Specifications (Ver1.3)

Model: MC285SPD-L0B0

Specifications Number : A-205-B112-A

July 2004

Texas Instruments Japan Ltd.

MC285SPD-L0B0 Specifications

1) General Description

The MC285SPD-L0B0 is a CCD camera equipped with a 2/3-inch one million-pixel frame transfer CCD with 12-bit parallel LVDS outputs. It has a variety of functions, such as camera gain, shutter speed and pixel summation, that are programmable through the RS232C.

<table>
<tr><th></th><th colspan="3">MC285SPD-L0B0</th></tr>
<tr><td>Imager</td><td colspan="3">TI's frame transfer CCD TC285SPD</td></tr>
<tr><td>Imager Size</td><td colspan="3">8.0 mm (H) x 8.0 mm (V) 2/3-inch</td></tr>
<tr><td>Effective Pixels</td><td colspan="3">1000(H) x 1000(V)</td></tr>
<tr><td>Pixel Size</td><td colspan="3">8.0 µm Square Lattice</td></tr>
<tr><td>Aspect Ratio</td><td colspan="3">1 : 1</td></tr>
<tr><td>CCD Installed</td><td colspan="3">Standard</td></tr>
<tr><td>Device Operation</td><td colspan="3">Progressive scan (all-pixel-sequential readout)</td></tr>
<tr><td>Lens Mount</td><td colspan="3">C-mount</td></tr>
<tr><td>Flange Back</td><td colspan="3">17.526 mm (Typical)</td></tr>
<tr><td>Video Signal Output</td><td colspan="3">12-bit parallel LVDS RS-644</td></tr>
<tr><td>Video Signal Scanning Method</td><td colspan="3">Progressive</td></tr>
<tr><td>Data Rate</td><td colspan="3">35 MHz</td></tr>
<tr><td>Clocks/H</td><td colspan="3">1140 clk</td></tr>
<tr><td>Horizontal Scan Time (1H)</td><td colspan="3">32.57 µsec.</td></tr>
<tr><td>Horizontal Scan Frequency</td><td colspan="3">30.7 KHz</td></tr>
<tr><td>Horizontal Scan Lines</td><td colspan="3">1024 lines (including 24 lines for blanking)</td></tr>
<tr><td>Effective Horizontal Scan Lines</td><td colspan="3">1000 lines</td></tr>
<tr><td>Vertical Scan Frequency</td><td colspan="3">29.98 Hz</td></tr>
<tr><td>Synchronization</td><td colspan="3">Internal and external (automatically selected)</td></tr>
<tr><td>Gain</td><td colspan="3">Programmable in 256 levels (RS232C control)</td></tr>
<tr><td>Gamma Characteristics</td><td colspan="3">1.0</td></tr>
<tr><td>Electronic Shutter</td><td colspan="3">Programmable in H count 128 levels and V count 128 levels (RS232C control)</td></tr>
<tr><td rowspan="2">Exposure Mode</td><td>Continuous Shutter Mode</td><td colspan="2">External Trigger Shutter (HD/VD Reset Type)</td></tr>
<tr><td>Exposure time is programmable in 256 levels.</td><td>Random Shutter Mode
Exposure time is programmable in 256 levels. Exposure is started with a random trigger signal externally provided.</td><td>VI Mode
Arbitrary exposure time can be specified with the pulse width of a trigger signal externally provided. The VI mode is programmed through the RS232C.</td></tr>
<tr><td>Binning Mode</td><td colspan="3">H (Horizontal) x V (Vertical): 2 x 2 and 4 x 4 (RS232C control)</td></tr>
<tr><td>Averaging Mode</td><td colspan="3">Two, four and eight times (RS232C control)</td></tr>
<tr><td>Cooling</td><td colspan="3">-18 degrees C (For Ambient Temperature of 17 degrees C) *Note 1</td></tr>
<tr><td>Supply Voltage</td><td colspan="3">100 ~ 240V AC</td></tr>
<tr><td>Weight</td><td colspan="3">2.3 kg (Camera) + 1.0 kg (Power Supply)</td></tr>
<tr><td>Color</td><td colspan="3">Chassis: TBD
Body Cover: White
Head: TBD</td></tr>
<tr><td>Dimensions</td><td colspan="3">110.0 x 110.0 x 202.0 mm (camera) (W x H x D)
136.0 x 54.0 x 214.2 mm (Power supply unit) (W x H x D)</td></tr>
<tr><td>Accessories</td><td colspan="3">Power cable 2.5 m</td></tr>
</table>

* Note 1: The CCD uses a 2-stage Peltier cooler which is specified in terms of ambient temperature. The CCD can cool to as much as 35 degrees C below the ambient temperature.

2) Absolute Maximum Ratings (Ta=rated operating condition, unless otherwise specified.)

PARAMETER		MIN	MAX	UNIT	NOTE
Supply Voltage	100 ~ 240V AC	0	240	V	Note 1
Storage Temperature		-25	80	ºC	Note 2
Storage Humidity		35	85	%	Note 2

Note 1: Live insertion/withdrawal of connectors is not supported.

Note 2: No condensation.

3) Rated Operating Conditions (Ta = Rated operating condition, unless otherwise specified.)

PARAMETER		MIN	TYP	MAX	UNIT	NOTE
Supply Voltage	100 ~ 240V AC	100	120	240	V	
Operating Ambient Temperature		17		40	ºC	Note 3

Note 3: Use a cooling fan to maintain stable performance for long time periods if used in an environment such as outdoors, where the temperature may exceed the rated operating condition.

4) Electrical/Optical Characteristics (Ta = Rated operating condition, unless otherwise specified.)

PARAMETER		TEMPERATURE	MIN	TYP	MAX	UNIT	Measurement Conditions*
Sensitivity (Minimum illuminance on the light sensing area)		Ta=25ºC		0.18		Lux	A
S/N Ratio		Ta=25ºC	32			dB	B
Dynamic Range		Ta=25ºC	54			dB	C
Modulation Index	5 MHz	Ta=25ºC	57.5			%	D
	10 MHz	Ta=25ºC	28.0			%	D
Horizontal Resolution		Ta=25ºC		1000		Line	E
Horizontal Resolution		Ta=25ºC		1000		Line	E
H Shading	10% Output	Ta=25ºC		TBD		Count	F
	70% Output	Ta=25ºC			TBD	Count	F
V Shading	10% Output	Ta=25ºC		TBD		Count	F
	70% Output	Ta=25ºC			TBD	Count	F
Power Consumption	100 V/AC			55		VA	G

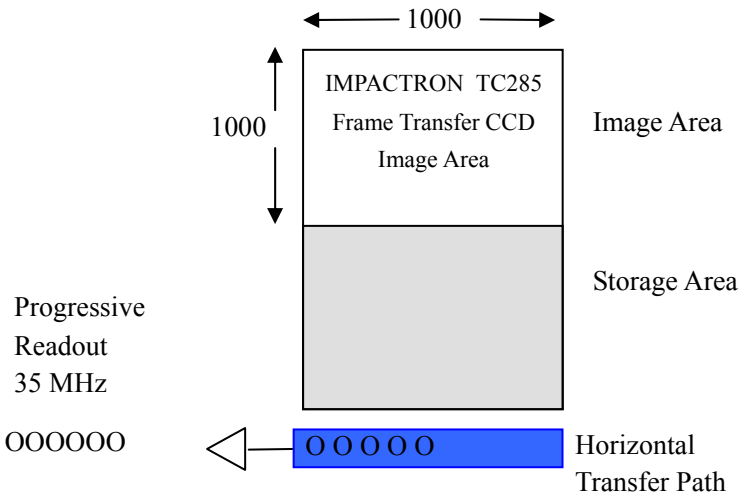
* For measurement conditions, see Appendix at the end of this document.（TBD）

