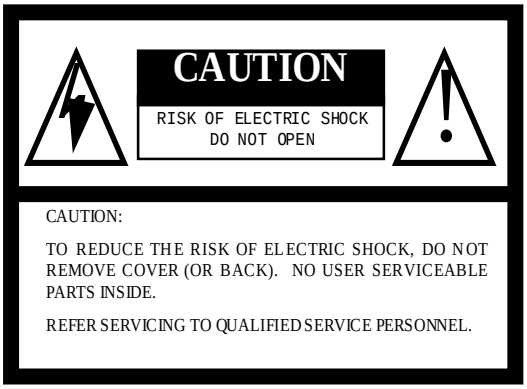
SENTECH

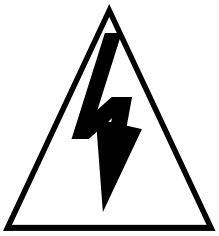
STC-700 Series

Industrial B&W CCD Camera

Application Manual

SENSOR TECHNOLOGY CO., LTD.





The lightning flash with arrowhead symbol, within an equilateral triangle, is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.

The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.

For U.S.A.

Warning:

This equipment generates and uses radio frequency energy and if not installed and used properly, I.e., in strict accordance with the instruction manual, may cause harmful interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment.

For Canada

Warning:

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

WARNING:

TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.

Table of Contents

1. Precaution

- **Handle the camera with care. Do not abuse the camera. Avoid striking or shaking it. Improper handling or storage could damage the camera.**
- **Do not pull or damage camera cable.**
- **During camera use, do not wrap the unit in any material. This will cause the internal temperature of the unit to increase.**
- **Do not expose the camera to moisture, or do not try to operate it in wet areas.**
- **Do not operate the camera beyond its temperature, humidity and power source ratings.**
- **While camera is not being used, keep lens or lens cap on the camera to prevent dust or contamination from getting in the CCD or filter area and scratching or damaging this area.**
- **Do not keep the camera under the following conditions**
  - **In wet, moist and high humidity place**
  - **Under hot direct sun light**
  - **In high temperature place**
  - **Near the object which releases strong magnetic or electric field**
  - **With strong vibration**
- **Use soft cloth to clean the camera. Use pressured air spray to clean the surface of the glass. Do not scratch the surface of the glass.**

2. Preface

This camera is designed mainly for machine vision and visual measurement applications. Its very small package design allows it to be installed in very limited spaces. Robust trigger and reset functions are suitable to capture moving objects. The video output signal is obtained simply by applying 12Vdc power supply. Various combinations of performance parameters can be obtained by setting the switches on the rear panel. These setting will enable the camera to be suitable for many different applications.

This series offer three different CCD formats (1/3”, 1/2” and 2/3”), and both EIA and CCIR video output formats for the most of the industries applications.

3. Contents of box

a. Contents of box

Content	QTY
Camera	1
Specification sheet	1

b. Optional parts

Power connector (HR-10A-10P-12S)

Power connector and cables assembly (2m:10W-02, 3m:10W-03, 5m:10W-05, 10m:10W-10)

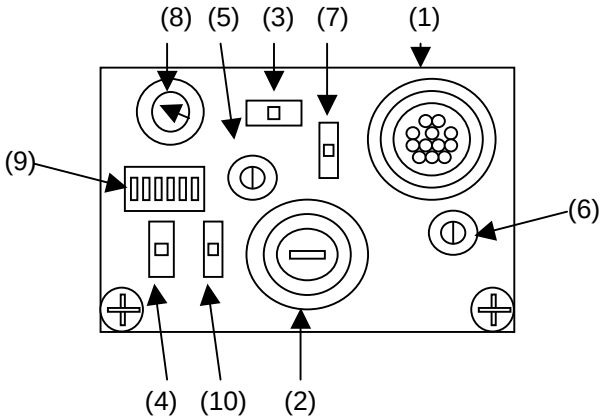
Tripod adapter with 1/4” 20 UNC screw thread hole (TP-700)

4. Features

- **1/3”, 1/2” and 2/3” CCD formats are available.**
- **Extremely compact.**
- **Built-in various trigger functions**
  Fixed integration random shutter trigger
  Variable integration random shutter trigger (one pulse and two pulse trigger)
- **Fast 1/100,000sec electronic shutter with one pulse variable integration random shutter trigger**
- **Extended integration capability with variable integration random shutter trigger**
- **Restart/Reset function**
  Integration period can be controlled by external VD
- **HD/VD or VS as external sync. Input (VD/VS auto detection)**
- **Easy set up**
  Most of switches and adjustments are located on the rear panel. 10 position rotary switch for the shutter speed setting.

5. Switches and Controls

(Back Panel View)



(1) 12 pin connector

Pin No.	Int. Sync.	Ext. HD/VD Sync.	Ext. VS(note 1)	Trigger(note2)
1	GND	GND	GND	GND
2	+12V	+12V	+12V	+12V
3	GND	GND	GND	GND
4	VIDEO	VIDEO	VIDEO	VIDEO
5	GND	GND	GND	GND
6	HD OUT	HD IN	———	HD IN
7	VD OUT	VD IN	VS IN	VD IN
8	GND	GND	GND	GND
9	———(note3)	———	———	S-TRIG IN
10	———	———	———	WEN OUT
11	———	———	———	TRIG IN
12	GND	GND	GND	GND

(Note 1): Not available with STC-700E.
(Note 2): Not available with STC-700E.
(Note 3): "———" indicates no function.

(2) BNC video output connector

(3) Sync. switch

Int. position: The camera operates in the internal sync. mode.
Ext. position: Set at this position when the camera should operate in HD/VD ext.sync. mode, VS sync. mode or trigger mode. The camera has auto detect function and turn to the internal sync. mode when HD/VD or VS input does not exist. However, there are no HD/VD outputs from the 12-pin connector in this position even though the camera operates in the internal sync. mode.

(4) 75Ω termination switch

On: 75Ω
Off: High impedance

(5) Gain mode selection switch

A (AGC): Gain varies from 0 to 20dB depending on the lighting conditions.
F (Fixed): The gain value is fixed at 13dB.
M (Manual): By manually adjusting the manual gain VR (see ⑥), the gain value can be adjusted from 0 to 20dB.

(6) Manual gain VR

(7) Gamma selection switch

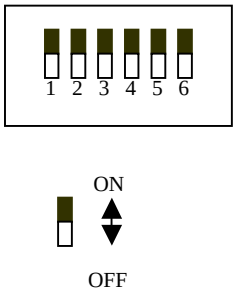
On: γ =0.45
Off: γ =1.0

(8) Shutter speed selection switch

(9) Mode selection DIP switches

DIP switch No.	ON	OFF
1	Field integration	Frame integration
2	Normal operation	Trigger operation
3	Fixed integration random shutter trigger	Variable integration random shutter trigger
4	One pulse variable integration random shutter trigger	Two pulse variable integration random shutter trigger
5	None-reset mode	Reset mode
6	None restart/reset	Restart/reset

DIP Switches



(Notes)
1. Please see page 9 “DIP Switched Setting Examples” for typical switch setting combinations.
2. As STC-700E does not have trigger and restart/reset functions, only switch No. 1 is enabled.

(10) Trigger pulse polarity selection switch

-: For negative active trigger pulse.
+: For positive active trigger pulse.

(Note)
This switch does not exists with STC-700E.

