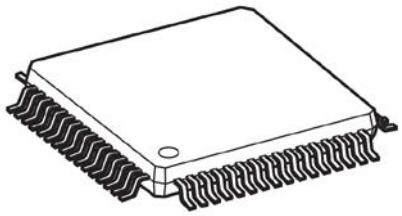
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC90106FG

Multi System Video Decoder for Component input

TC90106FG is the Video decoder which incorporates a video selector. It supports 3 inputs of CVBS, 2 inputs of component or Y/C signal. In addition, it supports 480i, 480p, 576i and576p of component input signal.
The output signal is available for ITU-R BT.656 or 4:2:2 signal of 8bit serial output (SAV & EAV implantation)



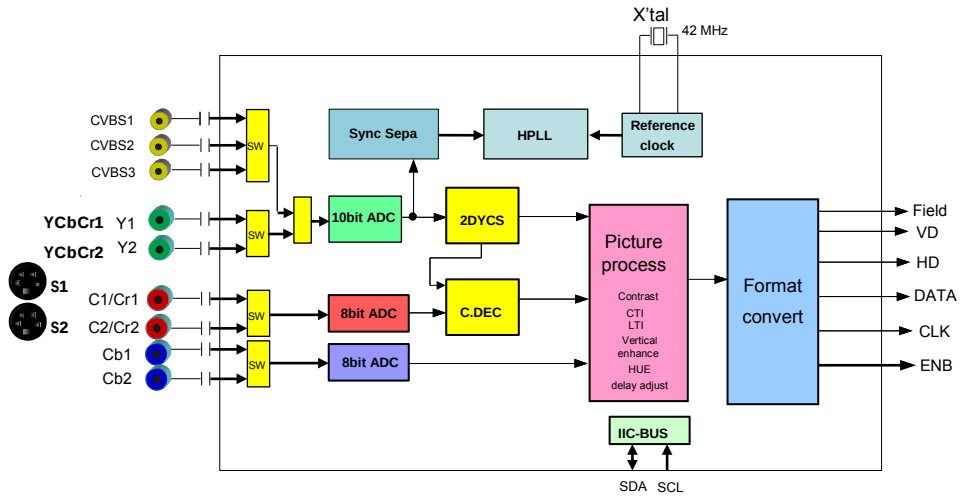
LQFP64-P-1010-0.50E

Weight: 0.4 g (typ.)