5) Circuit Configuration

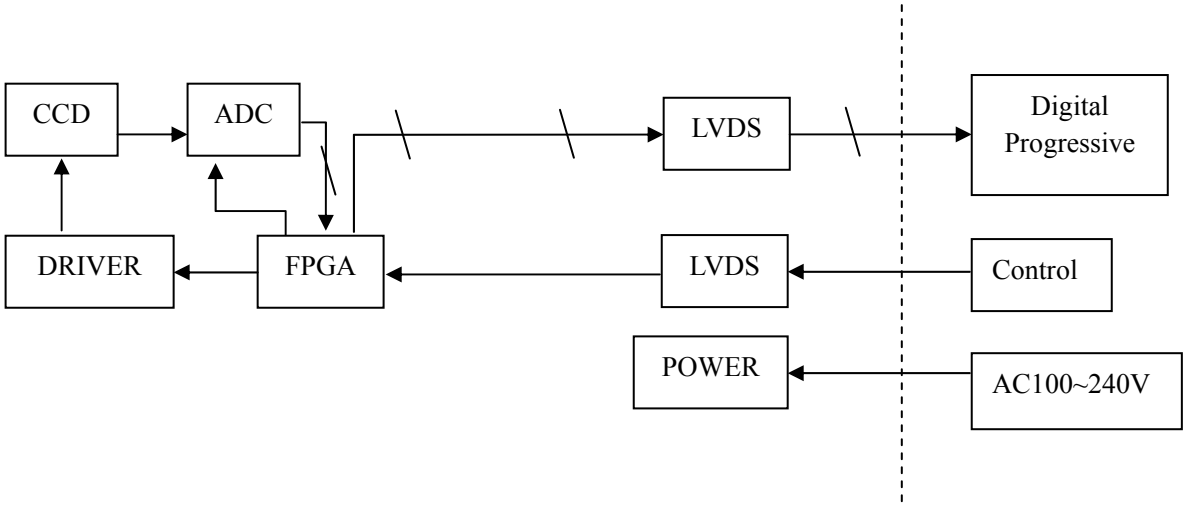
■ CCD Readout Operation

The MC285SPD-L0B0 performs all-pixel-sequential progressive readout operation, in which it uses one CCD output line at a data rate of 35 MHz.

The analog output signal from the CCD is sequentially converted to 12-bit digital data through the AD converter, and then output as LVDS parallel data.



Functional Block Diagram



6) Description of Functions

■ Internal Synchronization and External Synchronization

(1) Internal Synchronization Mode
In this mode, the device operates using internally provided timing.

(2) External Synchronization Mode
In this mode, the device operates using the timing of an external sync signal.
The device automatically switches to the external synchronization mode when an external sync signal (HD/VD) is applied. If no VD input is applied for 2000H or more, the device automatically returns to the internal synchronization mode.

■ Operation Modes

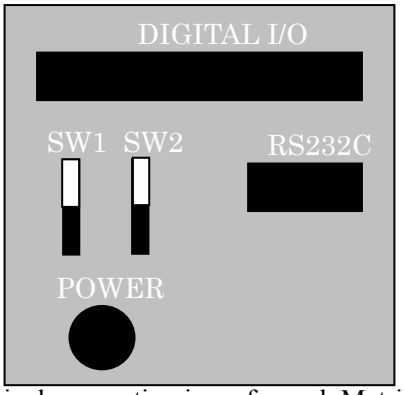
(1) Continuous Shutter Mode
Continuous electronic shutter operation is performed according to the programmed exposure time. The electronic shutter is programmed with an RS232C control command.

(2) Random Shutter Mode
The shutter can be operated at arbitrary timing with a trigger signal (shutter command signal), which is externally provided. When a decreasing slope shutter command signal is detected, the internal synchronization sequence is reset and the programmed electronic shutter operation is performed.

In the random shutter mode, any arbitrary length of time can be specified for the shutter, in addition to the programmable 256 levels of electronic shutter speeds. In this case, by enabling the VI mode first, the duration from the falling slope to the rising slope of the shutter command signal is recognized as the exposure time.
When the random shutter signal is used, do not operate the device in the external synchronization mode.

When using the shutter command input signal, its type (TTL or LVDS) should be specified first.
To specify the type, set the switch SW1 on the back panel to "UP" or "DOWN" position.

SW1	■	Shutter Command TTL
		Shutter Command LVDS
SW2		Not Used



(3) Binning Mode
In this mode, H (Horizontal) x V (Vertical) pixel summation is performed. Matrices of 2 x 2 and 4 x 4 are available. Binning is programmed with an RS232C control command.

(4) Averaging Mode
In this mode, averaging is performed. Two, four and eight times averaging functions are available. Averaging is programmed with an RS232C control command.

■ RS232C Control

Transmission speed: 9600 bps
Transmission mode: Start/stop synchronization
Data Format: Bit Length 8 bits
Stop bit 1 bit
No parity

<RS232C commands>

Command	Values	Function	Description
ga	000-255	CM gain control	256 levels; non-linear control
ss	0-1	Shutter select	0=Short shutter (up to 1010H) 0= Long shutter (up to 128V)
sh	000-127	Shutter speed control	Short: 128 levels (H count) Long: 128 levels (V count)
vi	0-1	VI mode	0=VI mode OFF 1=VI mode ON
bn	0-3	Binning mode	0=No binning 1=2 x 2 2=4 x 4 3=No binning
av	0-3	Averaging (Weighted Summing)	0=No averaging 1=Two times averaging 2=Four times averaging 3=Eight times averaging
fn	0-3	Fan control	0=Fan rotation HIGH 1=Fan rotation LOW 2=Fan rotation OFF 3=Fan rotation OFF
Mode?	None	The current settings of the camera are shown.	None

- Put a comma (,) between the command name and its value.
- Values should be specified in the appropriate number of digits.

Example:

g a , 0 0 5 CR LF

v i , 1 CR LF

m o d e ? CR LF

When a command is successfully transmitted, the device responds with "OK". If a transmitted command is wrong or improperly specified, the device responds with "NG".
Settings programmed through the RS232C remain even after the power is turned off. Reprogramming is not required.

Detailed description of settings

(1) Gain setting: **ga command** 000 to 255

Gain of the Impactron Multiplier is programmable in 256 levels through the RS232C. (However, the programmed value and gain are not guaranteed to be linearly related.)

(2) Electronic shutter speed: **sh command** and **ss command**

The electronic shutter speed is programmable in 128 levels of H counts through the RS232C.

In this case, exposure increases with 1H steps for the values 000 to 007, and with 8H steps for the values 008 to 127 (up to 968H).

The electronic shutter speed is also programmable in V counts by transmitting the SS command with its value set to 1.

Note) If the programmed exposure time is longer than the V (Vertical) cycle, the frame rate depends on the exposure time.

ss command = 0, short exposure (1H is approximately 31.4μsec):

RS232C command	Exposure time	
sh,XXX CRLF	H	msec
000	1	0.03
001	2	0.07
003	3	0.10
:	:	
007	8	0.26
008	16	0.52
009	24	0.78
:	:	:
126	960	31.27
127	968	31.53

ss command = 1, long exposure (1V is approximately 33 msec):

RS232C command	Exposure time	
sh,XXX CRLF	V	msec
000	1	33.35
001	2	67.23
:	:	:
127	128	4335

(3) VI Mode: **vi command**

VI =1 VI (Variable Integration) mode

Exposure starts when the Shutter Command signal is switched from "High" to "Low". The falling slope of this signal serves as the trigger. Exposure time is equal to the time period during which the signal is kept Low.

VI =0 Continuous shutter mode or random shutter mode

(4) Binning mode: **bn command**

Binning provides H (Horizontal) x V (Vertical) pixel summation (2 x 2 and 4 x 4) and is programmable through the RS232C.

RS232C command **bn**, X CRLF	Pixel summation
0	1 x 1
1	2 x 2
2	4 x 4
3	1 x 1

Note 1) As the H cycle is constant in horizontal binning, the same pixel data are continuously output until the binning count is reached.

Note 2) If the programmed exposure time is longer than the programmed vertical lines for binning, the frame rate depends on the exposure time.

(5) Averaging (weighted summing) mode: **av command**

Averaging (recursive filter) provides noise reduction and is programmable through the RS232C.