2. Factory Default Setting

STC-700,STC-705,STC-720,STC-725,STC-730,STC-735

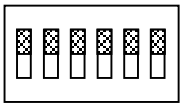
(3) Sync. switch:	Ext (External sync.)
(4) 75Ω termination switch:	On (75Ω)
(5) Gain mode selection switch:	F (Fixed gain)
(6) Manual gain VR	Minimum position
(7) Gamma selection switch	Off (γ =1)
(8) Shutter speed selection switch	0 (Position 0)
(9) Mode selection DIP switches	All on position
(10) Trigger pulse polarity selection switch	- (Active negative)

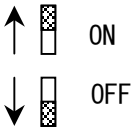
STC-700E

(3) Sync. switch:	Ext (External sync.)
(4) 75Ω termination switch:	On (75Ω)
(5) Gain mode selection switch:	F (Fixed gain)
(6) Manual gain VR	Minimum position
(7) Gamma selection switch	Off (γ =1)
(8) Shutter speed selection switch	0 (Position 0)
(9) Mode selection DIP switches	All on position

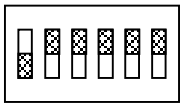
【 DIP Switches Setting Examples 】

① Normal operation
Field integration

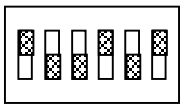




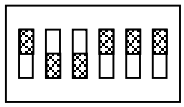
② Normal operation
Frame integration



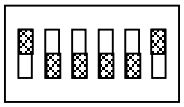
③ One pulse variable integration random shutter trigger (reset)



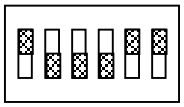
④ One pulse variable integration random shutter trigger (none-reset)



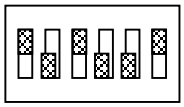
⑤ Two pulse variable integration random shutter trigger (reset)



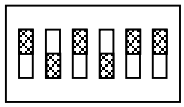
⑥ Two pulse variable integration random shutter trigger (none-reset)



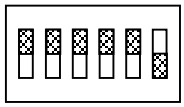
⑦ Fixed integration random shutter trigger (reset)



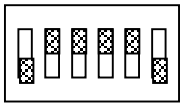
⑧ Fixed integration random shutter trigger (none-reset)



⑨ Restart/reset
(field accumulation)



⑩ Restart/reset
(frame accumulation)

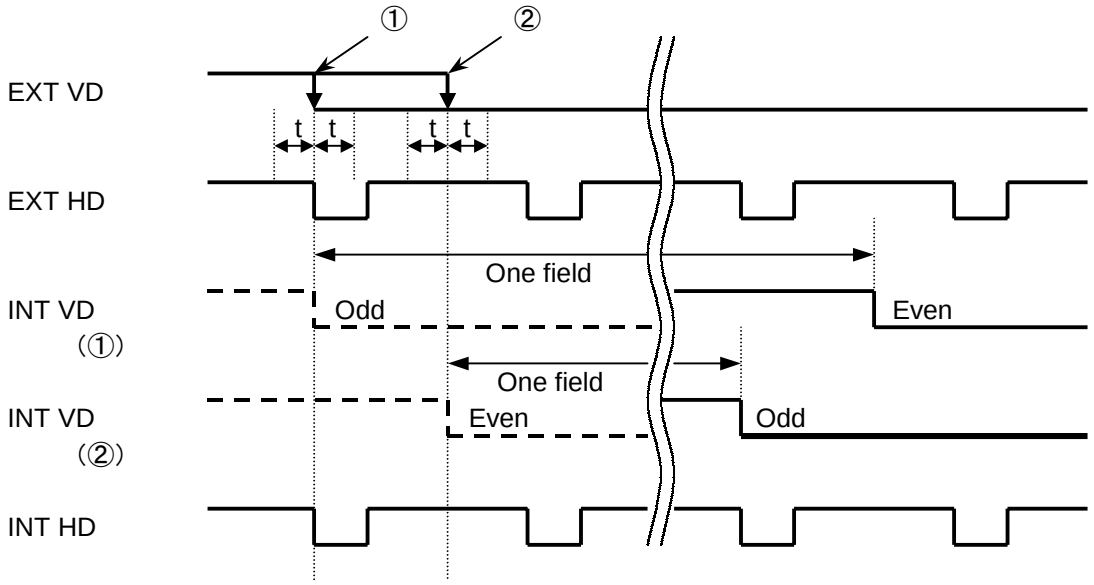


6. External Synchronization Operation

a. EIA Types (STC-700, 700E, 720 and 730)

i) HD/VD external sync. operation

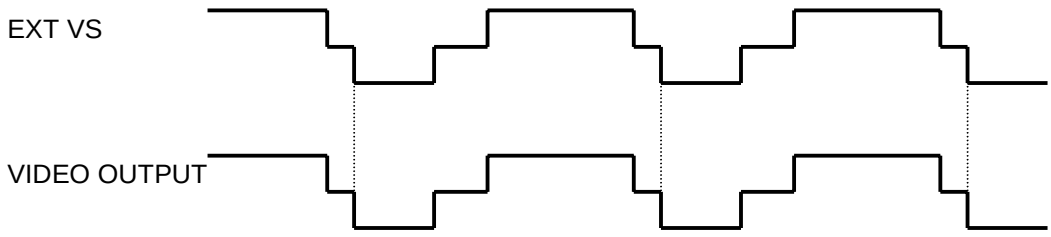
When the external HD signal is applied to the camera, the internal HD synchronizes to the external HD by the PLL (Phase Lock Loop) method. Odd or even field is determined based on the phase relationship between the external VD and the HD as shown below, then the following VD is reset. For example, when odd timing VD comes, the following VD (one field later) is reset to the even timing.



(Note) t=15uSec. The falling edge of the external VD must be within the indicated areas.

ii) VS external sync. operation

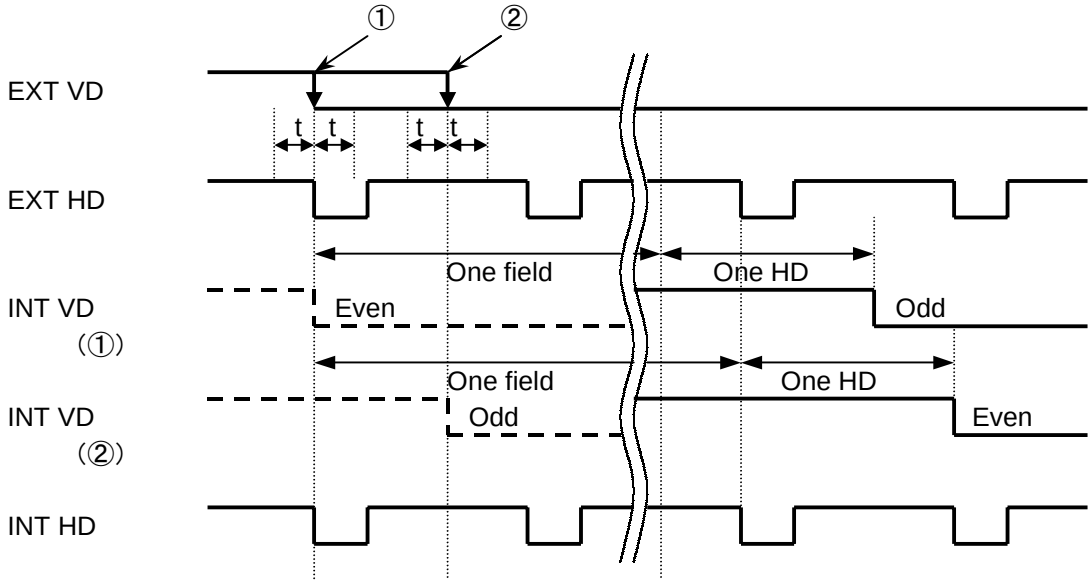
When the external VS (composite video signal) is applied, the camera synchronizes to the input VS. However, HD rate synchronization is not guaranteed. Use HD/VD sync. method when accurate HD synchronization is required.



b. CCIR Types (STC-705, 725 and 735)

i) HD/VD external sync. operation

When the external HD signal is applied to the camera, the internal HD synchronizes to the external HD by the PLL (Phase Lock Loop) method. Odd or even field is determined based on the phase relationship between the external VD and the HD as shown below, then the following VD is reset at the point of one field plus one HD. For example, when odd timing VD comes, the following VD (one field plus one HD later) is reset to the even timing.



