REALTEK

RTD2786-CG

MULTI-FUNCTION DISPLAY CONTROLLER

DATASHEET

Rev. 1.1
8 April 2015
Track ID: JATR-8275-15

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TRADEMARKS

USING THIS DOCUMENT

This document is intended for the software engineer's reference and provides detailed programming information.

Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide.

REVISION HISTORY

Revision	Release Date	Summary
1.1	2015/4/8	First release.

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1. General Description

The Realtek RTD2786 monitor controller combines an analog RGB input interface, multiple HDMI 2.0 compliant digital input interfaces with HDCP1.4, multiple DP1.2 digital input interfaces with HDCP1.4, and multiple MHL2.2 digital input interfaces with HDCP1.4. The embedded MCU is based on an industrial standard 8051 core with external serial flash.

The RTD2786 is suitable for multiple market segments and display applications, such as monitor, All in One PC, and embedded applications.

2. Features

General

■ RTD2786 supports input format up to 2560x1600 @ 60Hz, 2560x2048 @ 50Hz.

■ RTD2786 supports one analog RGB input and four multiple-digital- interface combo inputs

■ Support multiple panel interfaces like LVDS, and eDP

■ Support DisplayPort 1.2 MST daisy-chaining

■ RTD2786 supports PIP / PBP function

■ Zoom scaling up and down

■ Embedded one MCU with SPI flash controller.

■ It contains 4 ADCs in key pad application

■ Require only one crystal to generate all timing.

■ Programmable internal low-voltage-reset (LVR)

■ High resolution 6 channels PWM output, and wide range selectable PWM frequency.

Crystal

■ Support 14.318MHz crystal type

Analog RGB Input Interface

■ 1 Analog input supported

■ 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 PLLs

■ High resolution true 64 phase ADC PLL

■ YPbPr support up to HDTV 1080p resolution

Ultra-High Speed Combo Receiver

■ 2 ports of Ultra-High Speed Combo Receivers.

■ Each port can be configured as HDMI2.0 (6GHz), DisplayPort1.2(5.4GHz, HBR2), MyDP(5.4GHz, HBR2), or DVI as desired

■ In HDMI mode, the latest HDMI2.0 is supported

■ In HDMI mode, data enable only mode is supported

■ In HDMI mode, 6-bit, 8-bit, 10-bit, and 12-bit color depth transport is supported

■ In HDMI mode, High-Bandwidth Digital Content Protection (HDCP 1.4) is supported

■ In HDMI mode, HDMI audio is allowed to transmit to I2S/SPDIF output

■ In DisplayPort mode, the latest DisplayPort 1.2 is supported

■ In DisplayPort mode, three link layer speed HBR2 (5.4GHz), HBR (2.7GHz), RBR (1.62GHz) are supported

■ In DisplayPort mode, 6-bit, 8-bit, 10-bit, and 12-bit color depth transport is supported

- In DisplayPort mode, High-Bandwidth Digital Content Protection (HDCP 1.4) is supported

- In DisplayPort mode, HDMI audio is allowed to transmit to I2S/SPDIF output

- In MyDP mode, three link layer speed HBR2 (5.4GHz), HBR (2.7GHz), RBR (1.62GHz) are supported

- In MyDP mode, High-Bandwidth Digital Content Protection (HDCP 1.4) is supported

High Speed Combo Receiver

- RTD2786 supports 2 ports of High Speed Combo Receivers.

- Each port can be configured as HDMI1.4 (3GHz), MHL2.2 (3GHz), or DVI as desired

- In HDMI mode, HDMI1.4 is supported

- In HDMI mode, data enable only mode is supported

- In HDMI mode, 6-bit, 8-bit, 10-bit, and 12-bit color depth transport is supported

- In HDMI mode, High-Bandwidth Digital Content Protection (HDCP 1.4) is supported

- In HDMI mode, HDMI audio is allowed to transmit to I2S/SPDIF output

- In MHL mode, MHL2.2 is supported

- In MHL mode, High-Bandwidth Digital Content Protection (HDCP 1.4) is supported

- In MHL mode, packet pixel mode is supported

- In DVI mode, Digital Content Protection (HDCP 1.4) is supported

- In DVI mode, two adjacent receivers to support dual-link DVI with HDCP

Embedded MCU

- Industrial standard 8051 core with external serial flash

- Low speed ADC for various application

- I2C Master or Slave hardware supported

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

Audio

- Output: IIS , SPDIF

- Embedded Audio DAC

- Embedded headphone amp

Scaling

- Fully programmable zoom ratios

- Independent horizontal/vertical scaling

- Advanced zoom algorithm provides high image quality

- Sharpness/Smooth filter enhancement

- Support non-linear scaling from 4:3 to 16:9 or 16:9 to 4:3

Color Processor

- True 12-bit color processing engine

- Programmable 14-bit gamma support

- Programmable 12-bit 3D gamma support

- xvYCC supported

- Adobe/sRGB compliance

- Advanced dithering logic for the fewer panel color depth enhancement

- Dynamic overshoot-smear canceling engine

- Brightness and contrast control

- Peaking/Coring function for video sharpness

- Support UltraVivid III function to enhance image quality with minimal artificial effect on productivity applications

- Panel Uniformity (Brightness and color uniformity)

VividColor™

- Independent color management (ICM)

- Dynamic contrast control (DCC)

- 2nd generation of Precise color mapping (PCM)

- Content adaptive backlight control (CABC)

- Support ADC Noise Reduction

Embedded DDR3 Controller

- RTD2786 supports maximal 1 external 16-bit DDR3 DRAM

- Support DDR3 speed up to 1.6GHz

- Support 90 degree image rotation: Portrait-to-Landscape or Landscape-to-Portrait

- LiveShow™ Function, High-performance RTC (response time compensation).

