1. Features

General

- Embedded 2 DDC with DDC1/2B/CI
- Zoom scaling up and down
- Embedded one MCU with SPI flash controller
- It contains 3 ADCs in key pad application
- Require only one crystal to generate all timing
- Programmable internal low-voltage-reset (LVR)
- High resolution 4 channels PWM output, and wide range selectable PWM frequency
- Support input format up to FHD
- Embedded 1.2V LDO
- Embedded PC 99 support

Crystal

- 14.318MHz

Analog RGB Input Interface

- 1 Analog input support
- Integrated 8-bit, triple-channel 210MHz ADC/PLL
- Embedded programmable Schmitt trigger of HSYNC
- Support Sync-On-Green (SOG) and various kinds of composite sync modes
- On-chip high-performance hybrid PLL
- High resolution true 64 phases ADC PLL
- YPbPr support up to HDTV 1080p resolution

DVI 1.0 Compliant Digital Input Interface with HDCP 1.1

- Single link on-chip TMDS receiver
- Long cable support to 1.65GHz
- Adaptive algorithm for TMDS capability
- Data enable only mode support
- High-Bandwidth Digital Content Protection
- Enhanced protection of HDCP secret key

Embedded MCU

- Industrial standard 8051 core with external serial flash
- Low speed ADC for various applications
- I2C Master hardware support

Auto Detection /Auto Calibration

- Input format detection
- Compatibility with standard VESA mode and support user-defined mode
- Smart engine for Phase/Image position/Color calibration

Scaling

- Fully programmable zoom ratios
- Independent horizontal/vertical scaling
- Advanced zoom algorithm provides high image quality
- Sharpness/Smooth filter enhancement

Color Processor

- True 10 bits color processing engine
- xvYCC support
- sRGB compliance
- Advanced dithering logic for 18-bit panel color depth enhancement
- Dynamic overshoot-smear canceling engine
- Brightness and contrast control
- Programmable 10-bit gamma support
- Peaking/Coring function for video sharpness

VividColor™

- Independent color management (ICM)
- Dynamic contrast control (DCC)

Output Interface

- Fully programmable display timing generator
- Flexible data pair swapping for easier system design
- Display clock supports up to 93MHz for Single LVDS and 186MHz for Dual LVDS
- LVDS-output interface on single PCB
- Support 8-bit LVDS output
- Spread-Spectrum DPLL to reduce EMI
- Fixed Last Line output for perfect panel capability

Embedded OSD

- Embedded 16.5K SRAM dynamically stores OSD command and fonts
- Support multi-color RAM font, 1, 2 and 4-bit per pixel
- 64 color palette
- Maximum 18 window with alpha-blending/ gradient / gradient target color / gradient reversed color/ dynamic fade-in/fade-out, bordering/ shadow/3D window type
- Rotary 90,180,270 degree
- Independent row shadowing/bordering
- Programmable blinking effects for each character
- OSD-made internal pattern generator for factory mode
- Support 12x18~4x18 proportional font
- Hardware decompression for OSD font
- Support OSD scrolling
- Support 2 independent font based OSD

Power Supply

- 3.3V
- Low standby current (< 4mA)

2. Ordering Information

Part No.	VGA	DVI	HDCP	OD	FRC	Max. Resolution	Output	PKG
RTD2281CL-CG	Yes (210MHz)	Yes	Yes	No	No	1920x1080	Dual-LVDS	MQFN76 (green package)