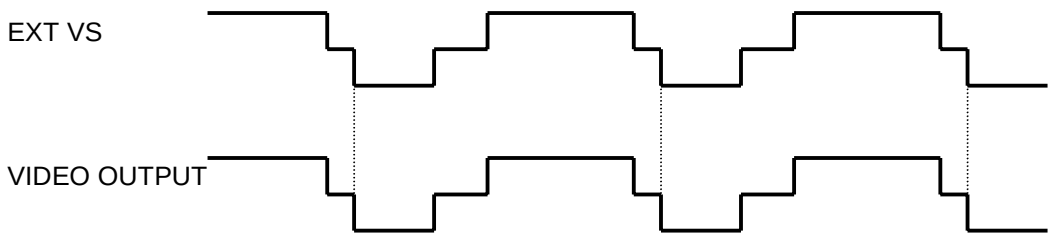
(Note) t=15uSec. The falling edge of the external VD must be within the indicated areas.

ii) VS external sync. operation

When the external VS (composite video signal) is applied, the camera synchronizes to the input VS. However, HD rate synchronization is not guaranteed. Use HD/VD sync. method when accurate HD synchronization is required.

iii) VS external sync. operation

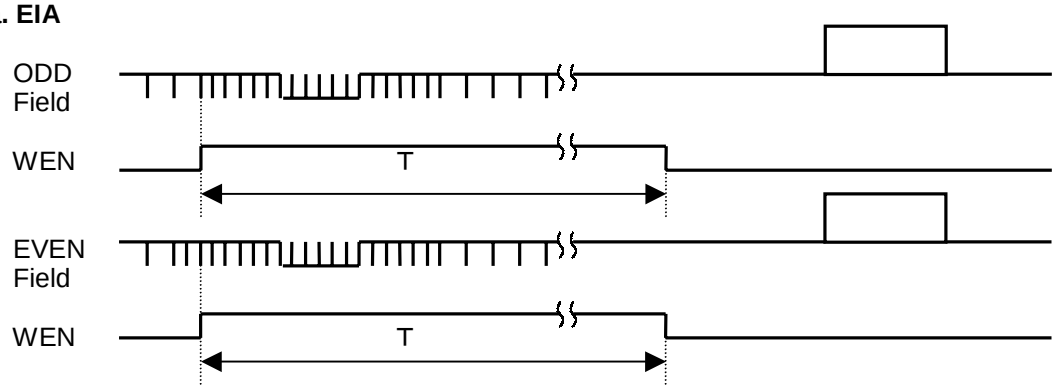
When the external VS (composite video signal) is applied, the camera synchronizes to the input VS. However, HD rate synchronization is not guaranteed. Use HD/VD sync. method when accurate HD synchronization is required.



7. WEN Output pulse

The timing relationship between video output and WEN is shown as below chart.

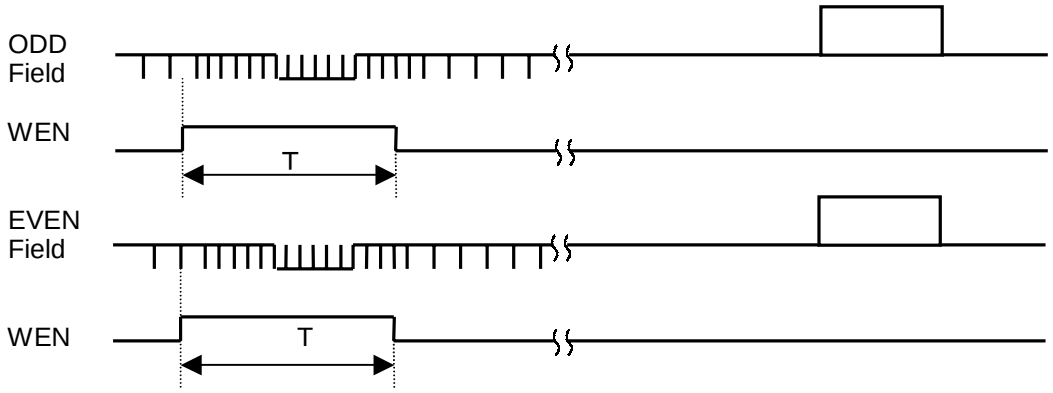
a. EIA



(Notes)

1. Pulse width of WEN (T) is;
   Reset mode: 678 μ sec
   None-reset mode: 646 - 678 μ sec
2. Always start with “Odd field” when reset mode.
3. “Odd” or “Even field” is determined by the timing of the video output when none-reset mode.

b. CCIR



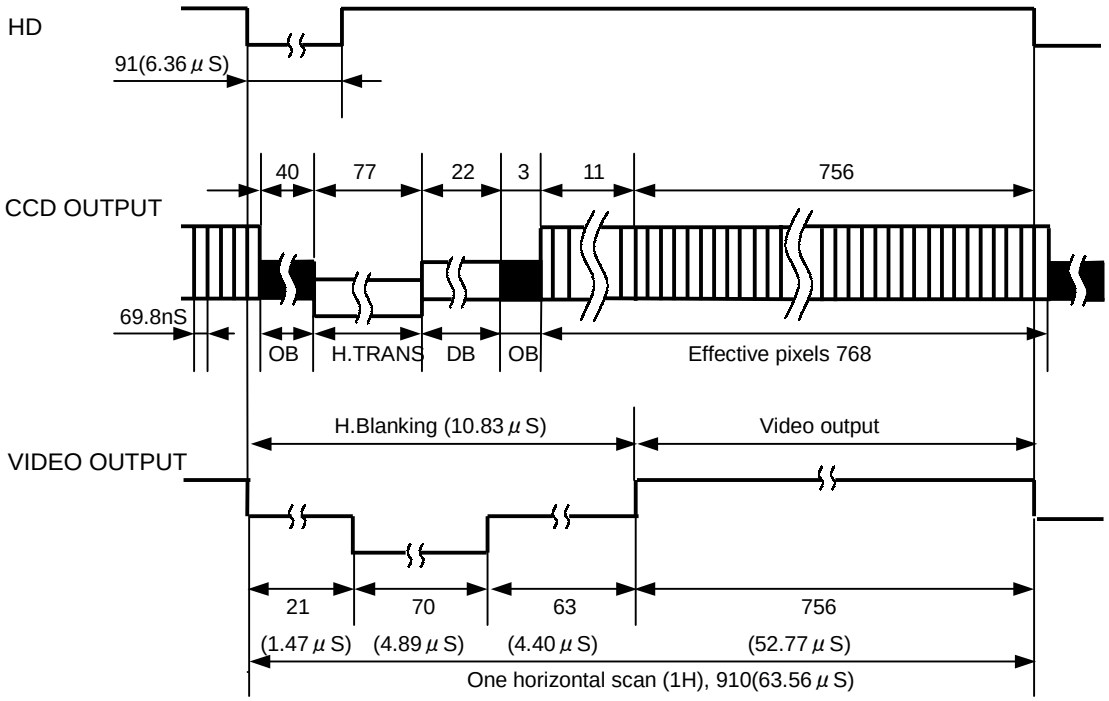
(Notes)

1. Pulse width of WEN (T) is;
   Reset mode: 1.07msec
   None-reset mode: 1.07 – 1.10msec
2. Always start with “Odd field” when reset mode.
3. “Odd” or “Even field” is determined by the timing of the video output when none-reset mode.

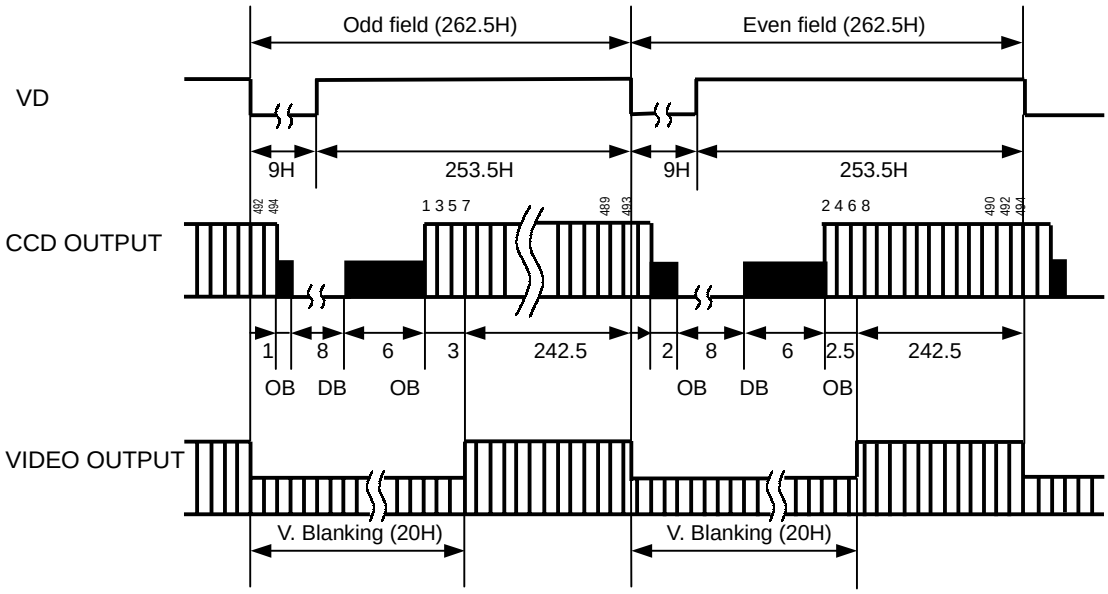
8. Video Output Timing Charts

a. EIA Types (STC-700, 700E, 720 and 730)