RS232C command **av**, X CRLF	Averaging
0	No averaging
1	Two times averaging 1/2 + Previous 1/2
2	Four times averaging 1/4 + Previous 3/4
3	Eight times averaging 1/8 + Previous 7/8

(6) Fan control: **fa command**

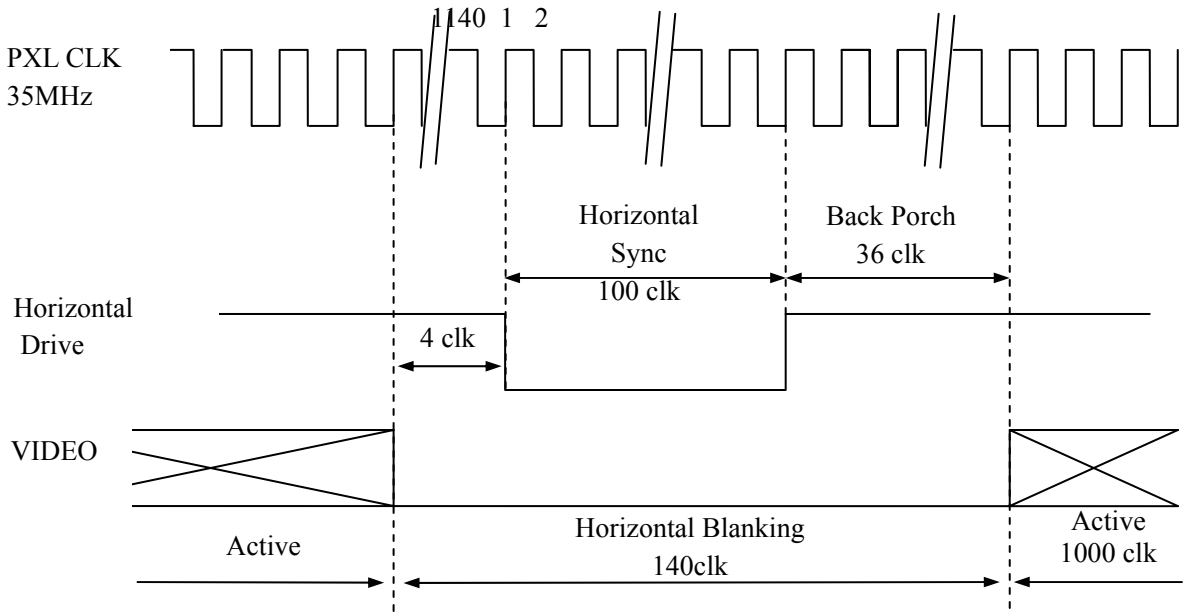
Fan control is programmable through the RS232C.

RS232C command **fa**, X CRLF	Fan control
0	Fan rotation HIGH
1	Fan rotation LOW
2	Fan rotation OFF
3	Fan rotation OFF

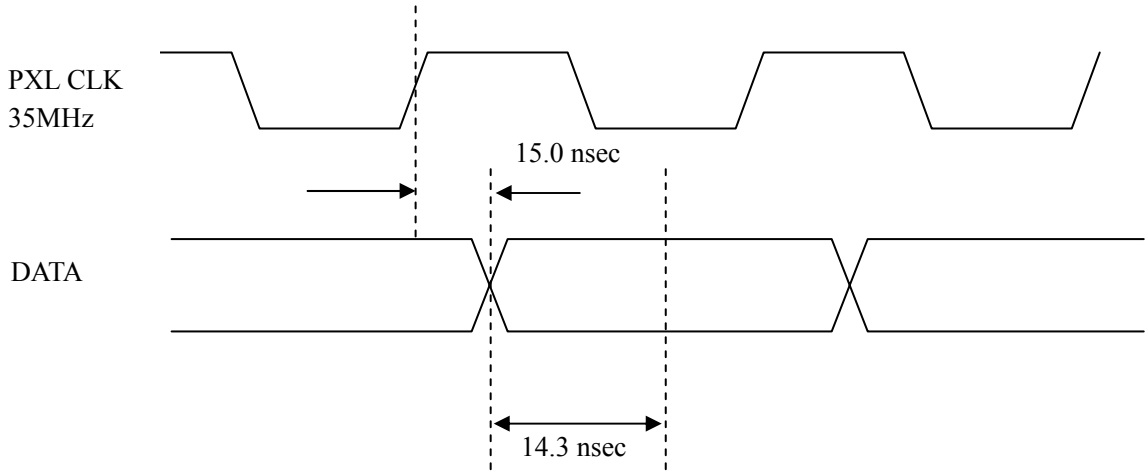
7)Description of Operation

■Timing Diagram

<Digital Video Signal: Horizontal Timing>



<Pixel Clock Timing>



#) The standard clock is 35.0 MHz. This is generated by dividing the base clock of 140.0 MHz by four.

■ Continuous Shutter Mode

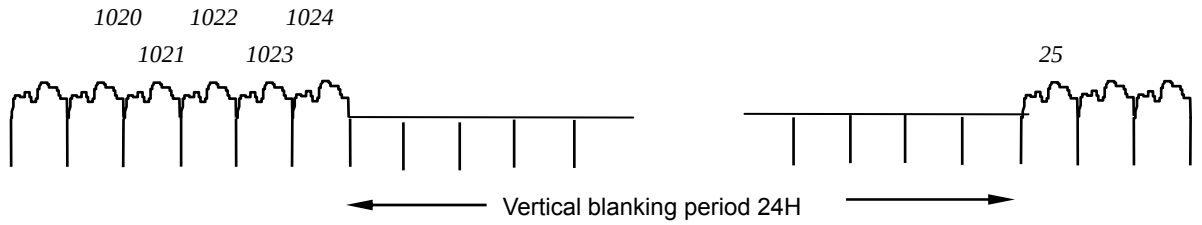
The camera performs continuous exposure and output according to the programmed shutter speed. Exposure time can be monitored using the shutter monitor signal output on #24 and #58 pins.

Note: For #24 and #58 pins, see "Digital Interface Pin Assignment".

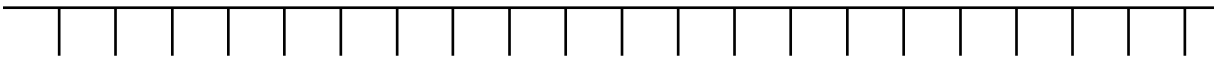
<Timing Diagram of Continuous Shutter Mode Operation>

In case of exposure time = 5H:

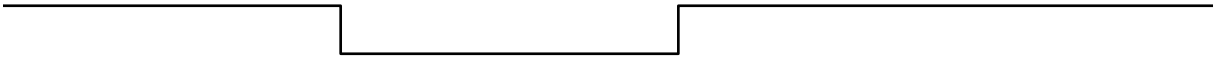
Video Output



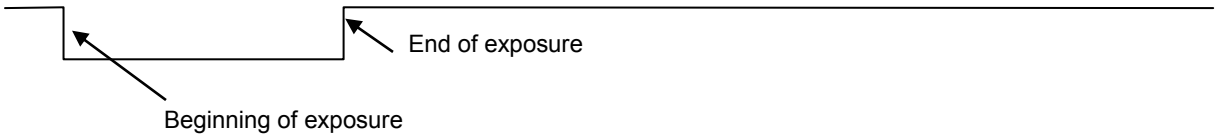
HD Output



VD Output



Shutter Monitor Output (Active LOW)



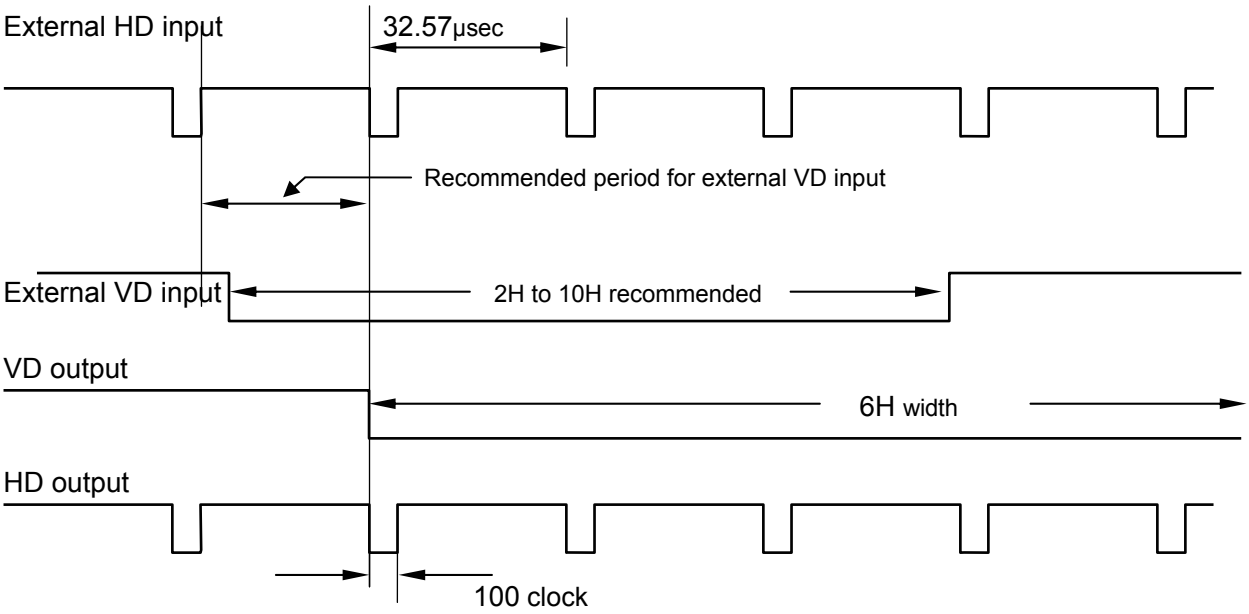
■ External Synchronization

The device automatically switches to external synchronization when an external sync signal (HD/VD) is applied. If no VD input is applied for 2000H or more, the device automatically returns to the internal synchronization mode.