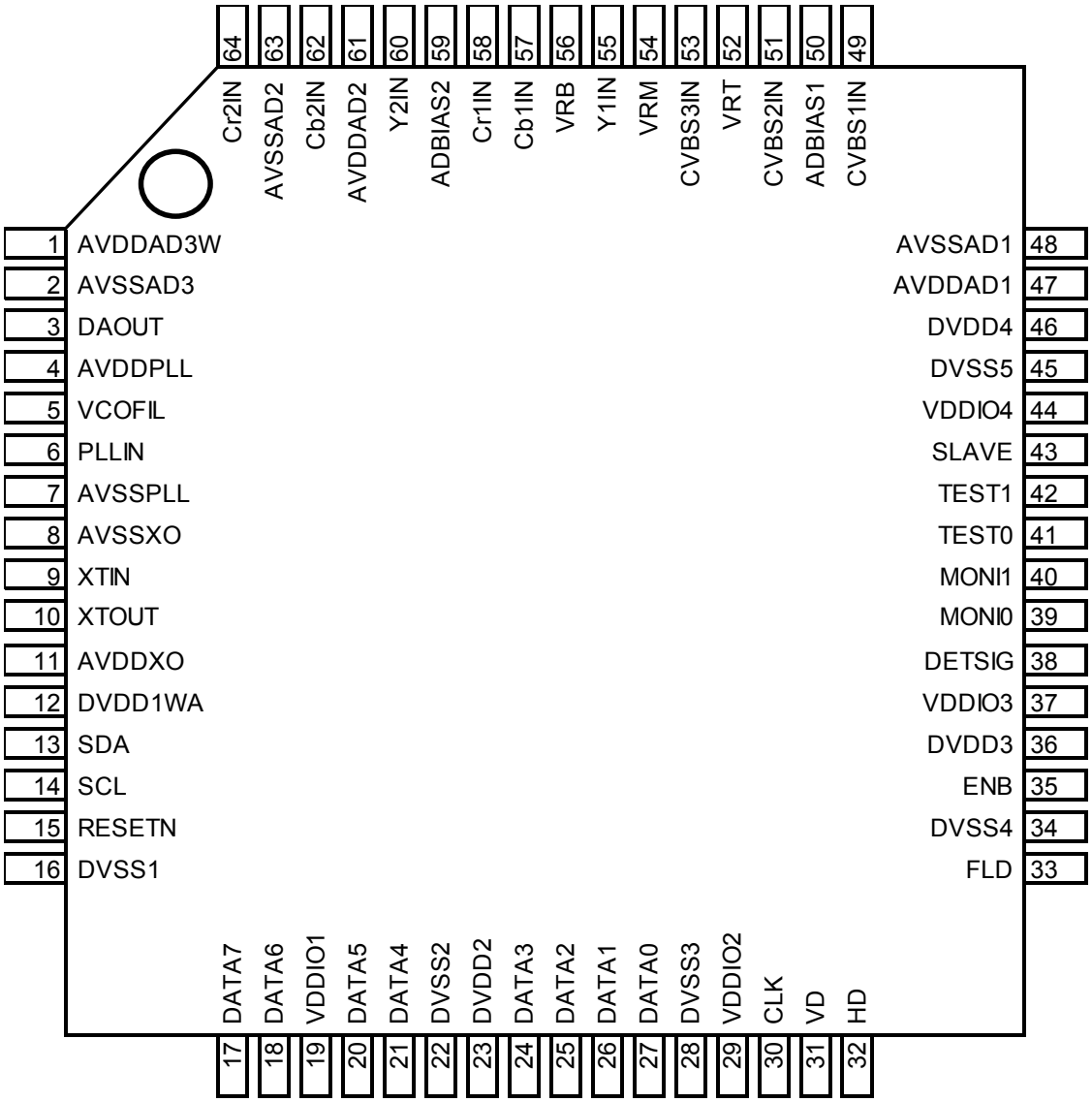
1. Feature

- Input signal: 3ch of CVBS, 2ch of S-video, 2ch of component.
- Internal 10bit ADC 1ch and 8bit ADC 2ch.
- Y/C separation: 3-line YCS (NTSC/PAL)
  Band Pass Filter (SECAM)
- Full multi-color decoder
- Picture process Y: brightness, contrast, sharpness, noise cancel, V-Enhance, LTI
  C: TOF, ACC, color gain, CTI, noise cancel, Hue
- Signal detection of D1/D2(525p/625p)
- High/Low output from a terminal (DETSIG) when input signal is nothing.
- Automatically mute function when input signal is nothing.
- 8bit ITU-R BT.656 / 8bit 4:2:2 Serial + SAV/EAV implantation or Sync output
- I^2C-bus control
- Operating temperature: -40°C to + 85°C
- Package: LQFP64-P-1010-0.50E (0.50 mm pitch)
- Power supply: 3.3 V, 2.5 V, 1.5 V

2. Block Diagram



3. Pin Layout



4. Pin Descriptions

Pin No.	Pin Name	Pin Function	Pin Type	Withstand voltage [V] (standard withstand voltage)	Processing at unused case
1	AVDDAD3W	2.5 V power supply for ADC	VDD	2.5	−
2	AVSSAD3	GND for ADC	GND	0	−
3	DAOUT	Output of DAC circuit	OUT	2.5	−
4	AVDDPLL	2.5 V power supply for DAC/PLL	VDD	2.5	−
5	VCOFIL	VCO Filter terminal	OUT	2.5	−
6	PLLIN	Input of PLL circuit	IN	2.5	−
7	AVSSPLL	DAC/PLL GND	GND	0	−
8	AVSSXO	GND for X'tal circuit	GND	0	−
9	XTIN	Input for X'tal circuit	IN	2.5	−
10	XTOUT	Output for X'tal circuit	OUT	2.5	−
11	AVDDXO	Power supply for X'tal	VDD	2.5	−
12	DVDD1WA	1.5 V power supply for Logic circuit	VDD	1.5	−
13	SDA	I^2C-BUS SDA terminal	IN/OUT	5.0	−
14	SCL	I^2C-BUS SCL terminal	IN	5.0	−
15	RESETN	System reset	IN	3.3	−
16	DVSS1	Digital GND	GND	0	−
17	DATA7	DATA7 output	OUT	3.3	Open
18	DATA6	DATA6 output	OUT	3.3	Open
19	VDDIO1	3.3 V power supply for I/O	VDD	3.3	−
20	DATA5	DATA5 output	OUT	3.3	Open
21	DATA4	DATA4 output	OUT	3.3	Open
22	DVSS2	Digital GND	GND	0	−
23	DVDD2	1.5 V power supply for Logic circuit	VDD	1.5	−
24	DATA3	DATA3 output	OUT	3.3	Open
25	DATA2	DATA2 output	OUT	3.3	Open
26	DATA1	DATA1 output	OUT	3.3	Open
27	DATA0	DATA0 output	OUT	3.3	Open
28	DVSS3	Digital GND	GND	0	−
29	VDDIO2	3.3 V power supply for I/O	VDD	3.3	−
30	CLK	Clock signal output	OUT	3.3	−
31	VD	VD signal output	OUT	3.3	Open
32	HD	HD signal output	OUT	3.3	Open
33	FLD	Field signal output	OUT	3.3	Open
34	DVSS4	Digital GND	GND	0	−
35	ENB	Enable signal output. It is same timing of the HD signal.	OUT	3.3	Open
36	DVDD3	1.5 V power supply for Logic circuit	VDD	1.5	−
37	VDDIO3	3.3 V power supply for I/O	VDD	3.3	−
38	DETSIG	Output of No signal Low： No signal detected High： Signal detected	OUT	3.3	Open
39	MONI0	Monitor output terminal 0	OUT	3.3	Open
40	MONI1	Monitor output terminal 1	OUT	3.3	Open
41	TEST0	For TEST signal, Connect to GND	IN	3.3	−
42	TEST1	For TEST signal, Connect to GND	IN	3.3	−
43	SLAVE	Slave address select	IN	3.3	−
44	VDDIO4	3.3 V power supply for I/O	VDD	3.3	−
45	DVSS5	Digital GND	GND	0	−