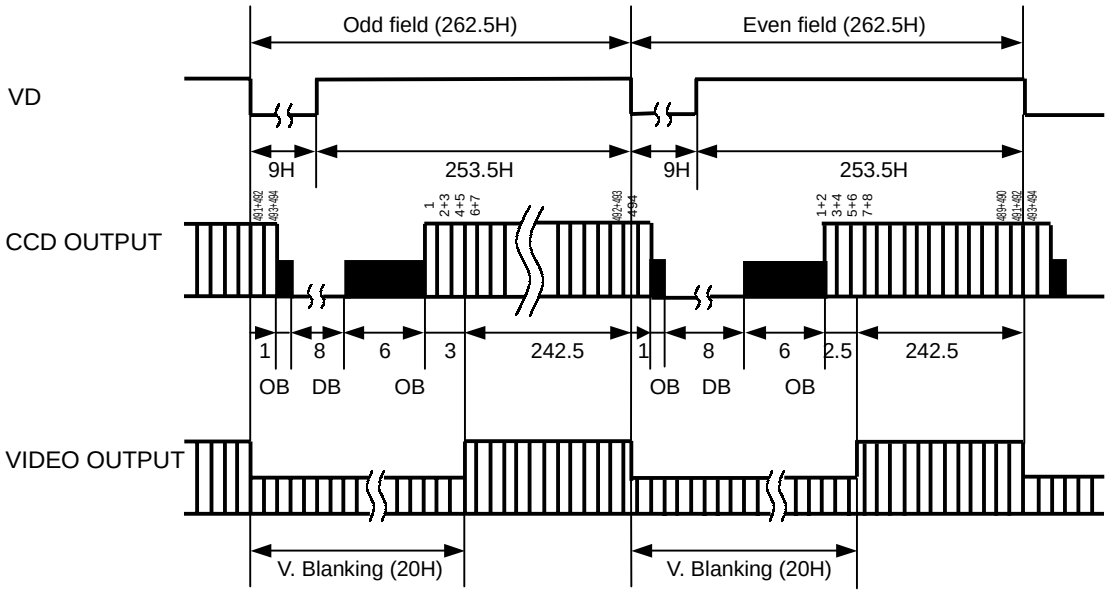
i) Horizontal timing



ii) Vertical Timing (2:1 Interlace, Frame Integration)

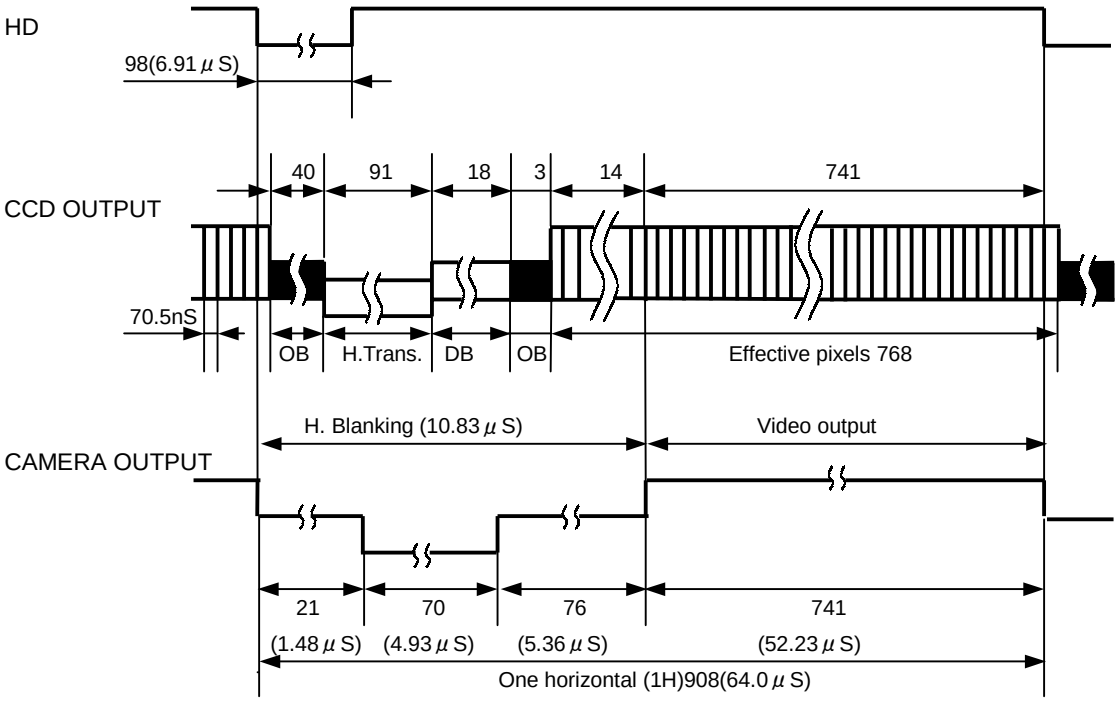


iii) Vertical Timing (2:1 Interlace, Field Integration)

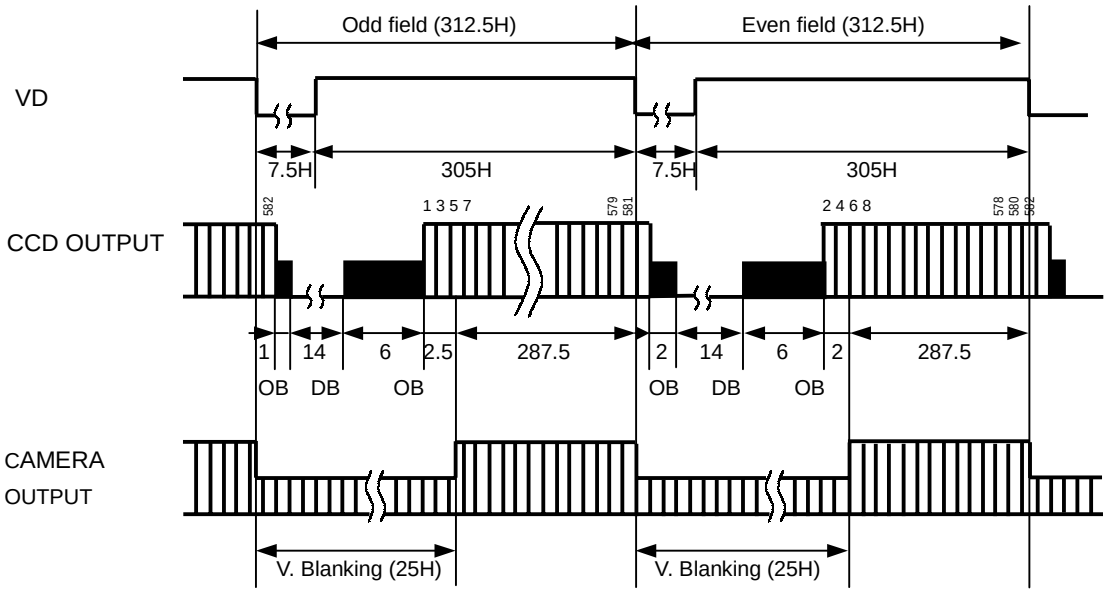


b. CCIR Types (STC-705, 725 and 735)