- Frame Rate Control Function

- RTD2786 supports PIP / PBP function

Output Interface

- Support 8-bit / 10-bit output through either LVDS, or eDP

- Support 4-port LVDS with the speed of each port up to 100MHz

- Support 4-lane eDP (HBR2) with the output format up to 2560x1600 @ 60Hz

- Support DisplayPort 1.2 Multi-stream Transport (MST) with 3 maximal downstream capability. Share same ports of 4-lane eDP (HBR2)

- Fully programmable display timing generator

- Flexible data pair swapping for easier system design

- Fixed Last Line output for perfect panel capability

Embedded OSD

- Embedded 128K SRAM dynamically stores OSD command and fonts

- Support multi-color RAM font, 1, 2 and 4-bit per pixel

- 64 color palette

- Maximum 26 window with alpha-blending /

- gradient / gradient target color / gradient reversed color/ dynamic fade-in/fade-out, bordering/ shadow

- Rotate 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 / 1.5V / 1.1V power supply

3. System Applications

■ Display System on Motherboard, Monitor

■ Display System for All in One PCs and embedded applications

4. Pin Assignments

702-Ball EDHS BGA

Figure 1. Ball Diagram of EDHS BGA

Ball Diagram of RTD2786-CG

5. Pin Assignments Table

EDHS BGA Pin Table

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

Signals   Total : 368 balls

Table 1.   Signals Pin Assignment of EDHS BGA

Pin Name	I/O	Pin #	Description	Note
CBUS2 / GPIO	AIO	A4	MHL CBUS 2 / MCU GPIO	5V tolerance even when power-off
MHL_CABLE_DET2 / GPIO	IO	N5	MHL Cable Detect 2 / MCU GPIO	5V tolerance even when power-off
CBUS3 / GPIO	AIO	A3	MHL CBUS 3 / MCU GPIO	5V tolerance even when power-off
MHL_CABLE_DET3 / GPIO	IO	N6	MHL Cable Detect 3 / MCU GPIO	5V tolerance even when power-off
TMDS REXT	AI	N9	Impedance Match Reference Resistor For Scan mode,it should be pulled high	Ref value: 12 K ohm (Reference to GND)
NC		B3	NC	
NC		B1	NC	
NC		B2	NC	
NC		C3	NC	
NC		C2	NC	
NC		D3	NC	
NC		D2	NC	
NC		D1	NC	
NC		E3	NC	
NC		E1	NC	
NC		E2	NC	
NC		F3	NC	
NC		F2	NC	
NC		G3	NC	
NC		G2	NC	
NC		G1	NC	
RX2P_3	AI	H3	TMDS Differential Signal Input	3.3V tolerance
RX2N_3	AI	H1	TMDS Differential Signal Input	3.3V tolerance
RX1P_3	AI	H2	TMDS Differential Signal Input	3.3V tolerance
RX1N_3	AI	J3	TMDS Differential Signal Input	3.3V tolerance
RX0P_3	AI	J2	TMDS Differential Signal Input	3.3V tolerance
RX0N_3	AI	K3	TMDS Differential Signal Input	3.3V tolerance
RXCP_3	AI	K2	TMDS Differential Signal Input	3.3V tolerance
RXCN_3	AI	K1	TMDS Differential Signal Input	3.3V tolerance
RX2P_2	AI	L3	TMDS Differential Signal Input	3.3V tolerance
RX2N_2	AI	L1	TMDS Differential Signal Input	3.3V tolerance
RX1P_2	AI	L2	TMDS Differential Signal Input	3.3V tolerance