During the external synchronization operation, do not input the shutter command. The external synchronization only works in the continuous shutter mode and should not be used with the binning mode.

CAUTION: The external synchronization input has no windows for noise error protection and is ready to receive signals.

<Timing Diagram of External Synchronization>

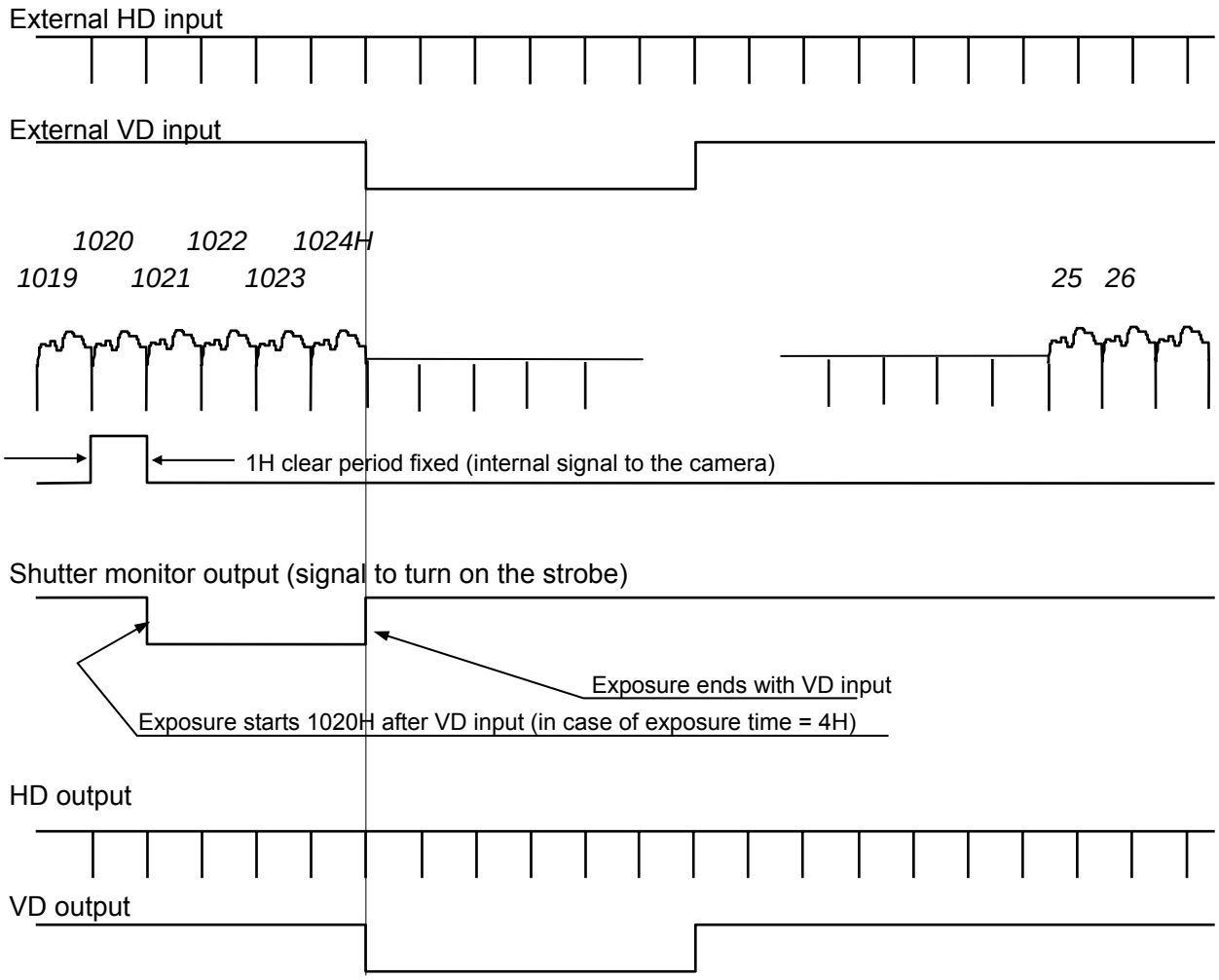


Recommended external HD signal width:	1μsec or more
Recommended external HD frequency:	30.7 KHz
Recommended external VD signal width:	2H to 10H
Recommended external VD frequency:	29.98 Hz

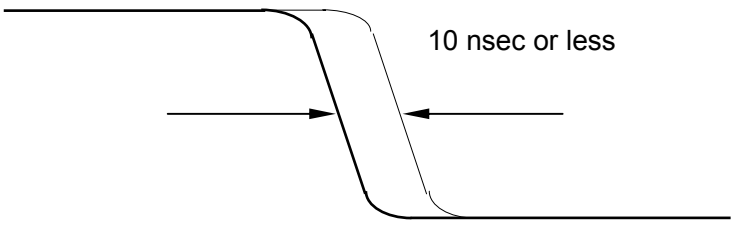
<Overview of exposure timing in external synchronization>

In case of exposure time = 4H:

Note: The position where exposure starts can vary depending on the programmed length of exposure time.



H Drive jitter in external synchronization



■ Random Shutter Mode

Random shutter is a function to control the shutter in an arbitrary timing with the shutter command signal input from the outside of the camera. Images are obtained synchronously with the externally provided shutter command signal.

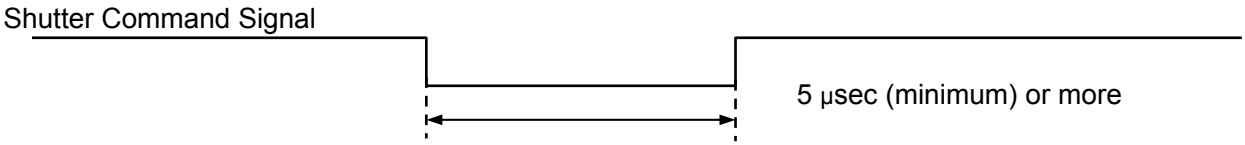
Caution: In the external synchronization mode, do not use the shutter command.

Caution: In the external synchronization mode, do not use the averaging function.

The random shutter operation is performed in the following sequence.