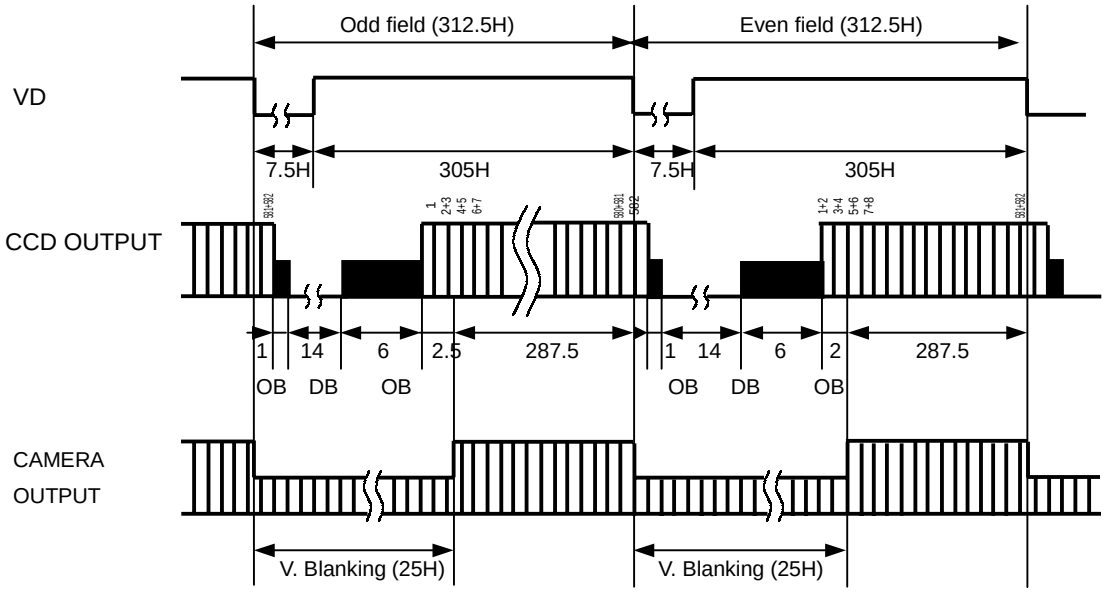
i) Horizontal timing



ii) Vertical Timing (2:1 Interlace, Frame Integration)



iii) Vertical Timing (2:1 Interlace, Field Integration)



9. Shutter Speed Setting

(Caution)

Sutter speed settings are different in the normal operation mode and trigger operation mode. The rotary switch for this setting is located on the back panel.

a. Shutter speed setting for the normal operation

Switch Position	Shutter Speed (Second)
0	1/60 (EIA), 1/50 (CCIR)
1	Flicker less mode, 1/100 (EIA), 1/120 (CCIR)
2	1/250
3	1/500
4	1/1000
5	1/2000
6	1/4000
7	1/10000
8	Shutter off (Field Integration): 1/60（EIA), 1/50(CCIR) Shutter off (Frame Integration): 1/30(EIA), 1/25(CCIR)
9	Invalid

b. Shutter speed setting for the fixed integration random shutter trigger

Switch Position	Shutter Speed (Second)
0	1/60
1	1/120
2	1/250
3	1/500
4	1/1000
5	1/2000
6	1/4000
7	1/10000
8	1/30
9	Extended integration operation (note 1)

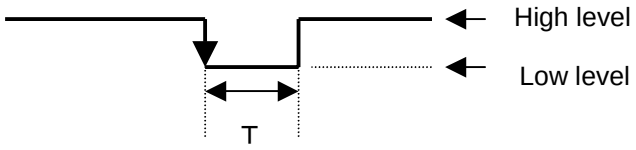
(Note 1)

This extended integration operation is available only when variable integration random shutter trigger mode (either one pulse or two pulse) is selected. With this setting, the integration time can exceed 1/3 of second (333 ms).

10. Trigger Pulse

This camera accepts both “negative” and “positive” active trigger pulses. To select a type of the pulses, use 5-⑩ Trigger pulse polarity selection switch. The following shows the requirements for those trigger pulses.

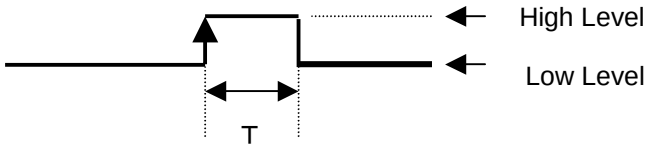
a. Negative active trigger pulse (Select “ - “ by the switch)



High: 3 – 5V
Low: 0 – 0.6V

(Note)
In the case of the one pulse variable integration random shutter trigger mode, T becomes integration time. In the case of all other trigger modes, activation timing is defined at the falling edge of the pulse.

b. Positive active trigger pulse (Select “ + “ by the switch)



High: 3 – 5V
Low: 0 – 0.6V

(Note)
In the case of the one pulse variable integration random shutter trigger mode, T becomes integration time. In the case of all other trigger modes, activation timing is defined at the rising edge of the pulse.

(CAUTION)

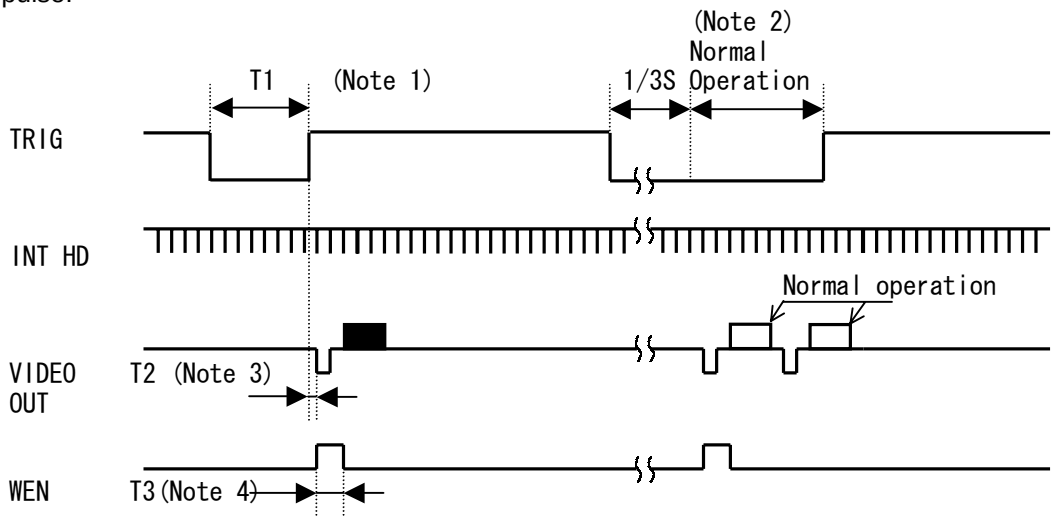
1. When the extended integration operation is executed, many white noises may appear in the image. This is a typical phenomenon of CCD.
2. Do not apply next trigger pulse before completing the previous image output.

11. Trigger Operation

(Note)
In the following section, always negative trigger pulse is used to explain the timing. However, this camera accepts both negative and positive trigger pulses. Please select the appropriate polarity of the trigger pulse by the Trigger pulse polarity selection switch on the back panel described (See section 5-⑩).

a. One pulse Variable integration random shutter trigger (reset mode)
With this "one-pulse variable integration shutter trigger mode", one trigger pulse input signal can control camera's integration time based on its pulse duration time. In other words, the integration time starts at the falling edge of the trigger pulse then ends at its rising edge (see the drawing below). The integration time is controlled very accurately since "XSUB" is activated in the camera at the falling edge of the trigger pulse and "XSG" is activated at the rising edge.

Video signal is output after "T2" period from the rising edge of the trigger pulse as shown below. The timing of this video signal synchronizes to the internal HD pulse. Therefore T2 varies ± 1H depending on the timing of the rising edge of the trigger pulse when the trigger pulse does not synchronizes to the internal HD. This situation is used in the following example. If your application requires accurate "T2" period, please use external HD drive and synchronize the trigger pulse to this HD pulse.