RX1N_2	AI	M3	TMDS Differential Signal Input	3.3V tolerance
RX0P_2	AI	M2	TMDS Differential Signal Input	3.3V tolerance
RX0N_2	AI	N3	TMDS Differential Signal Input	3.3V tolerance
RXCP_2	AI	N2	TMDS Differential Signal Input	3.3V tolerance
RXCN_2	AI	N1	TMDS Differential Signal Input	3.3V tolerance
LANE0P_1	AI	P5	DP Input : LANE0P / TMDS Differential Signal Input	3.3V tolerance
LANE0N_1	AI	P4	DP Input : LANE0N / TMDS Differential Signal Input	3.3V tolerance
LANE1P_1	AI	R2	DP Input : LANE1P / TMDS Differential Signal Input	3.3V tolerance
LANE1N_1	AI	R1	DP Input : LANE1N / TMDS Differential Signal Input	3.3V tolerance
LANE2P_1	AI	T4	DP Input : LANE2P / TMDS Differential Signal Input	3.3V tolerance
LANE2N_1	AI	T3	DP Input : LANE2N / TMDS Differential Signal Input	3.3V tolerance
LANE3P_1	AI	U2	DP Input : LANE3P / TMDS Differential Signal Input	3.3V tolerance
LANE3N_1	AI	U1	DP Input : LANE3N / TMDS Differential Signal Input	3.3V tolerance
LANE0P_0	AI	V4	DP Input : LANE0P / TMDS Differential Signal Input	3.3V tolerance
LANE0N_0	AI	V3	DP Input : LANE0N / TMDS Differential Signal Input	3.3V tolerance
LANE1P_0	AI	W2	DP Input : LANE1P / TMDS Differential Signal Input	3.3V tolerance
LANE1N_0	AI	W1	DP Input : LANE1N / TMDS Differential Signal Input	3.3V tolerance
LANE2P_0	AI	Y4	DP Input : LANE2P / TMDS Differential Signal Input	3.3V tolerance
LANE2N_0	AI	Y3	DP Input : LANE2N / TMDS Differential Signal Input	3.3V tolerance
LANE3P_0	AI	AA2	DP Input : LANE3P / TMDS Differential Signal Input	3.3V tolerance
LANE3N_0	AI	AA1	DP Input : LANE3N / TMDS Differential Signal Input	3.3V tolerance
CBUS0 / GPIO	AIO	AB5	MHL CBUS 0 / MCU GPIO	5V tolerance even when power-off
GPIO84_MHL_CABLE_DET0	I	Y7	MHL Cable Detect 0 / MCU GPIO	5V tolerance even when power-off
CBUS1 / GPIO	AIO	AB4	MHL CBUS 1/ MCU GPIO	5V tolerance even when power-off
GPIO86_MHL_CABLE_DET1	I	Y6	MHL Cable Detect 1 / MCU GPIO	5V tolerance even when power-off
DDCSCL_AUXP_D1	IO	AA7	AUX-CH 1 / DDC1 (Open drain I/O)	5V tolerance even when power-off
DDCSDA_AUXN_D1	IO	AA6	AUX-CH 1 / DDC1 (Open drain I/O)	5V tolerance

				even when power-off
DDCSCL_AUXP_D0	IO	AB7	AUX-CH 0 / DDC0 (Open drain I/O)	5V tolerance even when power-off
DDCSDA_AUXN_D0	IO	AB6	AUX-CH 0 / DDC0 (Open drain I/O)	5V tolerance even when power-off
NC		AC6	NC	
NC		AC4	NC	
NC		AC5	NC	
NC		AD6	NC	
NC		AD5	NC	
NC		AE6	NC	
NC		AE5	NC	
NC		AE4	NC	
NC		AF4	NC	
AVS	I	AC1	ADC vertical sync input	5V tolerance even when power-off
AHS	I	AC2	ADC horizontal sync input	5V tolerance even when power-off
B-	AI	AC3	Negative Blue analog input (Pb-)	3.3V tolerance
B+	AI	AD2	Positive Blue analog input (Pb+)	3.3V tolerance
G-	AI	AD3	Negative Green analog input (Y-)	3.3V tolerance
G+	AI	AE2	Positive Green analog input (Y+)	3.3V tolerance
SOG	AI	AE1	Sync-On-Green	3.3V tolerance
R-	AI	AE3	Negative RED analog input (Pr-)	3.3V tolerance
R+	AI	AF3	Positive RED analog input (Pr+)	3.3V tolerance
DDCSCL_VGA / GPIO	IO	AG2	DDC(Open drain I/O) / MCU GPIO	5V tolerance even when power-off
DDCSDA_VGA / GPIO	IO	AG1	DDC1(Open drain I/O) / MCU GPIO	5V tolerance even when power-off
MY_DP_SWITCH_1 / PWM2 / TCON[7] / GPIO	IO	AH2	My DP Switch 1 / PWM / TCON / MCU GPIO	5V tolerance even when power-off
MY_DP_SWITCH_0 / PWM3 / TCON[8] / GPIO	IO	AH1	My DP Switch 0 / PWM / TCON / MCU GPIO	5V tolerance even when power-off
VGA_CAB_DET_0 / PWM0 / TCON[4] / GPIO	I	AJ2	VGA Cable Detect 0 / PWM / TCON / MCU GPIO	3.3V tolerance
PWM1 / TCON[5] / INT0 / GPIO	I	AJ1	PWM / TCON / INT / MCU GPIO	3.3V tolerance
KEY_POWER_CTL / PWM4 / TCON[10] / INT1 / GPIO	IO	AK2	Key Power Control / PWM / TCON / MCU GPIO	3.3V tolerance
PANEL_POWER_CTL / PWM5 / TCON[12] / GPIO	IO	AK1	Panel Power Control / PWM / TCON / MCU GPIO	3.3V tolerance