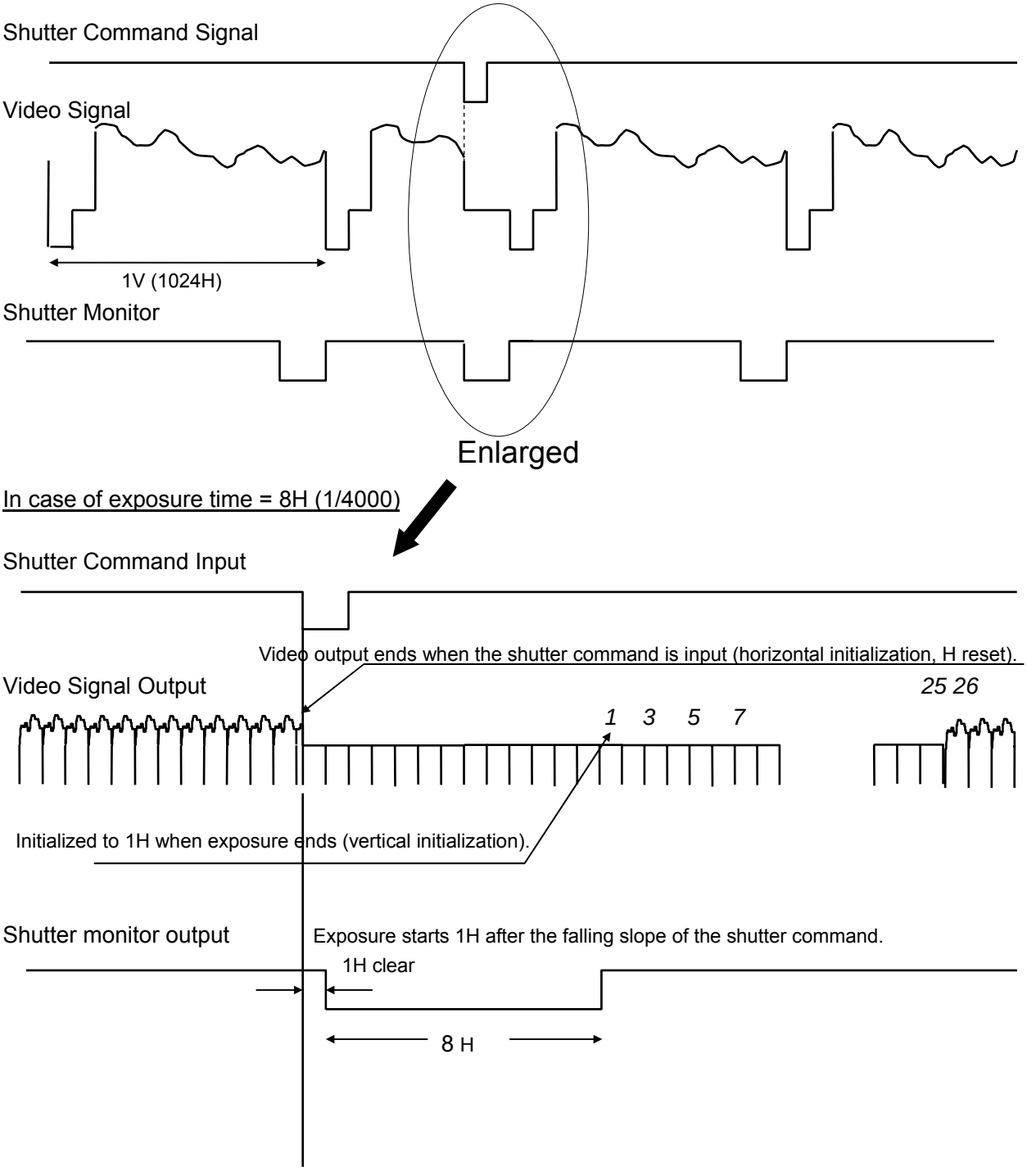
(1) Charge clearing: When the shutter command signal is input, no matter what the state is at that time, the horizontal sync signal is initialized and the video output is forcefully terminated. The accumulated charge on the CCD is swept and cleared by the OFD, and exposure is started 1H (31.4μsec) after the shutter command signal is detected.
(2) Exposure termination: When the time of programmed shutter speed elapses, the charge accumulated in the image area of the CCD is instantly transferred to the storage area and the exposure is terminated.
(3) Video output: The vertical sync of video signal is initialized synchronously with the exposure termination, and active video output is started at 25H of the next new frame.

The shutter command signal for the random shutter (trigger shutter signal input) must have a pulse width of 5μsec or more.



The shutter command signal is LVDS and active LOW.

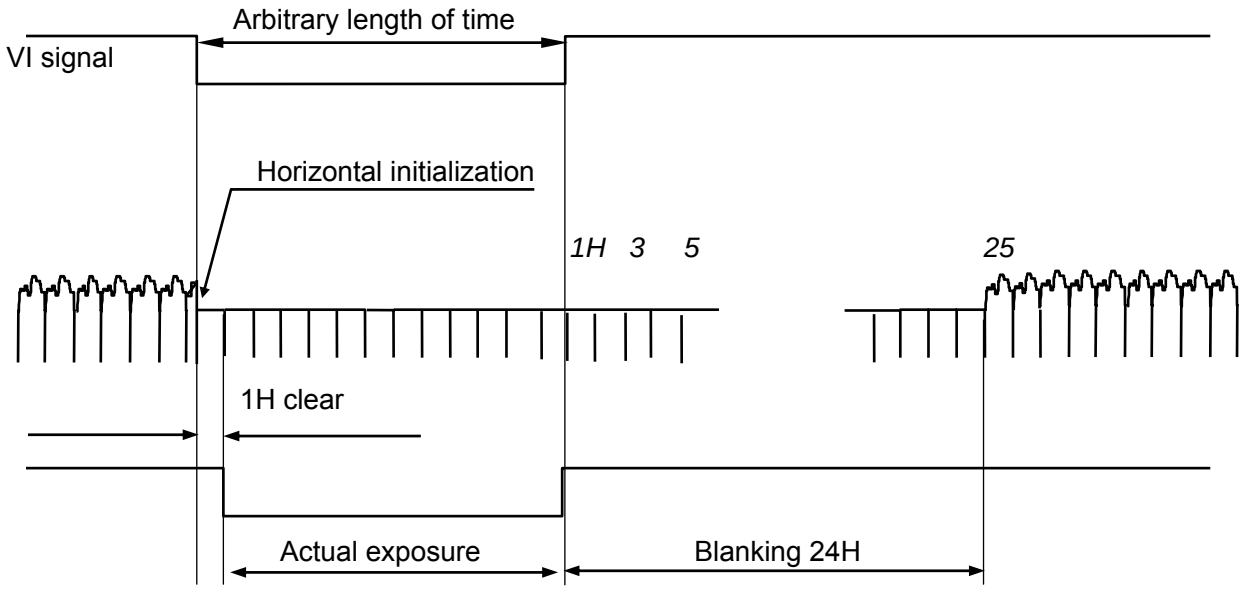
<Timing Diagram of Random Shutter Operation>



■ VI (Variable Integration) mode

In the VI mode, the shutter speed is controlled with the width of an external shutter signal, and any arbitrary length of exposure time can be obtained. To start this mode, transmit the RS232C command VI with its value set to 1.

1. After the RS232C command VI with its value set to 1 is received, the device still operates in the continuous shutter mode.
2. When the shutter command input signal/VI signal (using the same line) become active, the internal HD is reset and actual exposure is started 1H after. At this point, no image is output.
3. The actual exposure is terminated immediately after the rising slope of the signal that indicates the end of exposure. At this point, the vertical sync of video signal is initialized to 1H. After a blanking period of 24H, the captured image is output from 25H. Only one frame is output as an active image.When the entire frame is output, the VI mode returns to the continuous shutter mode.



Note: The minimum exposure time is equal to 32.6μsec (VI signal width is 65.1μsec).
No maximum limit is specified. Under long exposure condition, however, some parameters may not meet the specified performance characteristics.

8) Connectors and Functions

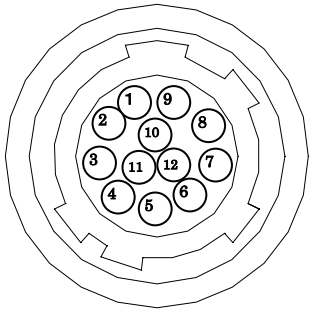
(1) Power Supply Inputs (12-pin):

On the camera: HIROSE ELECTRIC CO., LTD. HR-10A-10R-12PB

On the cable: HIROSE ELECTRIC CO., LTD. HR-10A-10P-12S

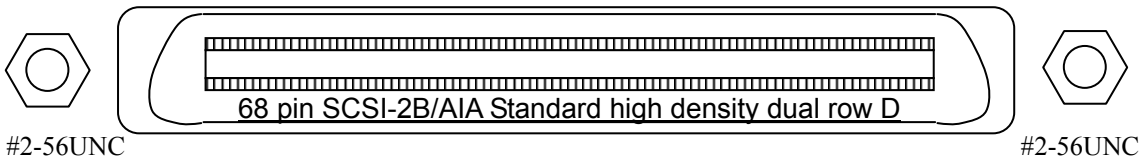
* The cable and the connector on the cable are not included.

PIN#	Input/Output
1	Ground
2	DC +15V
3	Ground
4	DC +27V
5	Ground
6	P-IN
7	P-IN
8	Ground
9	DC -12V
10	Ground
11	DC +15V
12	Ground



(2) Digital Interface

68 pin SCSI-2B/AIA Standard high density dual row D Amphenol G257B-068-2011 or Equivalent (Female)
Connector case fixing screws #2-56UNC



* The cable and the connector on the cable are not included.