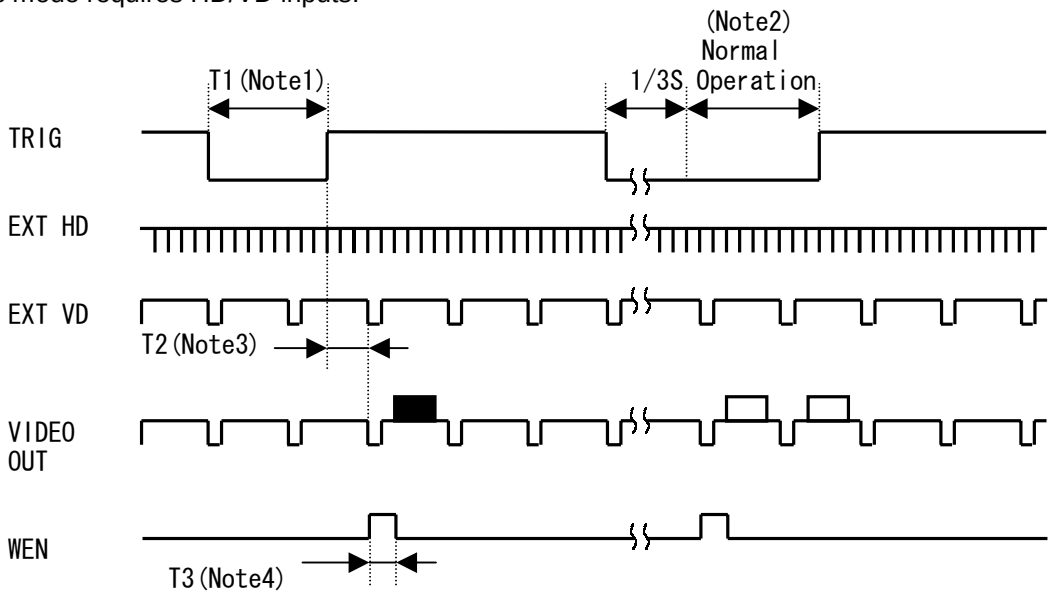


(Notes)
1. Integration time T1 = 100 μ sec – 250msec
2. When the trigger pulse duration exceeds 1/3 second (333msec), the camera operation automatically switches to normal operation mode (shutter off condition) as shown in the following example unless the "extended integration operation" is selected.
3. T2 ≦ 1H
4. WEN pulse duration is the following. See section 7. WEN Output Pulse for more details.
   T3 = 678 μ sec (EIA)
   T3 = 1.07msec (CCIR)

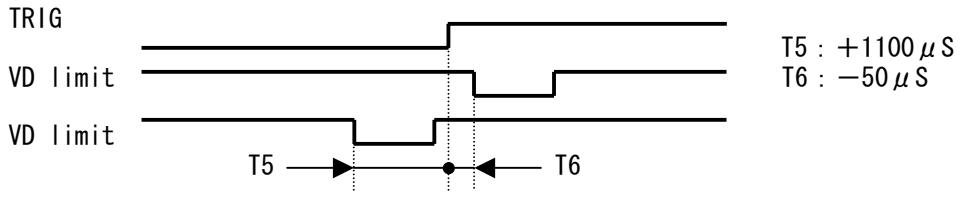
(CAUTION)
1. When the extended integration operation is executed, many white noises may appear in the image. This is a typical phenomenon of CCD.
2. Do not apply next trigger pulse before completing the previous image output.

b. One pulse Variable integration random shutter trigger (none-reset mode)
With this “one-pulse variable integration shutter trigger mode”, one trigger pulse input signal can control camera’s integration time based on its pulse duration time. In other words, the integration time starts at the falling edge of the trigger pulse then ends at its rising edge (see the drawing below). The integration time is controlled very accurately since “XSUB” is activated in the camera at the falling edge of the trigger pulse and “XSG” is activated at the rising edge.

Video signal is output at the subsequent internal VD following the rising edge of the trigger pulse. This mode requires HD/VD inputs.



(Notes)
1. Integration time T1 = 100 μsec – 250msec
2. When the trigger pulse duration exceeds 1/3 second (333msec), the camera operation automatically switches to normal operation mode (shutter off condition) as shown in the following example unless the “extended integration operation” is selected.
3. Video signal is output at the subsequent internal VD following the rising edge of the trigger pulse. However, it is prohibited to place the rising edge of trigger timing in the following time period as the video output timing becomes uncertain.

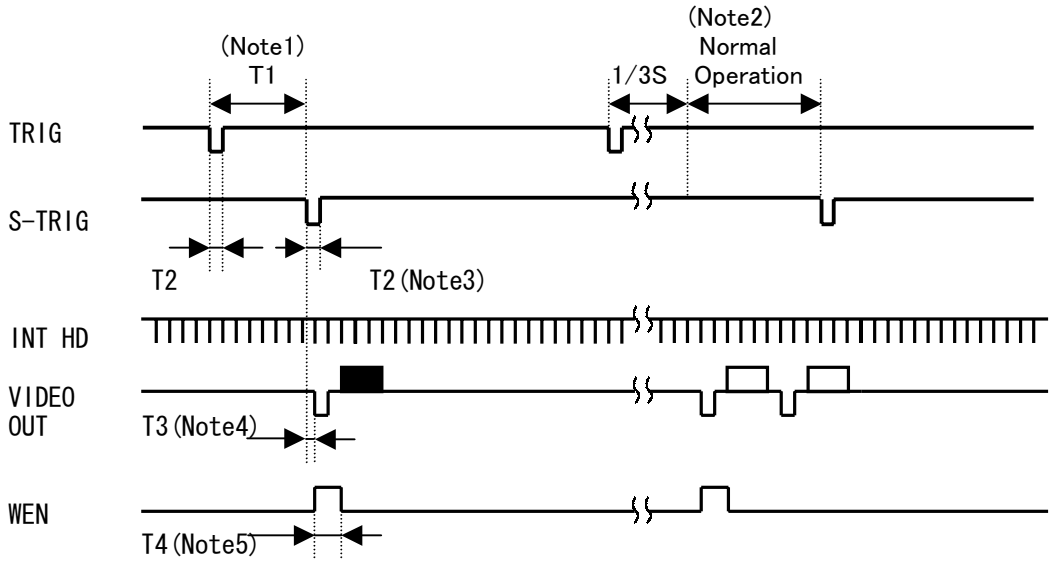


4. WEN pulse duration is the following. See section 7. WEN Output Pulse for more details.
   T3 = 646 - 678 μsec (EIA)
   T3 = 1.07 – 1.10msec (CCIR)

(CAUTION)
1. When the extended integration operation is executed, many white noises may appear in the image. This is a typical phenomenon of CCD.
2. Do not apply next trigger pulse before completing the previous image output.

c. Two pulse Variable integration random shutter trigger (reset mode)
With this “two-pulse variable integration shutter trigger mode”, one trigger pulse defines integration start and the other integration end. In other words, the integration time starts at the falling edge of the TRG pulse then ends at the falling edge of S-TRIG pulse (see the drawing below). The integration time is controlled very accurately since “XSUB” is activated in the camera at the falling edge of the TRG pulse and “XSG” is activated at the falling edge of the S-TRG pulse.

Video signal is output after “T3” period from the rising edge of the trigger pulse as shown below. The timing of this video signal synchronizes to the internal HD pulse. Therefore T3 varies ± 1H depending on the timing of the falling edge of the S-TRIG pulse when the trigger pulse does not synchronizes to the internal HD. This situation is used in the following example. If your application requires accurate “T3” period, please use external HD drive and synchronize the trigger pulse to this HD pulse.

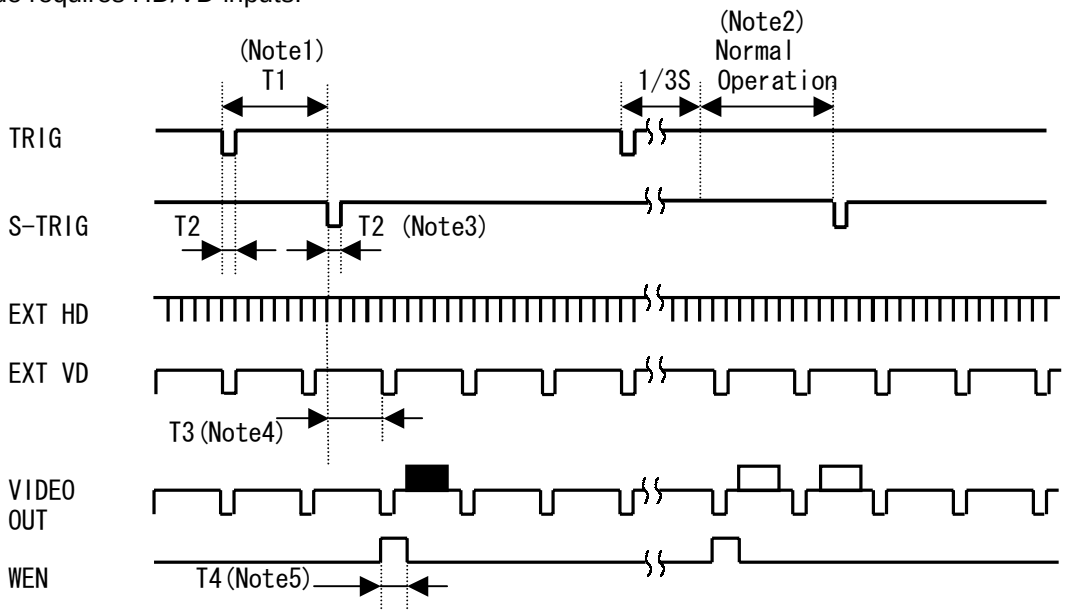


(Notes)
1. Integration time T1 = 10 μsec – 250msec
2. When the trigger pulse duration exceeds 1/3 second (333msec), the camera operation automatically switches to normal operation mode (shutter off condition) as shown in the following example unless the “extended integration operation” is selected.
3. T2 = 4 μsec – 1msec
4. T3 ≦ 1H
5. WEN pulse duration is the following. See section 7. WEN Output Pulse for more details.
   T3 = 678 μsec (EIA)
   T3 = 1.07msec (CCIR)