IICSDA _1 / PWM0 / TCON[3] / GPIO	IO	AG4	IIC BUS / PWM / TCON / MCU GPIO	5V tolerance even when power-off
IICSCL_1 / PWM1 / TTCON[7] / GPIO	IO	AG3	IIC BUS / PWM / TCON / MCU GPIO	5V tolerance even when power-off
HPD_0 / GPIO	I	AH4	Hot Plug Detect 0 / MCU GPIO	5V tolerance even when power-off
HPD_1 / GPIO	I	AH3	Hot Plug Detect 1 / MCU GPIO	5V tolerance even when power-off
HPD_2 / GPIO	I	AJ4	Hot Plug Detect 2 / MCU GPIO	5V tolerance even when power-off
HPD_3 / GPIO	I	AJ3	Hot Plug Detect 3 / MCU GPIO	5V tolerance even when power-off
HPD_4 / GPIO	I	AK4	Hot Plug Detect 4 / MCU GPIO	5V tolerance even when power-off
HPD_5 / GPIO	I	AK3	Hot Plug Detect 5 / MCU GPIO	5V tolerance even when power-off
HDMI_CAB_DET0 / GPIO	I	AG7	HDMI Cable Detect 0 / MCU GPIO	3.3V tolerance
DPTX_HPD / GPIO	I	AH7	DP Hot Plug Detect / MCU GPIO	3.3V tolerance
A-ADC0 / INT0 / GPIO	IO	AL2	8-bit MCU ADC Input / INT /MCU GPIO	3.3V tolerance
A-ADC1/ INT1 / GPIO	IO	AL1	8-bit MCU ADC Input / INT /MCU GPIO	3.3V tolerance
A-ADC2 / GPIO	IO	AM2	8-bit MCU ADC Input / MCU GPIO	3.3V tolerance
A-ADC3 / GPIO	IO	AM1	8-bit MCU ADC Input / MCU GPIO	3.3V tolerance
DPTX_AUX_CH_P / GPIO	IO	AJ6	DPTX AUX-CH / MCU GPIO	5V tolerance even when power-off
DPTX_AUX_CH_N / GPIO	IO	AK6	DPTX AUX-CH / MCU GPIO	5V tolerance even when power-off
XI	AI	AM4	Crystal Input	3.3V tolerance
XO	AO	AM5	Crystal Output	3.3V tolerance
DPTX_LAN3N	AO	AM7	DP Output : LANE3N	3.3V tolerance
DPTX_LAN3P	AO	AL7	DP Output : LANE3P	3.3V tolerance
DPTX_LAN2N	AO	AK8	DP Output : LANE2N	3.3V tolerance
DPTX_LAN2P	AO	AJ8	DP Output : LANE2P	3.3V tolerance
DPTX_LAN1N	AO	AM9	DP Output : LANE1N	3.3V tolerance
DPTX_LAN1P	AO	AL9	DP Output : LANE1P	3.3V tolerance
DPTX_LAN0N	AO	AK10	DP Output : LANE0N	3.3V tolerance
DPTX_LAN0P	AO	AJ10	DP Output : LANE0P	3.3V tolerance
LINE_INL / WS / GPIO	AI	AL11	LINE-IN / IIS-WS / MCU GPIO	3.3V tolerance
LINE_INR / SCK / GPIO	AI	AM11	LINE-IN / IIS-SCK / MCU GPIO	3.3V tolerance
AUDIO_REF / MCK / GPIO	I	AE14	Audio Reference Resistance / IIS-MCK / MCU GPIO	3.3V tolerance
AUDIO_SOUTL / SD0	AO	AJ12	Audio Speaker Output / IIS-SD0 /	3.3V tolerance