<Digital Interface Pin Assignment>

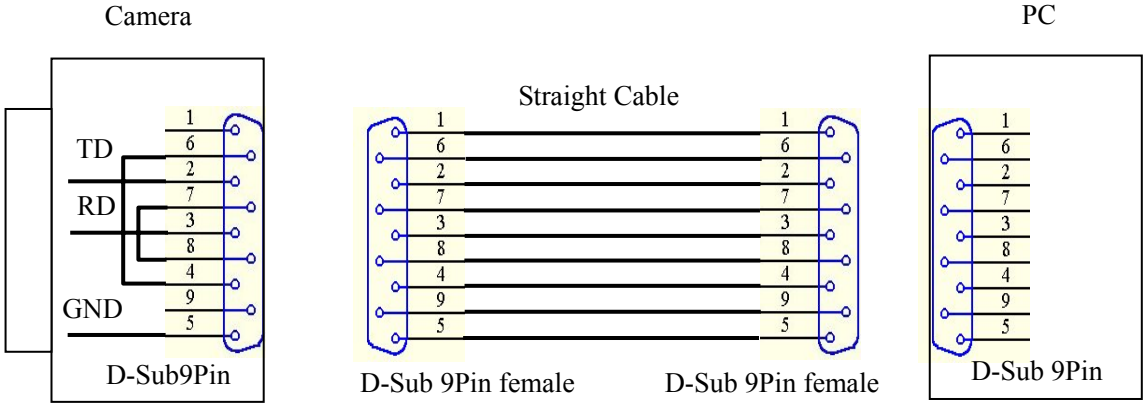
#	PIN NAME	#	PIN NAME
1	Data out 11 + (MSB)	35	Data out 11 - (MSB)
2	Data out 10 +	36	Data out 10 -
3	Data out 09 +	37	Data out 09 -
4	Data out 08 +	38	Data out 08 -
5	Data out 07 +	39	Data out 07 -
6	Data out 06 +	40	Data out 06 -
7	Data out 05 +	41	Data out 05 -
8	Data out 04 +	42	Data out 04 -
9	Data out 03 +	43	Data out 03 -
10	Data out 02 +	44	Data out 02 -
11	Data out 01 +	45	Data out 01 -
12	Data out 00 + (LSB)	46	Data out 00 - (LSB)
13	(Reserved)	47	(Reserved)
14	(Reserved)	48	(Reserved)
15	(Reserved)	49	(Reserved)
16	(Reserved)	50	(Reserved)
17	(Reserved)	51	(Reserved)
18	(Reserved)	52	(Reserved)
19	Shutter command input +	53	Shutter command input -
20	(Reserved)	54	(Reserved)
21	(Reserved)	55	(Reserved)
22	(Reserved)	56	(Reserved)
23	(Reserved)	57	(Reserved)
24	Shutter monitor output +	58	Shutter monitor output -
25	HD output +	59	HD output -
26	VD output +	60	VD output -
27	Clock output +	61	Clock output -
28	HD input +	62	HD input -
29	VD input +	63	VD input -
30	(Reserved)	64	(Reserved)
31	TTL shutter monitor output	65	TTL shutter monitor output RTN
32	(Reserved)	66	(Reserved)
33	TTL shutter command input	67	TTL shutter command RTN
34	(Reserved)	68	(Reserved)

CAUTION: No parts should be connected to pins indicated as "Reserved".

<RS232C Interface Pin Assignment>

RS232C

Camera Side D-Sub 9pin
(Connector case fixing screws #4-40UNC)
* The cable and the connector on the cable are not included.



1	Data carrier detect
2	Transmitted data
3	Received data
4	Data terminal ready
5	GND
6	Data set ready
7	Ready to send
8	Clear to send
9	Ring indicator

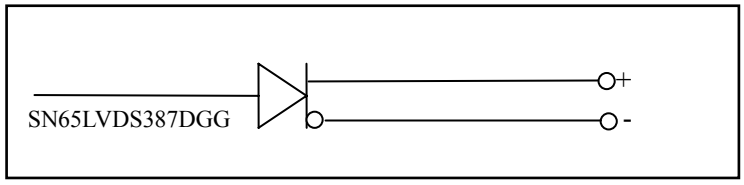
1	Data carrier detect
2	Received data
3	Transmitted data
4	Data terminal ready
5	GND
6	Data set ready
7	Ready to send
8	Clear to send
9	Ring indicator

<Interface Device List>

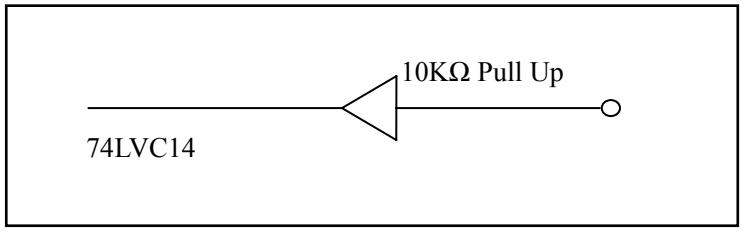
Data output	LVDS	SN65LVDS387DGG	[See Circuit 1]
HD output	LVDS	SN65LVDS387DGG	[See Circuit 1]
VD output	LVDS	SN65LVDS387DGG	[See Circuit 1]
Clock output	LVDS	SN65LVDS387DGG	[See Circuit 1]
Shutter monitor output	LVDS	SN65LVDS387DGG	[See Circuit 1]
TTL shutter command input	LVTTL	SN74LVC14	[See Circuit 2]
HD input	LVDS	SN65LVDT390PW	[See Circuit 3]
VD input	LVDS	SN65LVDT390PW	[See Circuit 3]
Shutter command input	LVDS	SN65LVDS390PW	[See Circuit 3]
TTL shutter monitor output	LVTTL	SN74LVC14	[See Circuit 4]

<Interface Circuits>

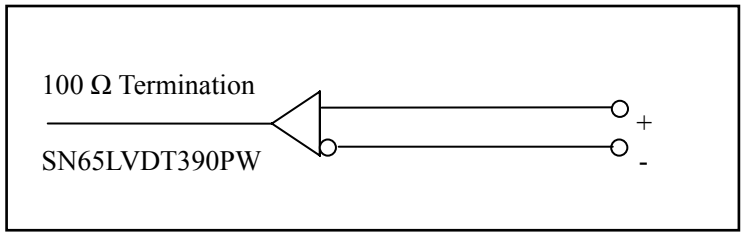
[Circuit 1]



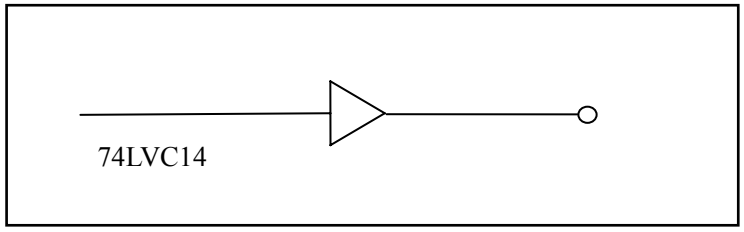
[Circuit 2]



[Circuit 3]