3. Chip Data Path Block Diagram

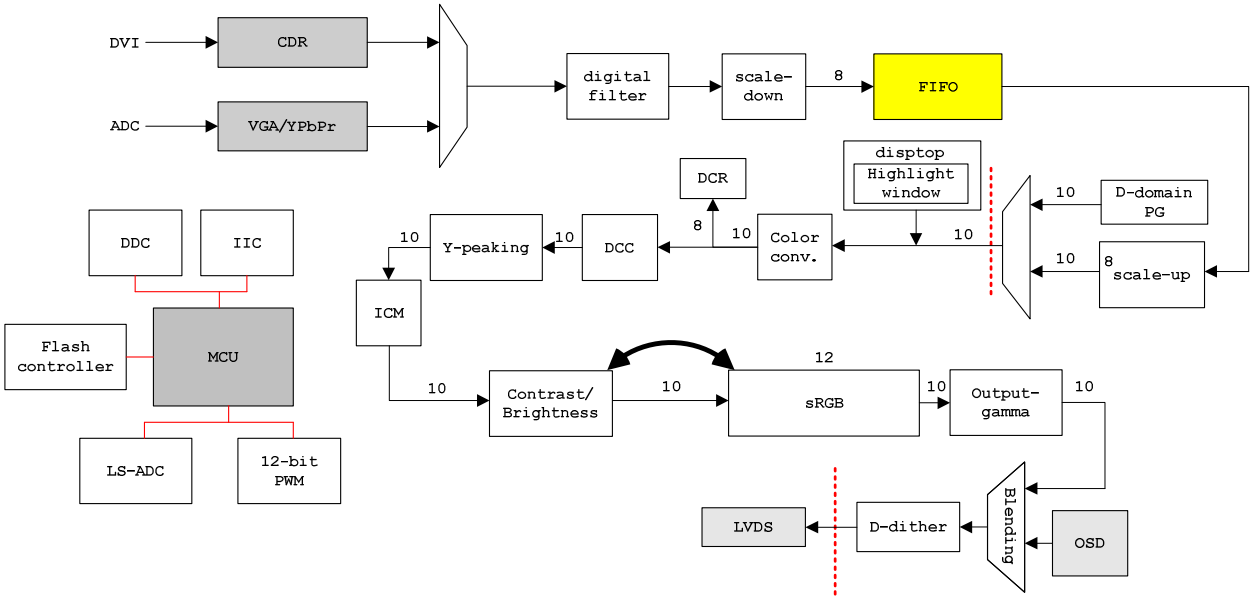


Figure1

4. Pin Diagram

76 Pin MQFN

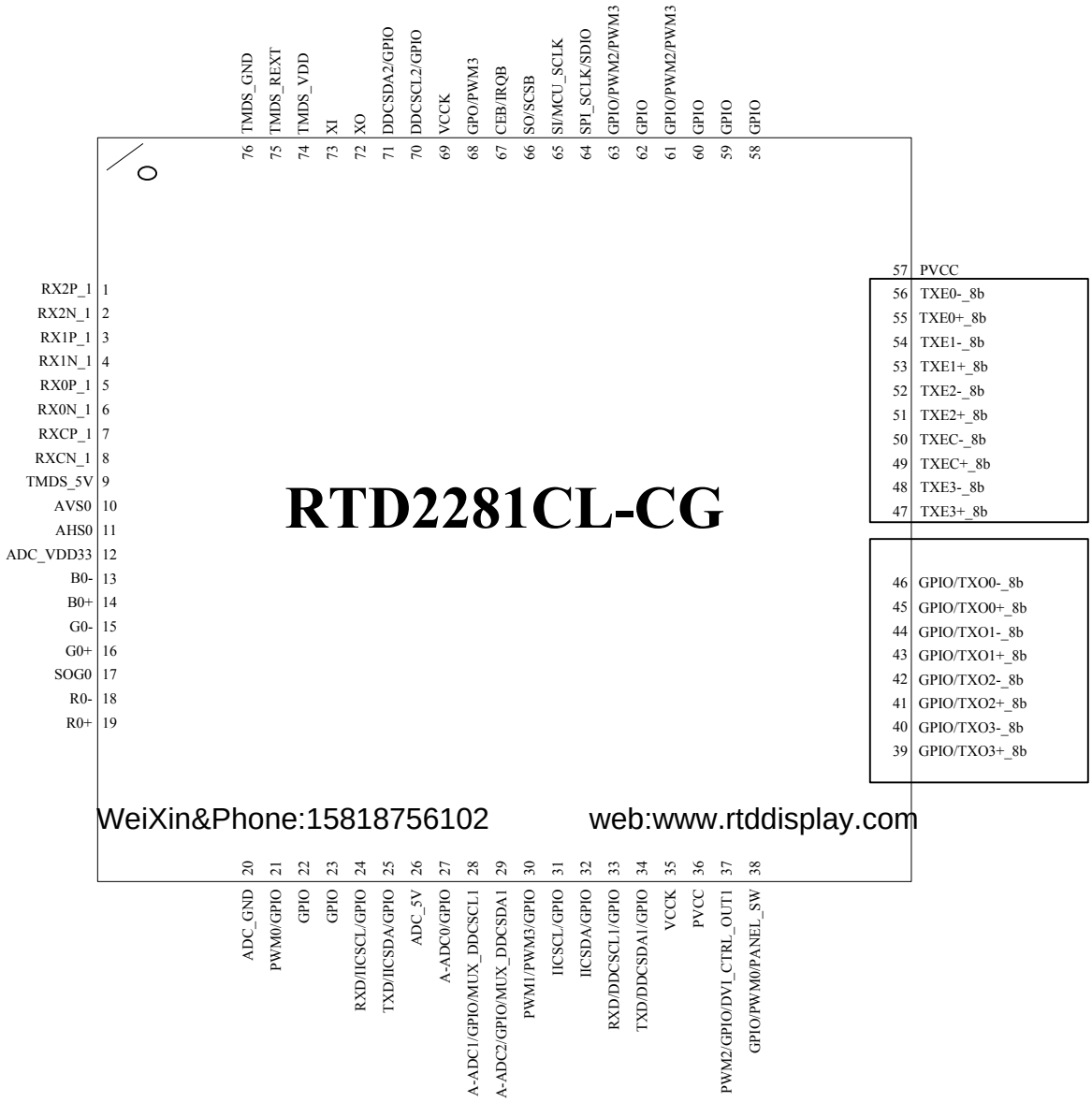


Table of Pin Assignment

(I/O Legend: A = Analog, I = Input, O = Output, P = Power, G = Ground)

Name	I/O	Pin #	Description	Note
RX2P_1	AI	1	TMDS Differential signal Input	
RX2N_1	AI	2	TMDS Differential signal Input	
RX1P_1	AI	3	TMDS Differential signal Input	
RX1N_1	AI	4	TMDS Differential signal Input	
RX0P_1	AI	5	TMDS Differential signal Input	
RX0N_1	AI	6	TMDS Differential signal Input	
RXCP_1	AI	7	TMDS Differential signal Input	
RXCN_1	AI	8	TMDS Differential signal Input	
TMDS_5V	P	9	TMDS 5V for embedded PC99	
AVS0	I	10	ADC vertical sync input	5V tolerance even when power-off
AHS0	I	11	ADC horizontal sync input	5V tolerance even when power-off
ADC_VDD33	AP	12	ADC 3.3V Power	(3.3V)
B0-	AI	13	Negative BLUE analog input (Pb-)	
B0+	AI	14	Positive BLUE analog input (Pb+)	