/ SPDIF0 / GPIO			SPDIF 0 / MCU GPIO	
AUDIO_SOUTR / SD1 / SPDIF1 / GPIO	AO	AK12	Audio Speaker Output / IIS-SD1 / SPDIF 1 / MCU GPIO	3.3V tolerance
AUDIO_HOUTL / SD2 / SPDIF2 / GPIO	AO	AH13	Audio Headphone Output / IIS-SD2 / SPDIF 2 / MCU GPIO	3.3V tolerance
AUDIO_HOUTR / SD3 / SPDIF3 / GPIO	AO	AJ13	Audio Headphone Output / IIS-SD3 / SPDIF 3 / MCU GPIO	3.3V tolerance
SPI_CLK	IO	AL13	SPI flash serial clock	3.3V tolerance
SPI_SI	IO	AM13	SPI flash serial data input	3.3V tolerance
SPI_SO	IO	AM14	SPI flash serial data output	3.3V tolerance
SPI_CEB	IO	AL14	SPI flash chip enable bar	3.3V tolerance
FLASH_WP / GPIO	IO	AK14	FLASH Write Protect / MCU GPIO	3.3V tolerance
USB_SPI_CLK / CLKO / GPIO	IO	AL15	Serial clock / CLKO /MCU GPIO	3.3V tolerance
USB_SPI_SI / INT0 / GPIO	IO	AL16	Serial data input / INT / MCU GPIO	3.3V tolerance
USB_SPI_SO / INT1 / GPIO	IO	AM16	Serial data output / INT /MCU GPIO	3.3V tolerance
USB_SPI_CEB0 / IRQB / GPIO	IO	AK15	SPI chip enable bar 0 /IRQB / MCU GPIO	3.3V tolerance
USB_SPI_CEB1 / T2EX / GPIO	IO	AJ15	SPI chip enable bar 1 /T2EX/ MCU GPIO	3.3V tolerance
HDMI_CAB_DET1 / WS / GPIO / Test4b	IO	AH24	HDMI Cable Detect 1 / IIS-WS / MCU GPIO	3.3V tolerance
HDMI_CAB_DET2 / SCK / GPIO / Test4b	IO	AC29	HDMI Cable Detect 2/ IIS-SCK / MCU GPIO	3.3V tolerance
HDMI_CAB_DET3 / MCK / GPIO / Test4b	IO	AH26	HDMI Cable Detect 3/ IIS-MCK / MCU GPIO	3.3V tolerance
DP_CAB_DET1_0 / TCON[8] / GPIO / Test4b	IO	AD28	DP Cable Detect 1_0/ TCON / MCU GPIO	3.3V tolerance
DP_CAB_DET1_1 / SD0 / SPDIF0 / TCON[9] / GPIO	IO	AH25	DP Cable Detect 1_1 / IIS-SD0 / SPDIF0 / TCON / MCU GPIO	3.3V tolerance
DP_CAB_DET1_2 / SD1 / SPDIF1 / TCON[10] / GPIO	IO	AB28	DP Cable Detect 1_2 / IIS-SD1 / SPDIF1 / TCON / MCU GPIO	3.3V tolerance
DP_CAB_DET0_0 / SD2 / SPDIF2 / TCON[11] / GPIO	IO	AH27	DP_CAB_DET0_0 / SD2 / SPDIF2 / TCON / MCU GPIO	3.3V tolerance
DP_CAB_DET0_1 / SD3 / SPDIF3 / TCON[12] / GPIO	IO	AE29	DP_CAB_DET0_1 / SD3 / SPDIF3 / TCON / MCU GPIO	3.3V tolerance
DP_CAB_DET0_2 / TCON[13] / GPIO / Test4b	IO	AH28	DP_CAB_DET0_2/ TCON / MCU GPIO / Test4b	3.3V tolerance
UART_TX / TCON[0] / GPIO / Test4b	IO	AC28	UART TX / TCON / MCU GPIO	5V tolerance even when power-off
UART_RX / TCON[1] / GPIO / Test4b	IO	AG28	UART RX / TCON/ MCU GPIO	5V tolerance even when power-off
PWM0_1 / TCON[2] /	IO	AE28	PWM / TCON / MCU GPIO / PCB	5V tolerance

GPIO / PCB_POWE_DOWN / Test4b			Power Down	even when power-off
PWM1_1 / TCON[3] / GPIO / Test4b	IO	AG29	PWM / TCON / MCU GPIO	5V tolerance even when power-off
PWM2_1 / TCON[4] / IR_RECEIVER / GPIO	IO	AB29	PWM / TCON / IR Receiver / MCU GPIO	5V tolerance even when power-off
PWM3_1 / TCON[5] / T2 / GPIO	IO	AF29	PWM / TCON / T2/ MCU GPIO	5V tolerance even when power-off
PWM4_1 / TCON[6] / T1 / GPIO	IO	AD29	PWM / TCON / T1 / MCU GPIO	5V tolerance even when power-off
PWM5_1 / TCON[7] / T0 / GPIO	IO	AF28	PWM / TCON / T0 / MCU GPIO	5V tolerance even when power-off
NC		AH16	NC	
NC		AH18	NC	
NC		AJ17	NC	
NC		AK17	NC	
NC		AL18	NC	
NC		AM18	NC	
NC		AJ19	NC	
NC		AK19	NC	
NC		AL20	NC	
NC		AM20	NC	
NC		AJ21	NC	
NC		AK21	NC	
NC		AL22	NC	
NC		AM22	NC	
NC		AJ23	NC	
NC		AK23	NC	
NC		AL24	NC	
NC		AM24	NC	
NC		AL26	NC	
NC		AM26	NC	
NC		AK27	NC	
NC		AM27	NC	
NC		AL27	NC	
NC		AK28	NC	
NC		AL28	NC	
NC		AK29	NC	
NC		AL29	NC	
NC		AM29	NC	
NC		AM30	NC	
NC		AL30	NC	
NC		AM31	NC	
NC		AL31	NC	
NC		AM32	NC	
NC		AL32	NC	

