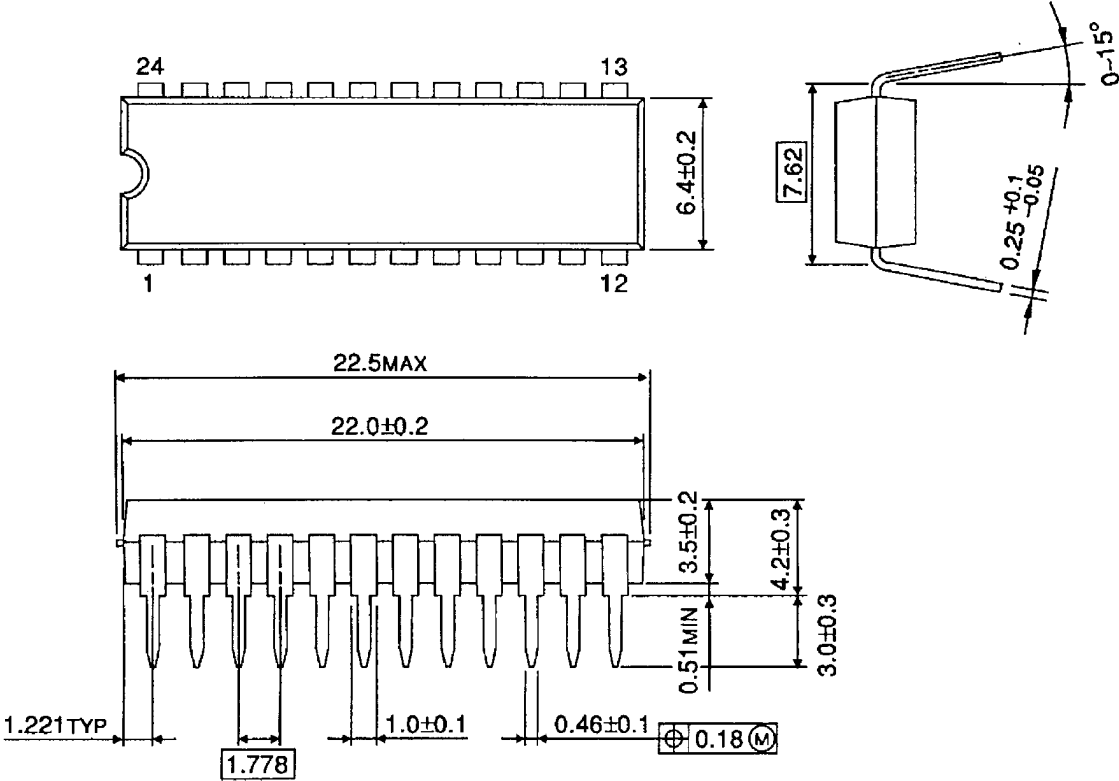
Application Circuit



Package Dimensions

SDIP24-P-300-1.78

Unit : mm



Weight: 1.22 g (typ.)