G0-	AI	15	Negative GREEN analog input (Y-)	
G0+	AI	16	Positive GREEN analog input (Y+)	
SOG0	AI	17	Sync-On-Green	
R0-	AI	18	Negative RED analog input (Pr-)	
R0+	AI	19	Positive RED analog input (Pr+)	
ADC_GND	AG	20	ADC ground	ADC GND
GPIO/PWM0	IO	21	MCU GPIO/PWM	5V tolerance even when power-off
GPIO	IO	22	MCU GPIO	5V tolerance even when power-off
GPIO	IO	23	MCU GPIO	5V tolerance even when power-off
RXD/GPIO/IICSCL	IO	24	MCU GPIO/IIC BUS	3.3V tolerance
TXD/GPIO/IICSDA	IO	25	MCU GPIO/IIC BUS	3.3V tolerance
ADC_5V	P	26	ADC 5V for embedded PC99	
A-ADC0/GPIO	IO	27	5-bit MCU ADC Input/MCU GPIO	5V tolerance (GPIO open-drain)
A-ADC1/GPIO /MUX_DDCSCL1	IO	28	5-bit MCU ADC Input /MCU GPIO /MUX_DDCSCL1 when (Page 10 , 0xAC[5] = 1) && (pin30 = 1), disable ddc function of pin33, 34 and swap to pin28, 29.	5V tolerance (GPIO open-drain)
A-ADC2/GPIO /MUX_DDCSDA1	IO	29	5-bit MCU ADC Input/MCU GPIO /MUX_DDCSDA1	5V tolerance (GPIO open-drain)