NC		AK30	NC	
NC		AK32	NC	
NC		AK31	NC	
NC		AJ30	NC	
NC		AJ31	NC	
NC		AH30	NC	
NC		AH31	NC	
NC		AH32	NC	
TXF4P	IO	AG30	LVDS 10bit Output	3.3V tolerance
TXF4N	IO	AG32	LVDS 10bit Output	3.3V tolerance
TXF3P / TXF3P_8b	IO	AG31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXF3N / TXF3N_8b	IO	AF30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXFCP / TXFCP_8b	IO	AF31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXFCN / TXFCN_8b	IO	AE30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXF2P / TXF2P_8b	IO	AE31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXF2N / TXF2N_8b	IO	AE32	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXF1P / TXF1P_8b	IO	AD30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXF1N / TXF1N_8b	IO	AD32	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXF0P / TXF0P_8b	IO	AD31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXF0N / TXF0N_8b	IO	AC30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXE4P	IO	AC31	LVDS 10bit Output	3.3V tolerance
TXE4N	IO	AB30	LVDS 10bit Output	3.3V tolerance
TXE3P / TXE3P_8b	IO	AB31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXE3N / TXE3N_8b	IO	AB32	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXECP / TXECP_8b	IO	AA30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXECN / TXECN_8b	IO	AA32	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXE2P / TXE2P_8b	IO	AA31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXE2N / TXE2N_8b	IO	Y30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXE1P / TXE1P_8b	IO	Y31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXE1N / TXE1N_8b	IO	W30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXE0P / TXE0P_8b	IO	W31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXE0N / TXE0N_8b	IO	W32	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXD4P	IO	V30	LVDS 10bit Output	3.3V tolerance
TXD4N	IO	V32	LVDS 10bit Output	3.3V tolerance
TXD3P / TXD3P_8b	IO	V31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXD3N / TXD3N_8b	IO	U30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXDCP / TXDCP_8b	IO	U31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXDCN / TXDCN_8b	IO	T30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXD2P / TXD2P_8b	IO	T31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXD2N / TXD2N_8b	IO	T32	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXD1P / TXD1P_8b	IO	R30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXD1N / TXD1N_8b	IO	R32	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXD0P / TXD0P_8b	IO	R31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXD0N / TXD0N_8b	IO	P30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXC4P	IO	P31	LVDS 10bit Output	3.3V tolerance
TXC4N	IO	N30	LVDS 10bit Output	3.3V tolerance
TXC3P / TXC3P_8b	IO	N31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXC3N / TXC3N_8b	IO	N32	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXCCP / TXCCP_8b	IO	M30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXCCN / TXCCN_8b	IO	M32	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXC2P / TXC2P_8b	IO	M31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXC2N / TXC2N_8b	IO	L30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance

TXC1P / TXC1P_8b	IO	L31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXC1N / TXC1N_8b	IO	K30	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXC0P / TXC0P_8b	IO	K31	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
TXC0N / TXC0N_8b	IO	K32	LVDS 10bit Output / LVDS 8bit Output	3.3V tolerance
NC		J30	NC	
NC		J32	NC	
NC		J31	NC	
NC		H30	NC	
NC		H31	NC	
NC		G30	NC	
NC		G31	NC	
NC		G32	NC	
NC		F30	NC	
NC		F32	NC	
NC		F31	NC	
NC		E30	NC	
NC		E31	NC	
NC		D30	NC	
NC		D31	NC	
NC		D32	NC	
NC		C30	NC	
NC		C32	NC	
NC		C31	NC	
NC		B30	NC	
NC		B31	NC	
NC		A30	NC	
NC		A31	NC	
NC		A32	NC	
WS / TCON[12] / GPIO / Test4b	IO	U28	IIS-WS / TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	3.3V tolerance
SCK / TCON[13] / GPIO / Test4b	IO	T29	IIS-SCK / TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	3.3V tolerance
MCK / GPIO / Test4b	IO	T28	IIS-MCK / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	3.3V tolerance
SPDIF0 / SD0 / GPIO / Test4b	IO	R29	SPDIF0 / IIS-SD0 / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	3.3V tolerance
SPDIF1 / SD1 / GPIO / Test4b	IO	R28	SPDIF1 / IIS-SD1 / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	3.3V tolerance

SPDIF2 / SD2 / GPIO / Test4b	IO	P29	SPDIF2 / IIS-SD2 / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	3.3V tolerance
SPDIF3 / SD2 / GPIO / Test4b	IO	P28	SPDIF3 / IIS-SD2 / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	3.3V tolerance
PWM0_0 /DPTX_AUX_CH_P_1 / TCON[6] / GPIO	IO	N29	PWM / DPTX AUX-CH / TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	5V tolerance even when power-off
PWM1_0 /DPTX_AUX_CH_N_1 / TCON[7] / GPIO	IO	N28	PWM / DPTX AUX-CH / TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	5V tolerance even when power-off
PWM2_0 / DPTX_AUX_CH_P_2 / TCON[8] / GPIO	IO	M29	PWM / DPTX AUX-CH / TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	5V tolerance even when power-off
PWM3_0 / DPTX_AUX_CH_N_ 2 / TCON[9] / GPIO	IO	M28	PWM / DPTX AUX-CH / TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	5V tolerance even when power-off
PWM4_0 / DVS / TCON[10] / GPIO	IO	L29	PWM / DVS / TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	5V tolerance even when power-off
PWM5_0 / XTAL_CLK_OUT / TCON[11] / GPIO	IO	L28	PWM / XTAL_CLK_OUT / TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	5V tolerance even when power-off
IICSDA_0 / TCON[5] / GPIO / Test4b	IO	K29	IIC BUS / TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	5V tolerance even when power-off
IICSCL_0 / TCON[4] / GPIO / Test4b	IO	K28	IIC BUS / TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to	5V tolerance even when power-off