Pin No.	Pin Name	Pin Function	Pin Type	Withstand voltage [V] (standard withstand voltage)	Processing at unused case
46	DVDD4	1.5V power supply for Logic circuit	VDD	1.5	—
47	AVDDAD1	2.5V power supply for ADC	VDD	2.5	—
48	AVSSAD1	Analog GND for ADC	GND	0	—
49	CVBS1IN	CVBS Input 1	IN	2.5	To GND via 0.1μF
50	ADBIAS1	Bias terminal for 10bit ADC	BIAS	2.5	-
51	CVBS2IN	CVBS Input 2	IN	2.5	To GND via 0.1μF
52	VRT	Upper limit reference voltage for ADC	BIAS	2.5	—
53	CVBS3IN	CVBS Input 3	IN	2.5	To GND via 0.1μF
54	VRM	Middle of reference voltage for ADC	BIAS	2.5	-
55	Y1IN	Y Input 1	IN	2.5	To GND via 0.1μF
56	VRB	Lower limit reference voltage for ADC	BIAS	2.5	-
57	Cb1IN	Cb Input 1	IN	2.5	To GND via 0.1μF
58	Cr1IN	Cr Input 1	IN	2.5	To GND via 0.1μF
59	ADBIAS2	Bias terminal for 8bit ADC	BIAS	2.5	-
60	Y2IN	Y Input 2	IN	2.5	To GND via 0.1μF
61	AVDDAD2	2.5V power supply for ADC	VDD	2.5	-
62	Cb2IN	Cb Input 2	IN	2.5	To GND via 0.1μF
63	AVSSAD2	Analog GND for ADC	GND	0	-
64	Cr2IN	Cr Input 2	IN	2.5	To GND via 0.1μF

5. Function

5.1 Overview

TC90106FG supports input signal of CVBS signal, Y/C signal(S signal) and Component signal (D1 or D2).

CVBS input signal is selectable among three signals, and Y signal and Chroma signal are separated by the 3line comb filter. Moreover chroma signal is processed by color decoder block. When input signal is CVBS, output signal format is ITU-R BT.656. This case, HD, VD, Field signal are also outputted.

It supports 480i, 480p, 576i and 576p for input component format.

Component signal is selectable from two input signals. In addition, output format is ITU-R BT.656 or 54 MHz 8bit (SAV&EAV implantation) and HD, VD and Field signals are outputted.

It chooses one among these inputs and it can output suitable signal.

In addition, it incorporates various picture improvement functions.

5.2 Input signal block

5.2.1 Main input signal format and internal processing

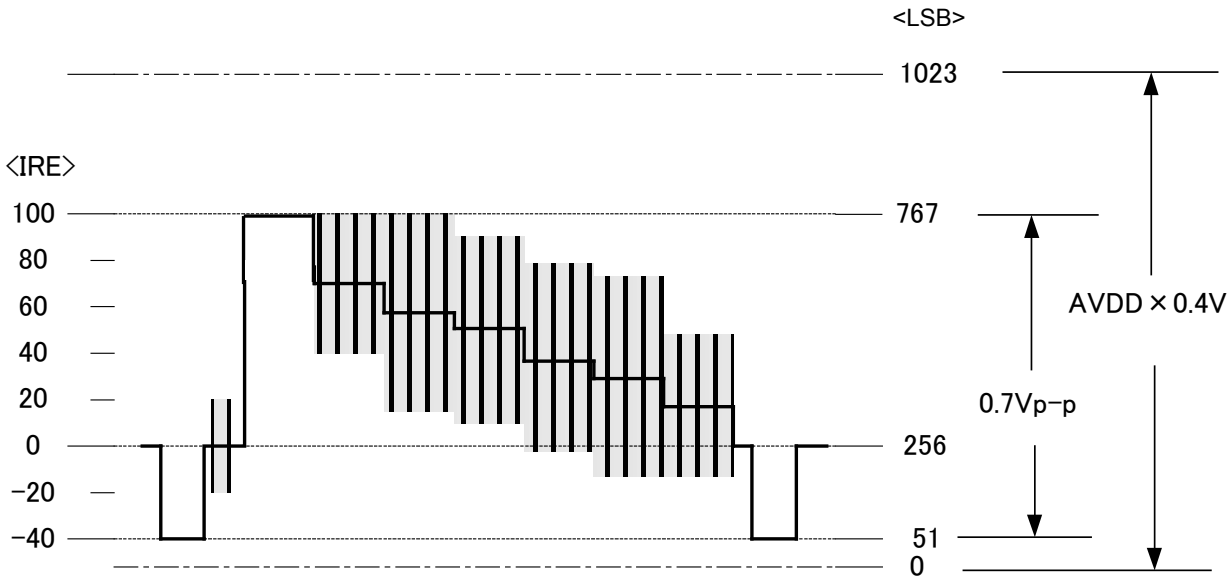
Main input signal formats are the following.
Sampling rate of ADC is 27MHz, and internal processing format is 4:2:2.