			when (Page 10 , 0xAC[5] = 1) && (pin30 = 1), disable ddc function of pin33, 34 and swap to pin28, 29.	
GPIO/PWM1/PWM3	IO	30	MCU GPIO/PWM	5V tolerance even when power-off (GPIO open-drain)
GPIO/IICSCL	IO	31	MCU GPIO/IIC BUS	5V tolerance even when power-off (GPIO open-drain)
GPIO/IICSDA	IO	32	MCU GPIO/IIC BUS	5V tolerance even when power-off (GPIO open-drain)
RXD/DDCSCL1/GPIO	IO	33	DDC1(Open drain I/O)/MCU GPIO	5V tolerance even when power-off (GPIO open-drain)
TXD/DDCSDA1/GPIO	IO	34	DDC1(Open drain I/O)/MCU GPIO	5V tolerance even when power-off (GPIO open-drain)
VCCK	P	35	Digital Power (supplied by embedded 1.2V)	(1.2V)
PVCC	P	36	Pad power	(3.3V)
GPIO/PWM2/DVI_CTRL_OUT1	IO	37	MCU GPIO/PWM/DVI Control Output	5V tolerance even when power-off (GPIO open-drain)
GPIO/PWM0/PANEL_SW	IO	38	MCU GPIO/PWM/Panel switch	5V tolerance even when power-off (GPIO open-drain)
TXO3+_8b/GPIO	IO	39	LVDS 8bit/MCU GPIO	3.3 V tolerance
TXO3-_8b /GPIO	IO	40	LVDS 8bit/MCU GPIO	3.3 V tolerance
TXO2+_8b/GPIO	IO	41	LVDS 8bit/MCU GPIO	3.3 V tolerance
TXO2-_8b/GPIO	IO	42	LVDS 8bit/MCU GPIO	3.3 V tolerance
TXO1+_8b/GPIO	IO	43	LVDS 8bit/MCU GPIO	3.3 V tolerance
TXO1-_8b/GPIO	IO	44	LVDS 8bit/MCU GPIO	3.3 V tolerance
TXO0+_8b/GPIO	IO	45	LVDS 8bit/MCU GPIO	3.3 V tolerance
TXO0-_8b/GPIO	IO	46	LVDS 8bit/MCU GPIO	3.3 V tolerance
TXE3+_8b	IO	47	LVDS 8bit	3.3 V tolerance