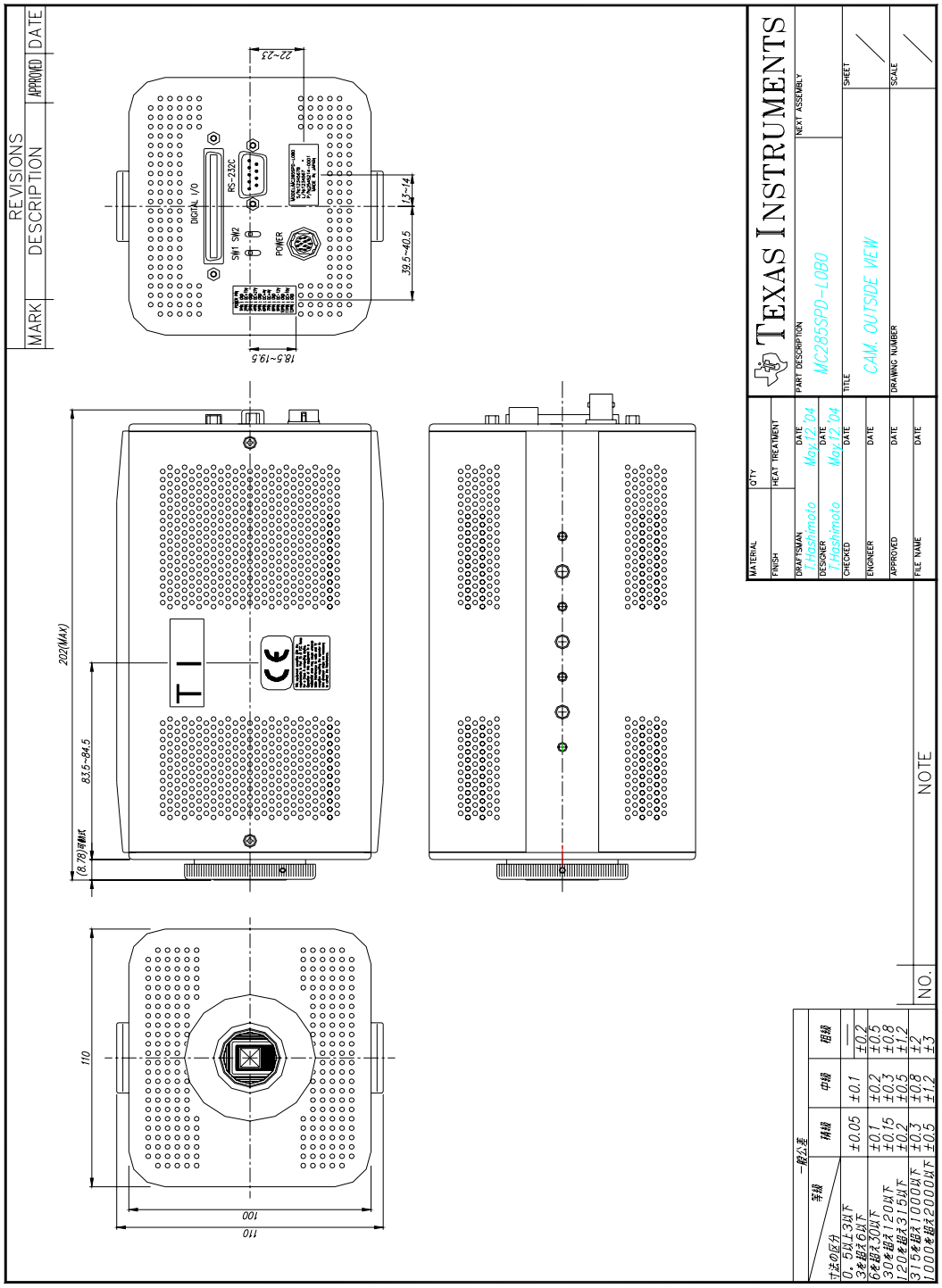


[Circuit 4]

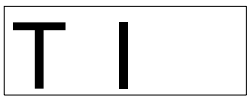


9) External Appearance

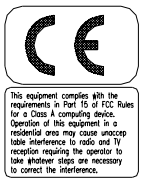
<Camera External Dimensions>



<Trade Name> The trade name and the logo are shown with an incombustible sticker on the side of the camera body.



<CE Mark> The CE mark are shown with an incombustible sticker on the side of the camera body.



<Product Model> The product model and the serial number are shown with an incombustible sticker on the top rear of the camera body.

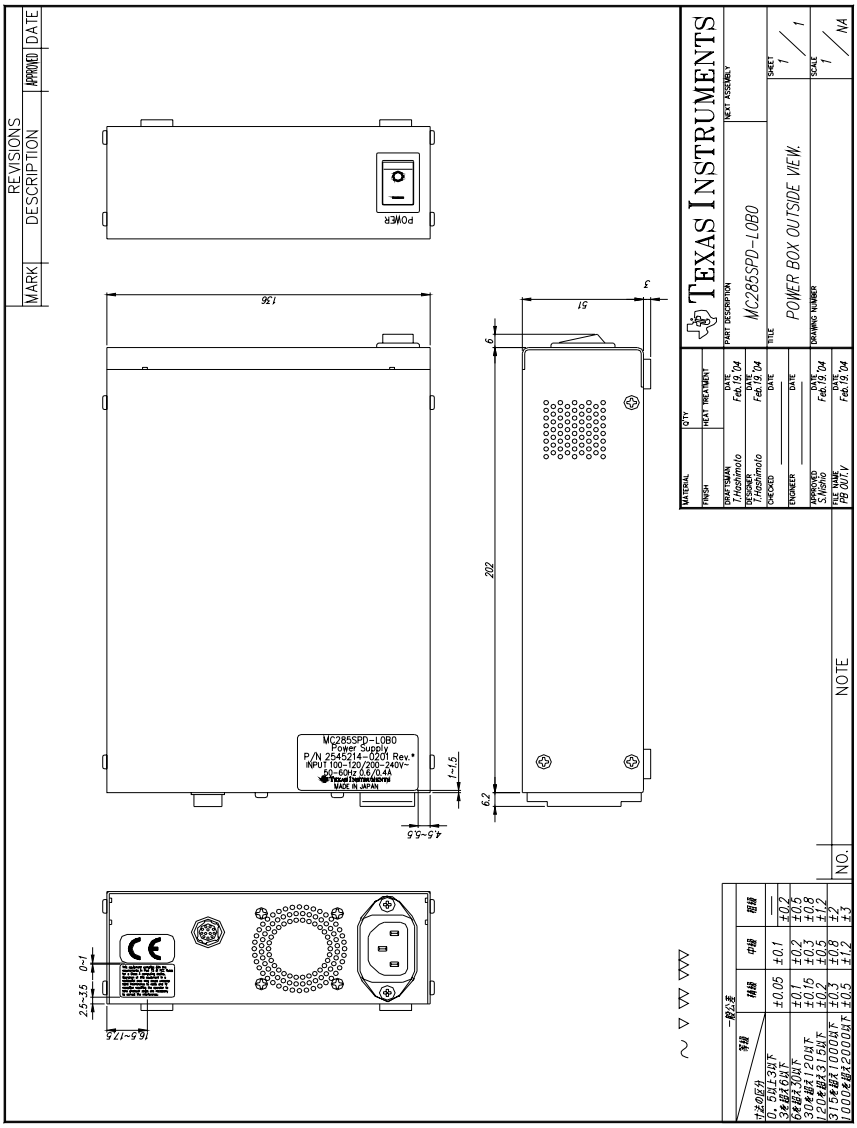
(1)	MODEL: MC285SPD-L0B0
(2)	S/N: 12345678
(3)	L/N: 1234567___xx
(4)	P/N: 123456789012
	MADE IN JAPAN

(1) MODEL: Name of the product
(2) S/N: Serial number
(3) L/N: Lot number
(4) P/N: Part number
* (3) and (4) are used for TI's production control.

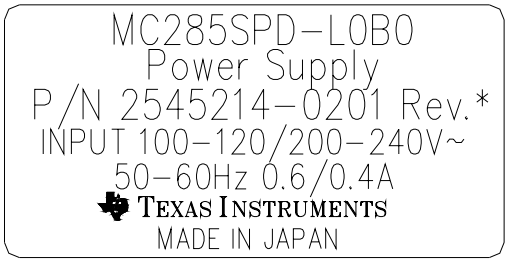
< Power Supply Inputs > The power pin number are shown with an incombustible sticker on the top rear of the camera body.