Input signal					Processing	
signal format			fH [kHz]	fV [Hz]	Sampling Clock [MHz]	Internal Processing Format
CVBS	NTSC		15.75/15.734	60/59.94	27	4:2:2
	PAL		15.625	50	27	4:2:2
Y/C	NTSC		15.75/15.734	60/59.94	27	4:2:2
	PAL		15.625	50	27	4:2:2
YCbCr	D1	525i	15.75/15.734	60	27	4:2:2
		625i	15.625	50	27	4:2:2
	D2	525p	31.5/31.469	60	27	4:2:2
		625p	31.25	50	27	4:2:2

5.2.2 Typical level of Analog input signal

The dynamic range of ADC is designed AVDD × 0.4. (AVDD = 2.5 V (Typ.))
Please set the recommended standard input level on 0.7 Vp-p in 140IRE when input signal is NTSC, PAL and Y signal of 480i/p, 576i/p.

1) CVBS signal / Y signal



CVBS(Y) signal (10bit ADC) has to input 0.7 Vp-p (equal 140IRE) when input signal is NTSC.
When input signal is chroma of the S-input, input level for ADC is 0.2 Vp-p (equal 40IRE) like 2) figure.
(It regards 0.7 Vp-p as 140IRE of the NTSC when VDD is 2.5 V.)
When input signal is CbCr (8 bit ADC) of component input level for ADC is 0.7 Vp-p at 100% like 3) figure.
(The figure above is 75% color bar signal)

Input and output level list

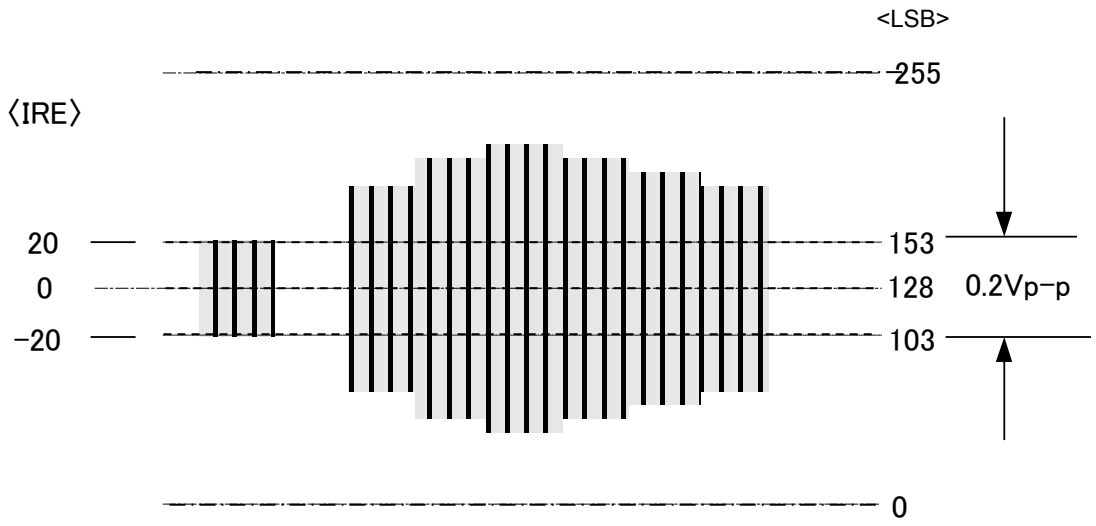
Input	Input level: Vp-p(*1)	Output: LSB (*2)	Notes
CVBS	0.7 Vp-p (500 mVp-p)	16-235 (8bit)	ITUR-BT656
Y	0.7 Vp-p (500 mVp-p)	16-235 (8bit)	ITUR-BT656
C	0.2 Vp-p (Burst)	31-225 (8bit)	ITUR-BT656
Cb	0.7 Vp-p	31-225 (8bit)	ITUR-BT656
Cr	0.7 Vp-p	31-225 (8bit)	ITUR-BT656

*1 Input level : Input level of CVBS and Y is 140IRE at white 100% of NTSC.
In (), It is the level from a pedestal to white 100%.
Input level of C (chroma) is Burst level of NTSC-CVBS signal.
Input level of CbCr is a level at the time of color-100% signal.

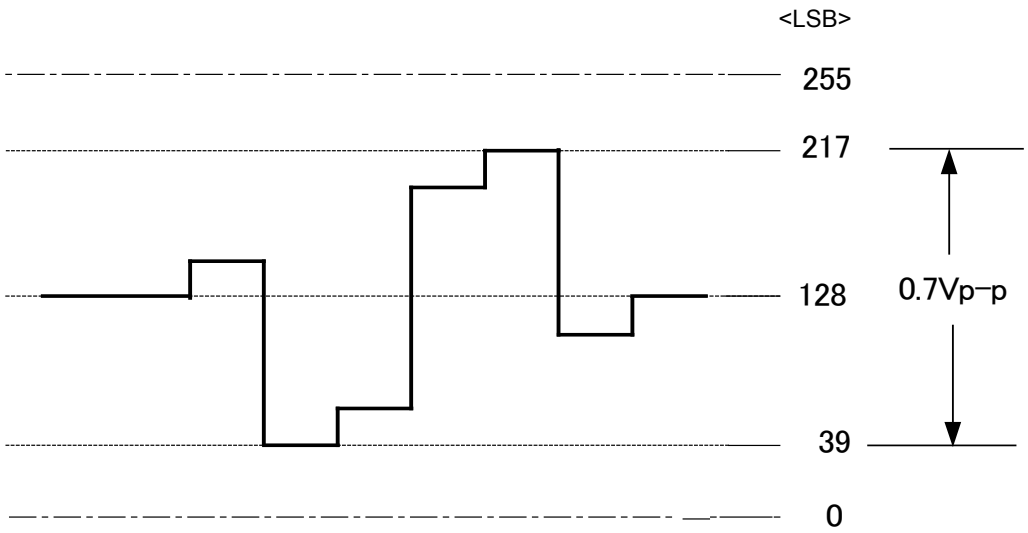
*2 Output level : Output level of CVBS and Y is 140IRE at white 100% of NTSC.
(Output is the level from a pedestal to white 100%.)
Output level of C is CbCr output level at time of color-100% signal.
Output of CbCr is a input at the time of color-100% signal.