			power on.)	
TCON[3] / GPIO / Test4b	IO	J29	TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	3.3V tolerance
TCON[2] / GPIO / Test4b	IO	J28	TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	3.3V tolerance
TCON[1] / GPIO / Test4b	IO	H29	TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	3.3V tolerance
TCON[0] / GPIO / Test4b	IO	H28	TCON / MCU GPIO (This pin can not work when power saving & power Down. It needs to be configured again when it comes back to power on.)	3.3V tolerance
D_VREF	I	E10	Reference Voltage	
A_DQ0	IO	D22	Data Input / Output	
A_DQ1	IO	D18	Data Input / Output	
A_DQ2	IO	D23	Data Input / Output	
A_DQ3	IO	D19	Data Input / Output	
A_DQ4	IO	C20	Data Input / Output	
A_DQ5	IO	C14	Data Input / Output	
A_DQ6	IO	B20	Data Input / Output	
A_DQ7	IO	B15	Data Input / Output	
A_DQ8	IO	A16	Data Input / Output	
A_DQ9	IO	D21	Data Input / Output	
A_DQ10	IO	E20	Data Input / Output	
A_DQ11	IO	A19	Data Input / Output	
A_DQ12	IO	D20	Data Input / Output	
A_DQ13	IO	E23	Data Input / Output	
A_DQ14	IO	E21	Data Input / Output	
A_DQ15	IO	E22	Data Input / Output	
NC		B27	NC	
NC		E24	NC	
NC		A27	NC	
NC		E25	NC	
NC		B28	NC	
NC		A21	NC	
NC		A28	NC	
NC		C21	NC	
NC		D25	NC	
NC		D27	NC	
NC		E26	NC	
NC		C25	NC	
NC		D26	NC	
NC		A25	NC	
NC		E27	NC	

NC		C24	NC	
A_DM0	IO	C15	Input Data Mask	
A_DM1	IO	B19	Input Data Mask	
A_DM2	IO	D24	Input Data Mask	
A_DM3	IO	B26	Input Data Mask	
A_DQS0	IO	A18	Data strobe : Output with read data. Edge-aligned with read data. Input with write data. Center-aligned to write data.	
A_DQS0B	IO	B18	Data strobe : Output with read data. Edge-aligned with read data. Input with write data. Center-aligned to write data.	
A_DQS1	IO	B17	Data strobe : Output with read data. Edge-aligned with read data. Input with write data. Center-aligned to write data.	
A_DQS1B	IO	C16	Data strobe : Output with read data. Edge-aligned with read data. Input with write data. Center-aligned to write data.	
NC		B24	NC	
NC		C23	NC	
NC		C22	NC	
NC		B22	NC	
A_BA0	IO	E13	Bank Address Input	
A_BA1	IO	E19	Bank Address Input	
A_BA2	IO	D11	Bank Address Input	
A_A0	IO	D15	Address Input	
A_A1	IO	E17	Address Input	
A_A2	IO	D14	Address Input	
A_A3	IO	D12	Address input	
A_A4	IO	C10	Address Input	
A_A5	IO	D8	Address Input	
A_A6	IO	D16	Address Input	
A_A7	IO	E14	Address Input	
A_A8	IO	D17	Address Input	
A_A9	IO	C8	Address Input	
A_A10	IO	C11	Address Input	
A_A11	IO	B9	Address Input	
A_A12	IO	E18	Address Input	
A_A13	IO	B8	Address Input	
A_A14	IO	B10	Address Input	
A_RESET	IO	E15	Reset : A_RESET is an active LOW CMOS input referenced to VSS.	
A_MCLK	IO	C13	Clock : A_ MCLK and A_ MCLKZ are differential clock inputs. All address and control input signals are sampled on the crossing of the positive edge of A_MCLK and negative edge of A_MCLKZ.	
A_MCLKZ	IO	B13	Clock : A_ MCLK and A_ MCLKZ are differential clock inputs. All address and control input signals are sampled on the crossing of the positive edge of A_MCLK and negative edge of A_MCLKZ.	

A_ODT	IO	D13	On-die termination : ODT enables (registered HIGH) and disables (registered LOW) termination resistance internal to the DDR3 SDRAM.	
A_CKE	IO	B12	Clock enable	
A_CS#	IO	C12	Chip select	
A_RASZ	IO	E16	Command inputs : A_RASZ, A_CASZ, and A_WEZ (along with A_CS#) define the command being entered and are referenced to VREFCA.	
A_CASZ	IO	A9	Command inputs : A_RASZ, A_CASZ, and A_WEZ (along with A_CS#) define the command being entered and are referenced to VREFCA.	
A_WEZ	IO	A8	Command inputs : A_RASZ, A_CASZ, and A_WEZ (along with A_CS#) define the command being entered and are referenced to VREFCA.	
D_ZQ	I	E9	External reference ball for output drive calibration: This ball is tied to an external 240Ω resistor (1%), which is tied to VSSQ.	
CEC1 / GPIO	IO	L7	CEC 1 / MCU GPIO	5V tolerance even when power-off
CEC0 / GPIO	IO	K7	CEC 0 / MCU GPIO	5V tolerance even when power-off
EEWD / PWM2 / Tcon[3] / GPIO	IO	G5	EEWD / PWM / Tcon / MCU GPIO	3.3V tolerance
EEI2CSCL / PWM0 / TCON[1] / GPIO	IO	J7	CSCL / PWM / TCON / MCU GPIO	3.3V tolerance
EEI2CSDA / PWM1 / TCON[2] / GPIO	IO	H6	EEI2CSDA / PWM / TCON / MCU GPIO	3.3V tolerance
SCAN_MODE_N	IO	H5	When AC power is turned on, this ball must be pull "High".	3.3V tolerance
DDCSCL5 / GPIO	IO	J6	DDC5(Open drain I/O) / MCU GPIO	5V tolerance even when power-off
DDCSDA5 / GPIO	IO	J5	DDC5(Open drain I/O) / MCU GPIO	5V tolerance even when power-off
DDCSCL4 / GPIO	IO	K6	DDC4(Open drain I/O) / MCU GPIO	5V tolerance even when power-off
DDCSDA4 / GPIO	IO	K5	DDC4(Open drain I/O) / MCU GPIO	5V tolerance even when power-off
DDCSCL3 / GPIO	IO	L6	DDC3(Open drain I/O) / MCU GPIO	5V tolerance