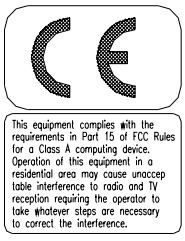
POWER PIN	
1PIN	: GND
2PIN	: DC+15V
3PIN	: GND
4PIN	: DC+27V
5PIN	: GND
6PIN	: DC+4V
7PIN	: DC+4V
8PIN	: GND
9PIN	: DC−12V
10PIN	: GND
11PIN	: DC+15V
12PIN	: GND

< Power Supply Box External Dimensions>



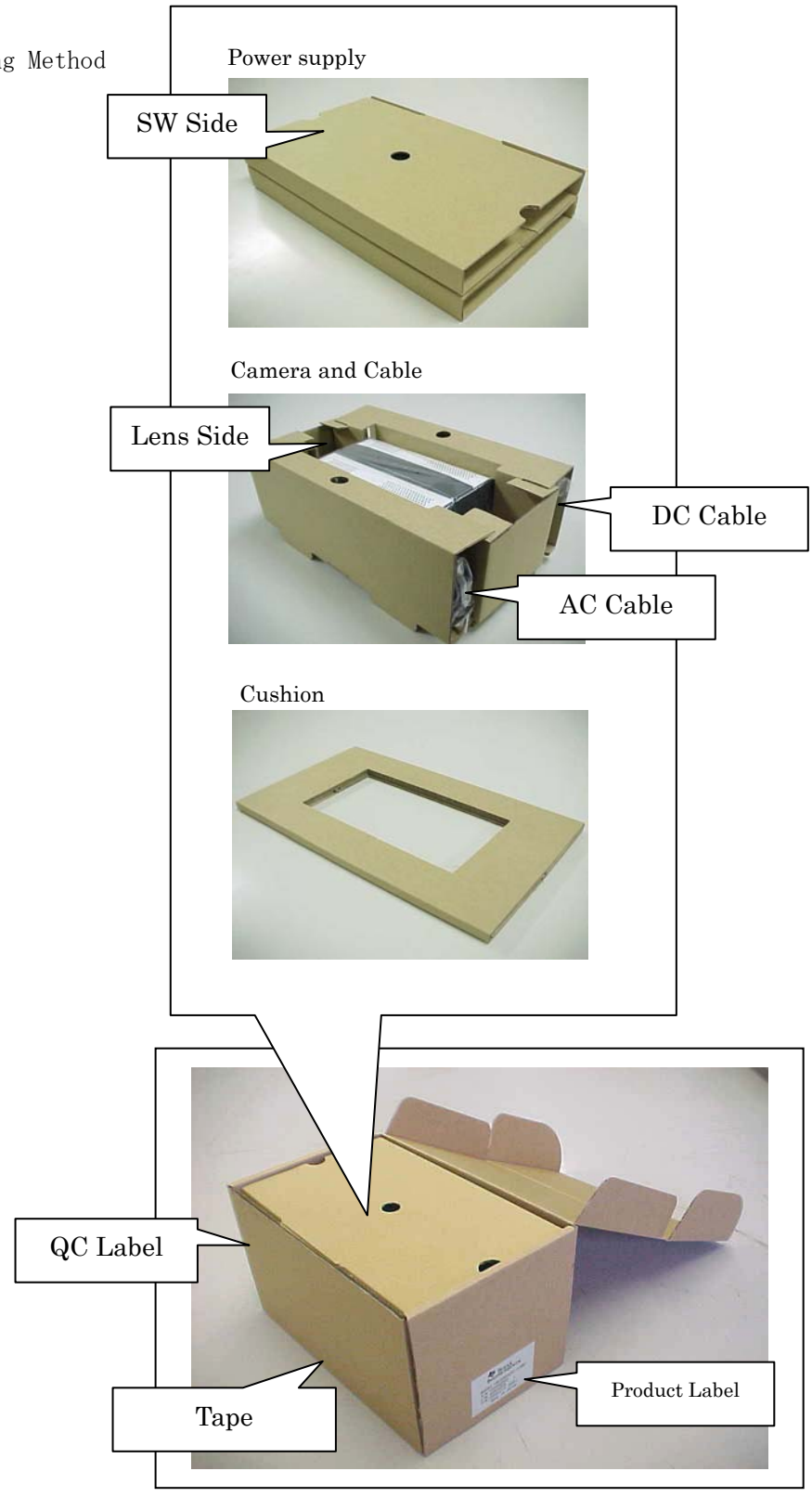
<Product Model and CE Mark> The product model are shown with an incombustible sticker on the top of the power supply body. The CE mark are shown with an incombustible sticker on the top rear of the power supply body



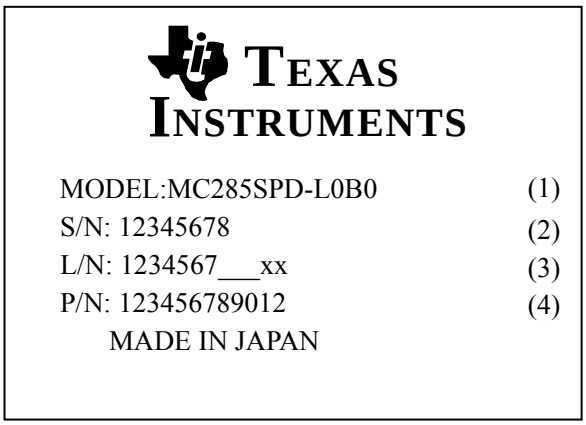


Packing

■ Packing Method



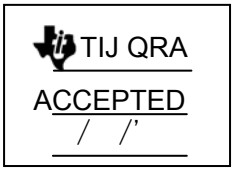
■ Product Label



(1) MODEL: Product name
(2) S/N: Serial number
(3) L/N: Lot number
(4) P/N: Part number
* (3) and (4) are used for TI's production control.

■ QC Label

The QC label is attached to the products that have passed the test before shipping, in which the quality assurance department of Texas Instruments Japan Ltd. or the quality assurance department of its partner factories checks their performance conformity to the shipping test document.



Appendix

A) Sensitivity

- Set the camera in the USS-600V UNIFORM SOURCE SYSTEM (LABSPHER CORP 3100°K) and connect the waveform monitor to the camera.
- Sensitivity is measured at room temperature (25 ± 5°C).

B) S/N Ratio

(1) Output at 100 IRE

- Place the camera with a zoom lens attached, in front of the standard color viewer at a distance of 20 to 30 cm, and then adjust the lens focus to ∞ and the zoom to 75mm (closest).
- Adjust the aperture so that the input voltage displayed on the S/N meter (SHIBASOKU 925D-1) becomes 0.714 ± 0.01 V (0.714 V ≒ 100 IRE).
- Measure the S/N with the S/N meter using its 100 kHz HPF and THRU LPF.

(2) Output at 0 IRE

- With the lens capped, close the aperture completely. With no incident light, measure the S/N in the same way as with the 100 IRE condition.

Both (1) and (2) are performed at room temperature (25 ± 5°C).

C) Modulation Index

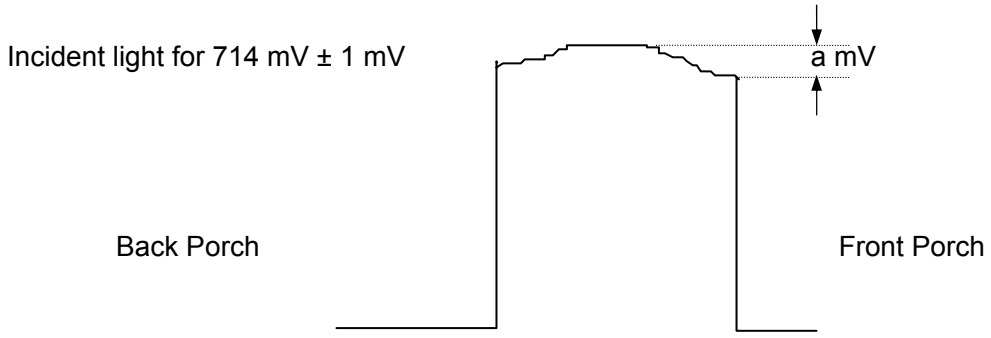
Set the IN MEGA CYCLE chart on the standard color viewer and place the camera and the viewer so that the eight ▲ marks on the chart edges align with the monitor screen edges.
Adjust the lens aperture and the waveform monitor so that the peak of 0.5 MHz signal becomes 100 IRE on the waveform monitor. Then, adjust the lens focus to obtain the maximum amplitude of waveforms.
Referring to the amplitude of the 0.5 MHz signal as 100%, measure the amplitude of 5MHz and 6MHz and calculate the percentage.

D) Resolution

- Set the EIAJ resolution chart on the Standard Color Viewer.
- Place the camera and the viewer so that the eight ▲ marks on the chart edges align with the monitor screen edges.
- Connect the waveform monitor and adjust the aperture so that the signal peak level becomes 100 IRE.
- Check this image visually and find the position at which four wedges look identical to determine the H and V resolution.

E) Video Level Shading

- Use incident light with flat characteristics from the Optoliner and adjust the amount of light so that the video output becomes 1VP-P and its video signal portion becomes 714mV±1mV.
- Scan the screen along the 130th line (its center line) with the waveform monitor.
- Measure the height of surge in the obtained waveform (a mV).



F) Pedestal Level Shading

- With the setup in F), turn off the power of the Optoliner.
- Measure the height of surge with the waveform monitor (b mV).