(notes) Mentioned output level changes by picture level adjustment of contrast, gain, ACC, etc.
These are not maximum level.

2) C signal



3) Cb/Cr signal



5.3 Signal Output Block

5.3.1 H/V sync process and output format

This IC processes horizontal sync separation and vertical sync separation, and outputs a signal of HD and VD.
There are two kinds of output mode for pulse phase and pulse width. One is based on 656 format, other one is sync through mode which can output same timing and width as sync of input signal.
In addition, it is selectable from 656-3 and 656-4 mode in 656 format.

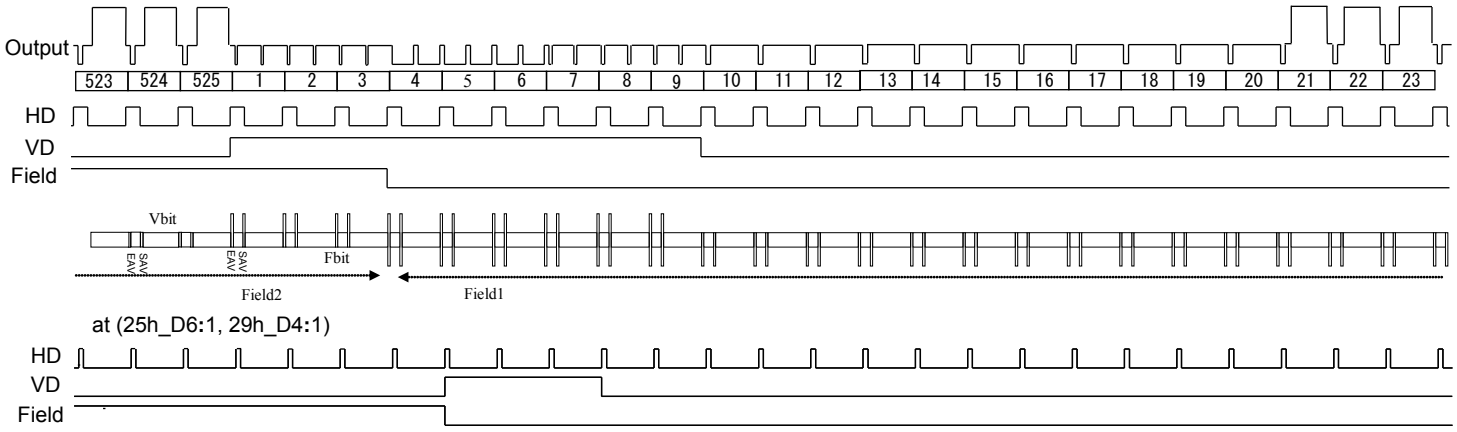
Setting the 656 mode

NTSC (CVBS)	Vbit: 1	Vbit: 0	Fbit: 1	Fbit:0
656-3	9 line SAV		3 line SAV	
		9 line EAV 263 line SAV		3 line EAV
	263 line EAV 272 line SAV			265 line SAV
		272 line EAV 525 line SAV	265 line EAV	
	525 line EAV		528(3) line SAV	
				528(3) line EAV
656-4	19 line SAV		3 line SAV	
		19 line EAV 263 line SAV		3 line EAV
	263 line EAV 282 line SAV			265 line SAV
		282 line EAV 525 line SAV	265 line EAV	
	525 line EAV		528(3) line SAV	
				528 line EAV

5.3.2 656 output timing of 480i / 60Hz

NTSC (525 line/60 Hz) first Field (odd)

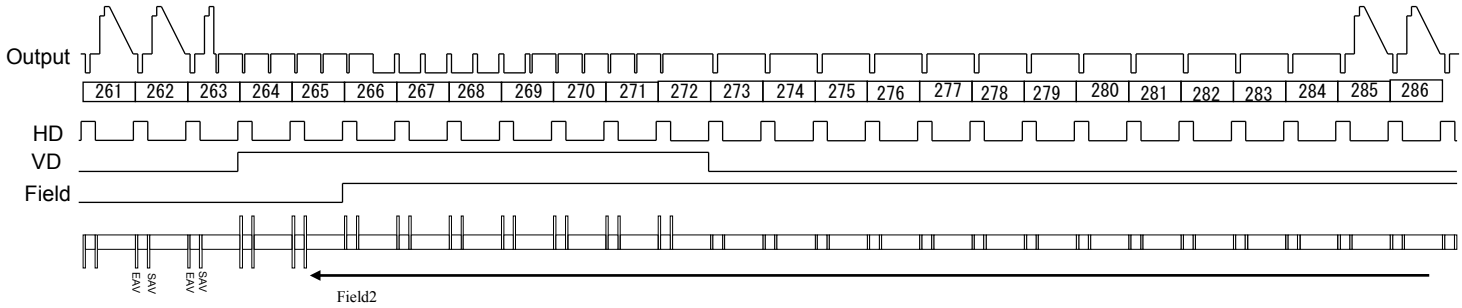
at (25h_D6:0, 29h_D4:0)