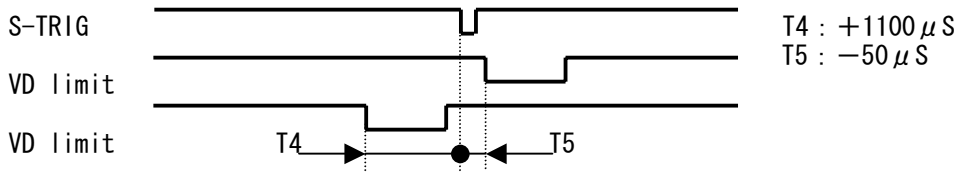
(CAUTION)
1. When the extended integration operation is executed, many white noises may appear in the image. This is a typical phenomenon of CCD.
2. Do not apply next trigger pulse before completing the previous image output.

d. Two pulse Variable integration random shutter trigger (none-reset mode)
With this “two-pulse variable integration shutter trigger mode”, one trigger pulse defines integration start and the other integration end. In other words, the integration time starts at the falling edge of the TRG pulse then ends at the falling edge of S-TRIG pulse (see the drawing below). The integration time is controlled very accurately since “XSUB” is activated in the camera at the falling edge of the TRG pulse and “XSG” is activated at the falling edge of the S-TRG pulse.

Video signal is output at the subsequent internal VD following the falling edge of S-TRIG pulse. This mode requires HD/VD inputs.



(Notes)
1. Integration time T1 = 10μsec – 250msec
2. When the trigger pulse duration exceeds 1/3 second (333msec), the camera operation automatically switches to normal operation mode (shutter off condition) as shown in the following example unless the “extended integration operation” is selected.
3. T2 = 4μsec - 1msec
4. Video signal is output at the subsequent internal VD following the falling edge of the S-TRIG pulse. However, it is prohibited to place the falling edge of the S-TRIG timing in the following time period as the video output timing becomes uncertain.



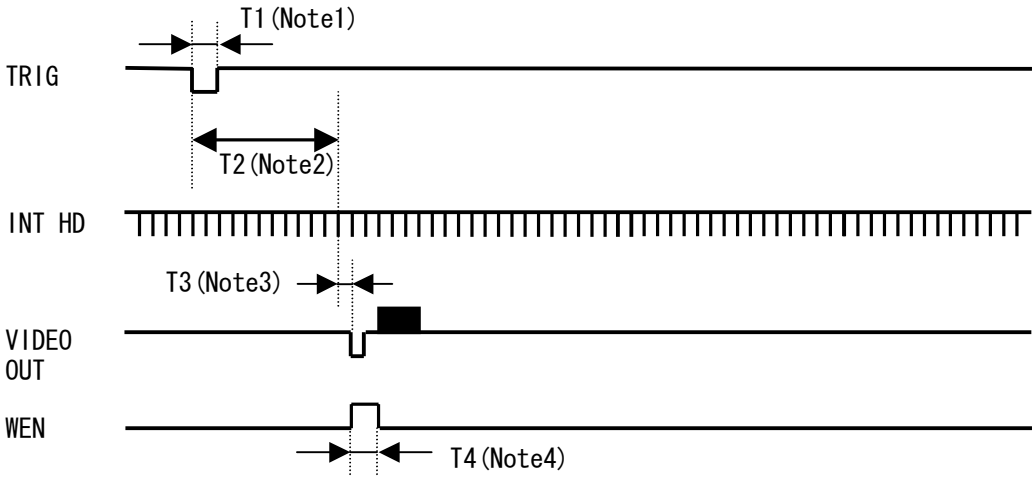
5. WEN pulse duration is the following. See section 7. WEN Output Pulse for more details.
   T3 = 646 - 678μsec (EIA)
   T3 = 1.07 – 1.10msec (CCIR)

(CAUTION)
1. When the extended integration operation is executed, many white noises may appear in the image. This is a typical phenomenon of CCD.
2. Do not apply next trigger pulse before completing the previous image output.

e. Fixed integration random shutter trigger (Reset mode)

With this mode, integration time is defined by the rotary switch setting. The integration period (T2) starts at the falling edge of the TRG pulse and continues for the period of the set value of the rotary switch.

Video signal is output after “T3” period from the end of the integration period as shown below. The timing of this video signal synchronizes to the internal HD pulse. Therefore T3 varies ± 1H depending on the timing of the end of the integration period when the trigger pulse does not synchronizes to the internal HD. This situation is used in the following example. If your application requires accurate “T3” period, please use external HD drive and synchronize the trigger pulse to this HD pulse.



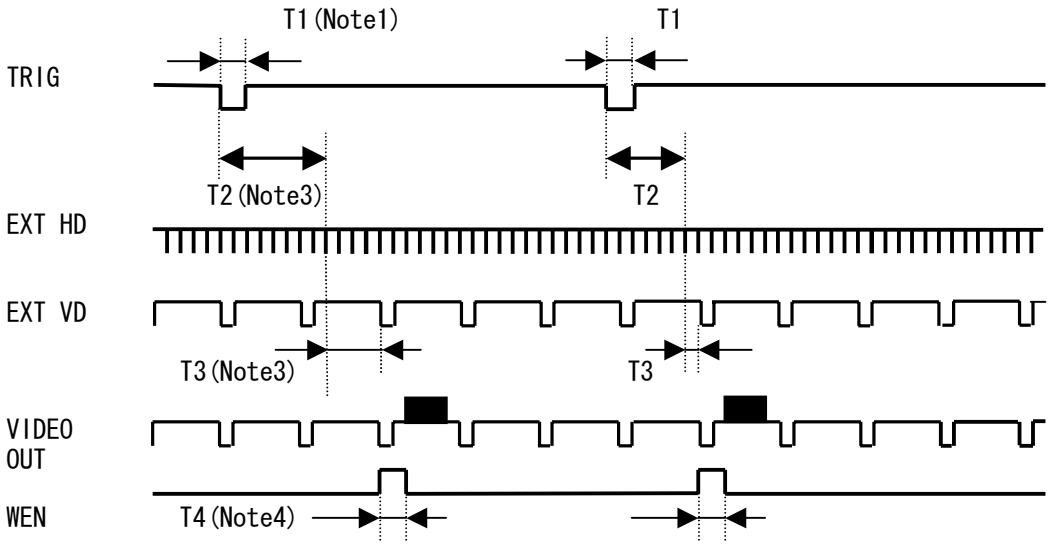
(Notes)

1. T1 = 4 μ sec – 1msec
2. The integration period (T2) is defined by the rotary switch setting.
3. T3 ≦ 1H
4. WEN pulse duration is the following. See section 7. WEN Output Pulse for more details.
   T3 = 678 μ sec (EIA)
   T3 = 1.07msec (CCIR)

f. Fixed integration random shutter trigger (None-reset mode)

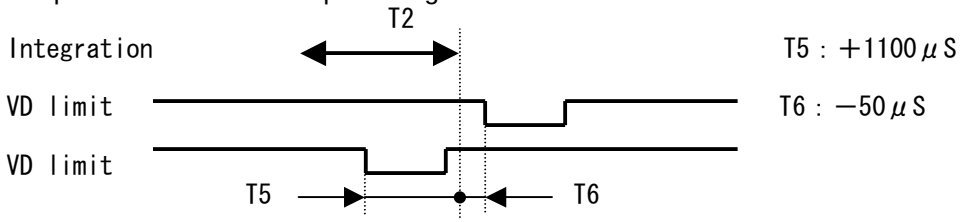
With this mode, integration time is defined by the rotary switch setting. The integration period (T2) starts at the falling edge of the TRG pulse and continues for the period of the set value of the rotary switch.