TXE3-_8b	IO	48	LVDS 8bit	3.3 V tolerance
TXEC+_8b	IO	49	LVDS 8bit	3.3 V tolerance
TXEC-_8b	IO	50	LVDS 8bit	3.3 V tolerance
TXE2+_8b	IO	51	LVDS 8bit	3.3 V tolerance
TXE2-_8b	IO	52	LVDS 8bit	3.3 V tolerance
TXE1+_8b	IO	53	LVDS 8bit	3.3 V tolerance
TXE1-_8b	IO	54	LVDS 8bit	3.3 V tolerance
TXE0+_8b	IO	55	LVDS 8bit	3.3 V tolerance
TXE0-_8b	IO	56	LVDS 8bit	3.3 V tolerance
PVCC	P	57	Pad 3.3V power	(3.3V)
GPIO	IO	58	MCU GPIO	5V tolerance even when power-off
GPIO	IO	59	MCU GPIO	5V tolerance even when power-off
GPIO	IO	60	MCU GPIO	5V tolerance even when power-off (GPIO open-drain)
GPIO/PWM2/PWM3	IO	61	MCU GPIO/PWM	5V tolerance even when power-off (GPIO open-drain)
GPIO	IO	62	MCU GPIO	5V tolerance even when power-off (GPIO open-drain)
GPIO/PWM3/PWM2	IO	63	MCU GPIO/PWM	5V tolerance even when power-off (GPIO open-drain)
SPI_SCLK/SDIO	IO	64	SPI flash serial data input/external MCU serial control I/F data in	3.3V tolerance
SI/MCU_SCLK	IO	65	SPI flash serial clock/external MCU serial control I/F clock	3.3V tolerance
SO/SCSB	IO	66	SPI flash serial data output /external MCU serial control I/F chip select	3.3V tolerance
CEB/IRQB	IO	67	SPI flash chip enable bar/IRQ Bar Note: It should be pulled down to 0 v or pulled up to 3.3 v in order to designate the MCU type(Internal MCU(3.3 volts) or External MCU(0 volts)).	3.3V tolerance

GPO/PWM3	IO	68	MCU GPO/PWM **(Power on latch Pin)** **(when AC Power On, Power on latch Pin must be "High")**	5V tolerance even when power-off
VCCK	P	69	Digital 1.2V Power (supplied by embedded 1.2V)	(1.2V)
DDCSCL2/GPIO	IO	70	DDC2(Open drain I/O)/MCU GPIO	5V tolerance even when power-off (GPIO open-drain)
DDCSDA2/GPIO	IO	71	DDC2(Open drain I/O)/MCU GPIO	5V tolerance even when power-off (GPIO open-drain)
XO	AO	72	Crystal Output	
XI	AI	73	Crystal Input	
TMDS_VDD	AP	74	TMDS power	(3.3 V)
TMDS_REXT	AI	75	Impedance Match Reference Resistor	Ref value: 12 K ohm to GND
TMDS_GND	AG	76	TMDS ground	

MCU GPIO Assignment

PIN No.	MCU GPIO Name	PIN No.	MCU GPIO Name	PIN No.	MCU GPIO Name
21	PB.0	32	P6.7	45	PA.3
22	PC.4	33	P3.0 / RXD<IO>	46	PA.4
23	PB.7	34	P3.1 / TXD<O>	58	P3.4 / CLKO<O>
24	PB.6 / RXD<IO>	37	PC.3 / INT0<I>	59	P3.2 / INT0<I> / T0<I>
25	PB.5 / TXD<O>	38	P1.0 / T2<I> / INT1<I>	60	P3.3 / INT1<I> / T2EX<I>
27	P6.1	39	P9.0	61	P3.5(BS) / T1<I>
28	P6.2	40	P9.1	62	P3.6
29	P6.3	41	P9.4	63	P3.7
30	P6.5	42	PA.0	68	PC.1
31	P6.6	43	PA.1	70	P7.3
		44	PA.2	71	P7.2

5. Electric Specification

DC Characteristics

Recommended Operating Conditions

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Voltage on Input (5V tolerant)	V_{IN}	-1		5	V
Supply Voltage	PVCC	3.14	3.30	3.47	V
Electrostatic Discharge	V_{ESD}			±2.5	kV
Latch-Up	I_{LA}			±100	mA
Ambient Operating Temperature	T_A	0		70	ºC
Storage temperature (plastic)	T_{STG}	-55		125	ºC
Thermal Resistance (Junction to Air)	θ_{JA}		25.7		ºC/W
Thermal Resistance (Junction to Case)	θ_{JC}		8.5		ºC/W
Junction Acceptable Temperature	T_j			125	ºC

Absolute Maximum Ratings

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Supply Voltage	PVCC			3.6	V
Storage temperature (plastic)	T_{STG}			150	ºC
Junction Acceptable Temperature	T_j			150	ºC

Note : Operation under the absolute maximum ratings doesn't imply the well function. Long term of stress to the absolute maximum ratings probably affect the device reliability and further cause permanent damage.