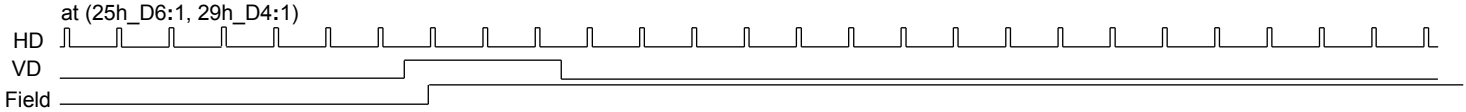
at (25h_D6:1, 29h_D4:1)

NTSC(525line/60Hz) second Field(even)

at (25h_D6:0, 29h_D4:0)



at (25h_D6:1, 29h_D4:1)



5.3.3 Output format

Output format is ITU-R BT.656 (27MHz_8bit_EAV&SAV) when input signal is CVBS, S or YCbCr(D1).
Output format is Clock=54MHz 8bit serial mode when input signal is YCbCr (525p/625p).

Output signal	Bit (Pin Number)	Data Rate		Notes
YCbCr [7-0]	8 (Pin17 to 27)	525i / 625i	27MHz	ITU-R BT.656
		525p / 625p	54MHz	Serial output (SAV & EAV implantation)
Field	1 (pin 33)	-		-
CLK	1 (Pin 30)	27MHz or 54MHz		-
HD	1 (pin 32)	fH		Output of regenerated Horizontal sync
VD	1 (Pin 31)	fV		Output of regenerated Vertical sync

Pedestal level for Y signal and center electric potential of CbCr signal are as below.

Y: pedestal level = 16 LSB
CbCr: center electric potential = 128 LSB

Signal processing under Y pedestal is set by register CLP (Bank 0, Sub address 29h).
CLP = 1 : The signal under pedestal level is fixed on 16LSB
CLP = 0 : The signal under pedestal level is outputted through

6. Absolute maximum rating

The absolute maximum ratings are rated values which must not be exceeded during operation, even for an instant. Exceeding the absolute maximum rating may result in destruction, degradation or other damage to the IC and other components. When designing applications for this IC, be sure that none of the absolute maximum rating values will ever be exceeded.

Characteristics	Symbol	Rating	Unit
Power voltage1 (1.5V system)	VDD1	-0.3 to VSS+2.0	V
Power voltage2 (2.5V system)	VDD2	-0.3 to VSS+3.5	V
Power voltage3 (3.3V system)	VDD3	-0.3 to VSS+3.9	V
Input voltage (2.5V system)	VIN2	-0.3 to VDD+0.3	V
Input voltage (3.3V system)	VIN3	-0.3 to VDD+0.3	V
Input voltage (3.3V system, 5V withstand voltage)	VIN4 (Note1)	-0.3 to VSS+5.5	V
Potential difference between power pins (between 1.5 V system power pins)	ΔVDG1 (Note2)	0.3	V
Potential difference between power pins (between 2.5 V system power pins)	ΔVDG2 (Note3)	0.3	V
Potential difference between power pins (between 3.3 V system power pins)	ΔVDG3 (Note4)	0.3	V
Power dissipation	PD (Note5)	1667	mW
Storage temperature	Tstg	-40 to 125	°C

Note1: The withstand voltage for pins (SDA, SCL) is 5 V.

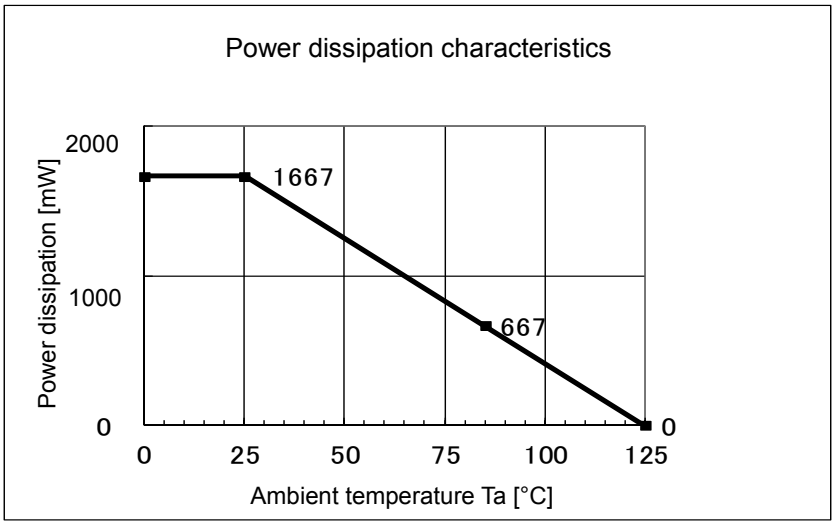
Note2: When you supply 1.5 V to the VDD pin, make sure that the potential difference between these VDD pins are not to exceed the rated value described here.