Video signal is output at the subsequent internal VD following the end of the integration period. This mode requires HD/VD inputs.



(Notes)

1. T1 = 4 μ sec – 1msec
2. The integration period (T2) is defined by the rotary switch setting.
3. Video signal is output at the subsequent internal VD following the end of the integration period. However, it is prohibited to place end of the integration period in the following time period as the video output timing becomes uncertain.

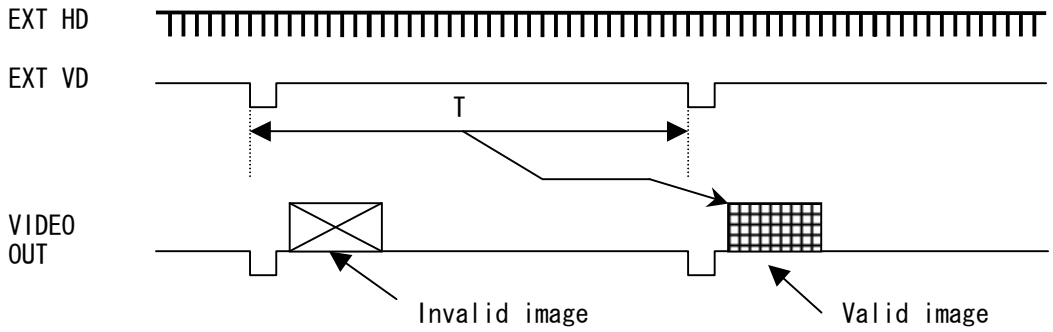


5. WEN pulse duration is the following. See section 7. WEN Output Pulse for more details.
   T3 = 646 - 678 μ sec (EIA)
   T3 = 1.07 – 1.10msec (CCIR)

12. Restart Reset Operation

a. Field Integration Restart Reset Operation

By applying HD and reset/restart signal (VD) externally, one field of image can be obtained. The start and end of the integration period for the image can be controlled by the two consecutive VD pulses.

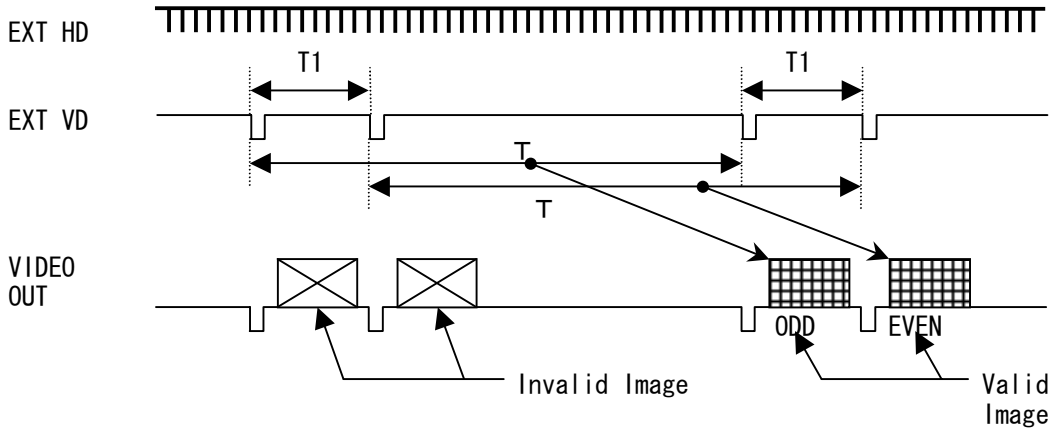


(Notes)

1. The integration period is defined as “T” in this chart.
2. T ≧ 262.5H (EIA)
   T ≧ 312.5H (CCIR)
3. External HD is required.

b. Frame Integration Restart Reset Operation

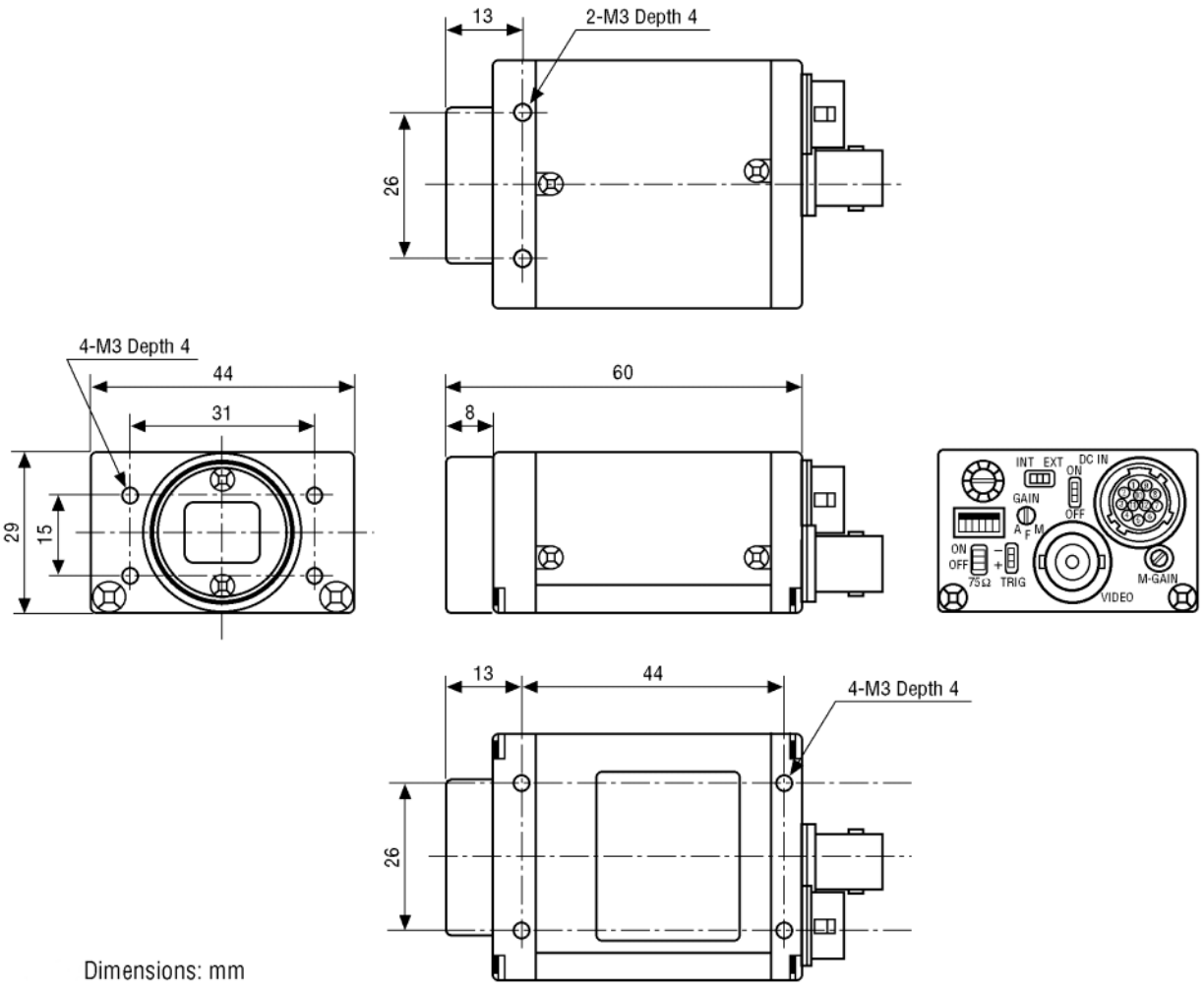
By applying HD and reset/restart signal (VD) externally, one frame of image can be obtained. The start and end of the integration period for each field is defined by the four consecutive VD input as shown in the following chart.



1. The integration period is defined as “T” in this chart.
2. T ≧ 262.5H (EIA)
   T ≧ 312.5H (CCIR)
3. External HD is required.
4. T1 must be the following value
   1/60 sec (EIA), 1/50 sec (CCIR)

APPENDIX – A

STC-700 Mechanical Information



Dimensions: mm