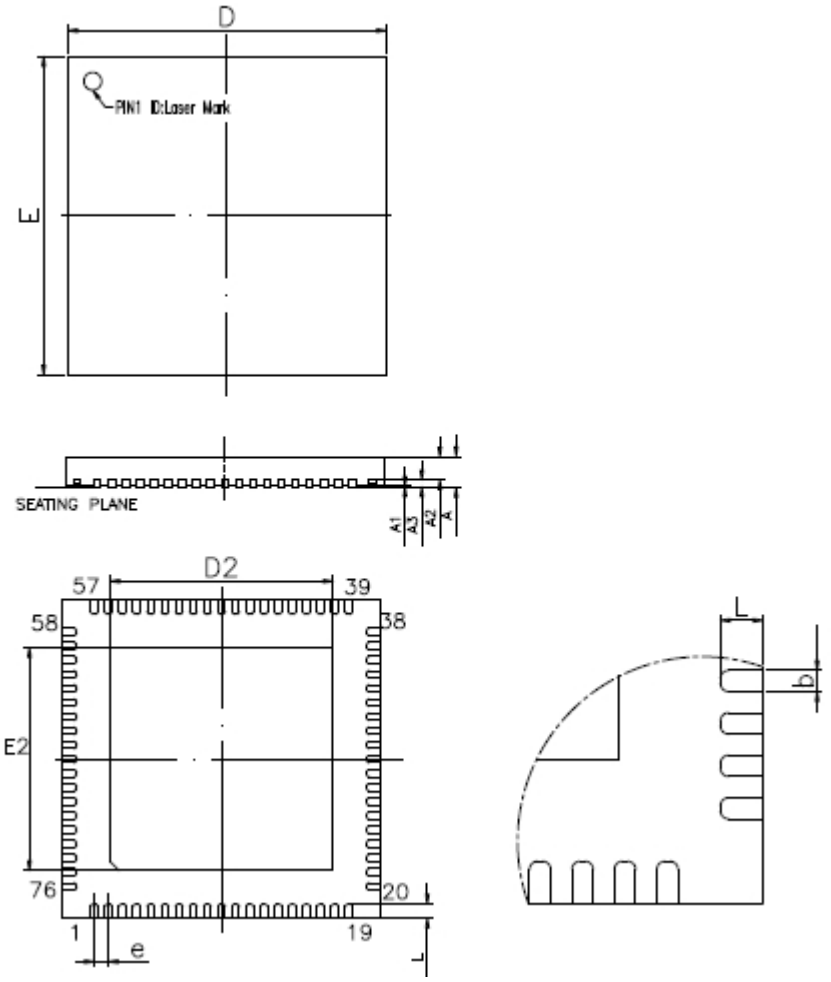
PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Reset pulse period	Trst-en[1]	1120			ns
Power on reset period	Tpor-rst[2]	145	146.5	148	ms

1. 16 * Xtal_cycle(1/14.318Mhz)
2. 65536*16*2*Xtal_cycle(1/14.318Mhz)

6. Mechanical Specification

76 Pin Package (MQFN)

Plastic Quad Flat No-Lead Package 76 Leads 9X9mm^2 Outline



Symbol	Dimension in mm			Dimension in inch		
	Min	Nom	Max	Min	Nom	Max
A	0.80	0.85	0.90	0.031	0.033	0.035
A_1	0.00	0.02	0.05	0.000	0.001	0.002
A_2	---	0.65	0.70	---	0.026	0.028
A_3	0.2 REF			0.008 REF		
b	0.15	0.20	0.25	0.006	0.008	0.010
D/E	9.00 BSC			0.354 BSC		
D_2/E_2	6.05	6.30	6.55	0.238	0.248	0.258
e	0.40 BSC			0.016 BSC		
L	0.30	0.40	0.50	0.012	0.016	0.020

Notes：

1. CONTROLLING DIMENSION：MILLIMETER(mm).

2. REFERENCE DOCUMENTL：JEDEC MO-220.