Note3: When you supply 2.5 V to the VDD pin, make sure that the potential difference between these VDD pins are not to exceed the rated value described here.

Note4: When you supply 3.3 V to the VDD pin, make sure that the potential difference between these VDD pins are not to exceed the rated value described here.

And, keep the maximum potential difference between all VSS pins within 0.01 V.

Note5: If you intended to use a temperature higher than Ta = 25°C, reduce by 16.67 mW per one degree (°C) increase.



7. Operating condition

The TC90106FG is not guaranteed to function correctly if it is used outside its specified power voltage range (1.5 V system power**:** 1.40 V to 1.60 V, 2.5 V system power**:** 2.3 V to 2.7 V, 3.3 V system power**:** 3.0 V to 3.6 V). Please use within the specified operating conditions.
If you temporarily leave and then return to the specified operating conditions, this IC's conditions will change, and so it is necessary to reset the IC's power to continue using it correctly within the specified operating conditions.

Characteristics	Corresponding terminal	Symbol	Min	Typ.	Max	Unit
Power voltage of digital block	12, 23, 36, 46	VDD-D	1.4	1.5	1.6	V
Power voltage of I/O block	19, 29, 37, 44	VDD-IO	3.0	3.3	3.6	V
Power voltage of XO block	11	VDDXO	2.3	2.5	2.7	V
Power voltage of PLL block	4	VDDPLL	2.3	2.5	2.7	V
Power voltage of analog block	1, 47, 61	VDDDA, VDDAD	2.3	2.5	2.7	V
Operating templature	-	Topr	-40	―	85	°C

8. Electrical characteristic

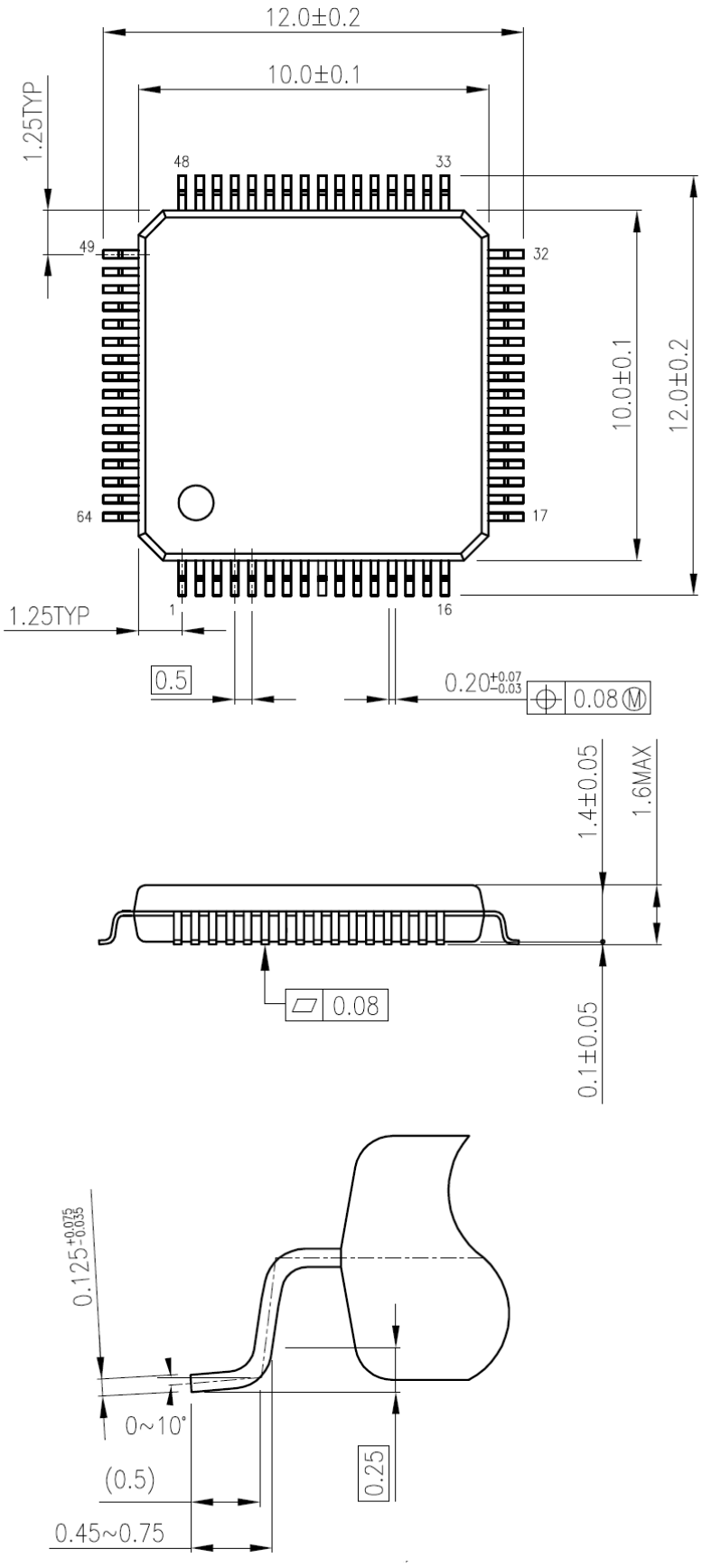
8.1 DC characteristic

(Ta = 25°C, VDD1 = 1.50 ± 0.1 V, VDD2 = 2.50 ± 0.2 V, VDD3 = 3.30 ± 0.3 V)

Characteristic	Terminal No.	Symbol	Min	Typ.	Max	unit	Notes
Power supply current	12, 23, 36, 46	IDD1 (1.5 V system)	—	30	45	mA	3.3 V system current will change by I/O.
	1, 4, 11, 47, 61	IDD2 (2.5 V system)	—	100	120	mA	
	19, 29, 37, 44,	IDD3 (3.3 V system)	—	25	65	mA	
Input Voltage	15, 41, 42, 43	VIH	VDD3 x 0.8	—	VDD3	V	3.3 V I/O terminal
	13, 14						5.0 V withstand voltage I/O terminal
	15, 41, 42, 43	VIL	VSS	—	VDD3 x 0.2	V	3.3 V I/O terminal
	13, 14						5.0 V withstand voltage I/O terminal
Input current	15, 41, 42, 43	IIH	-10	—	10	μA	3.3 V I/O terminal
	13, 14						5.0 V withstand voltage I/O terminal
	15, 41, 42, 43	IIL	-10	—	10	μA	3.3 V I/O terminal
	13, 14						5.0 V withstand voltage I/O terminal
Output voltage	17, 18, 20, 21, 24, 25, 26, 27, 30, 31, 32, 33, 35, 38, 39, 40	V_{OH}	VDD3 - 0.6	—	VDD3	V	3.3 V I/O terminal when 4 mA out load
		V_{OL}	VSS	—	0.4	V	3.3 V I/O terminal when 4 mA out load

9. Package

LQFP64-P-1010-0.50E **Unit: mm**



Weight: 0.4 g (typ.)

10. Revision History

Date	Revision	Contents
15/09/30	1.00	First edition
2016/06/21	2.00	2nd edition

RESTRICTIONS ON PRODUCT USE

- Toshiba Corporation, and its subsidiaries and affiliates (collectively "TOSHIBA"), reserve the right to make changes to the information in this document, and related hardware, software and systems (collectively "Product") without notice.
- This document and any information herein may not be reproduced without prior written permission from TOSHIBA. Even with TOSHIBA's written permission, reproduction is permissible only if reproduction is without alteration/omission.
- Though TOSHIBA works continually to improve Product's quality and reliability, Product can malfunction or fail. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of Product could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Before customers use the Product, create designs including the Product, or incorporate the Product into their own applications, customers must also refer to and comply with (a) the latest versions of all relevant TOSHIBA information, including without limitation, this document, the specifications, the data sheets and application notes for Product and the precautions and conditions set forth in the "TOSHIBA Semiconductor Reliability Handbook" and (b) the instructions for the application with which the Product will be used with or for. Customers are solely responsible for all aspects of their own product design or applications, including but not limited to (a) determining the appropriateness of the use of this Product in such design or applications; (b) evaluating and determining the applicability of any information contained in this document, or in charts, diagrams, programs, algorithms, sample application circuits, or any other referenced documents; and (c) validating all operating parameters for such designs and applications. **TOSHIBA ASSUMES NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS.**
- **PRODUCT IS NEITHER INTENDED NOR WARRANTED FOR USE IN EQUIPMENTS OR SYSTEMS THAT REQUIRE EXTRAORDINARILY HIGH LEVELS OF QUALITY AND/OR RELIABILITY, AND/OR A MALFUNCTION OR FAILURE OF WHICH MAY CAUSE LOSS OF HUMAN LIFE, BODILY INJURY, SERIOUS PROPERTY DAMAGE AND/OR SERIOUS PUBLIC IMPACT ("UNINTENDED USE").** Except for specific applications as expressly stated in this document, Unintended Use includes, without limitation, equipment used in nuclear facilities, equipment used in the aerospace industry, medical equipment, equipment used for automobiles, trains, ships and other transportation, traffic signaling equipment, equipment used to control combustions or explosions, safety devices, elevators and escalators, devices related to electric power, and equipment used in finance-related fields. **IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT.** For details, please contact your TOSHIBA sales representative.
- Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy Product, whether in whole or in part.
- Product shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.
- The information contained herein is presented only as guidance for Product use. No responsibility is assumed by TOSHIBA for any infringement of patents or any other intellectual property rights of third parties that may result from the use of Product. No license to any intellectual property right is granted by this document, whether express or implied, by estoppel or otherwise.
- **ABSENT A WRITTEN SIGNED AGREEMENT, EXCEPT AS PROVIDED IN THE RELEVANT TERMS AND CONDITIONS OF SALE FOR PRODUCT, AND TO THE MAXIMUM EXTENT ALLOWABLE BY LAW, TOSHIBA (1) ASSUMES NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (2) DISCLAIMS ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO SALE, USE OF PRODUCT, OR INFORMATION, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.**
- Do not use or otherwise make available Product or related software or technology for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). Product and related software and technology may be controlled under the applicable export laws and regulations including, without limitation, the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of Product or related software or technology are strictly prohibited except in compliance with all applicable export laws and regulations.
- Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. Please use Product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. **TOSHIBA ASSUMES NO LIABILITY FOR DAMAGES OR LOSSES OCCURRING AS A RESULT OF NONCOMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS.**