				even when power-off
DDCSDA3 / GPIO	IO	L5	DDC3(Open drain I/O) / MCU GPIO	5V tolerance even when power-off
DDCSCL2 / GPIO	IO	M6	DDC2(Open drain I/O) / MCU GPIO	5V tolerance even when power-off
DDCSDA2 / GPIO	IO	M5	DDC2(Open drain I/O) / MCU GPIO	5V tolerance even when power-off
RESETB	I	N7	Chip reset bar	Low active; 5V tolerance even when power-off

Power / Ground Pin Assignment

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

Total : 334 balls

Table 2.   Power / Ground Pin Assignment of EDHS BGA

P/G Pin Name	I/O	Pin #	Description	Note
GDI_GND	AG	A1,A2,B4,C4,D4,E4,F4,G4,H4,J4, K4,L4,M4,N4,P6,P10,P11,R5,R6, T5,T6,T8,T9,T10,T11,U5,U6,V5,V 6,W5,W6,W8,W9,W10,W11,Y5,Y 10,Y11,AC10,AC11,AL4	Analog Ground	41 balls
GDI_VDD33	AP	N10,N11,AA11,AB10,AB11	3.3V Analog Power	5 balls
GDI_VDD10	AP	U8,U9,U10,U11,V8,V9,V10,V11	1.1V Analog Power	8 balls
MHL_VDD33	AP	R8,R9,R10,R11,AA9,AA10	3.3V Analog Power	6 balls
ADC_VDD33	AP	AD10,AD11	3.3V ADC Power	2 balls
ADC_GND	AG	AD4,AE8,AE9,AE10,AE11	ADC Ground	5 balls
AUDIO _VDD33	AP	AC13,AD13	3.3V Audio Power	2 balls
AUDIO GND	AG	AC14,AD14,AG12,AG13,AG14,A H12,AH14	Audio Ground	7 balls
VTX_VDD10	AP	AB20,AC15,AC20,AD15,AD20	1.1V Analog Power	5 balls
VTX_VDD33	AP	AC17,AC18,AD17,AD18	3.3V Analog Power	4 balls
VTX_GND	AG	AB21,AC16,AC19,AD21,AH8,AH 9,AH10,AH11,AH17,AH19,AH20, AH21,AH22,AH23	Analog Ground	14 balls
PVCC	P	N23,N24,P23,P24,R23,R24,T23,T 24,U23,U24	Pad Power	10 balls
1.5V_DDR	P	A5,A6,B5,B6,C5,C6,D5,D6,E5,E6 ,F5,F6,L15,L16,L17,L18,L19,L20, M16,M17,M18,M19	1.5V DDR3 Power	22 balls
VCCK_ON	P	N13,P13,R13,T13,U13,V13,W13, Y13,AA13,AB22,AB23,AB24,AB2 5,AB26,AC22,AC23,AC24,AC25,	1.1V Core Power	24 balls

		AC26,AD22,AD23,AD24,AD25,AD26		
VCCK_OFF	P	J15,J16,K16,K18,N22,P22,R22,T22,U22,V22,V23,V24,W22,W23,W24,Y22,Y23,Y24,AA22,AA23,AA24	1.1V Core Power	21balls
DDRPLL_VDD10	P	F8	1.1V DDR PLL Power	1 balls
DDR PLL GND	G	F7	DDR PLL Ground	1 balls
DGND	G	A10,A12,A13,A15,A22,A24,B11,B14,B16,B21,B23,B25,C9,C17,C18,C19,C26,C27,C28,D7,D10,E7,E8,E11,E12,F13,F14,F15,F20,F21,F22,F23,F24,F25,F26,F27,F28,G13,G14,G15,G20,G21,G22,G23,G24,G25,G26,G27,G28,H13,H20,H21,H22,H23,N14,N15,N16,N17,N18,N19,N20,P14,P15,P16,P17,P18,P19,P20,P21,P25,P26,R14,R15,R16,R17,R18,R19,R20,R21,R25,R26,R27,T14,T15,T16,T17,T18,T19,T20,T21,T25,T26,T27,U14,U15,U16,U17,U18,U19,U20,U21,U25,U26,U27,V14,V15,V16,V17,V18,V19,V20,V21,V25,V26,V27,V28,V29,W14,W15,W16,W17,W18,W19,W20,W21,W25,W26,W27,W28,W29,Y14,Y15,Y16,Y17,Y18,Y19,Y20,Y21,Y25,Y26,Y27,Y28,Y29,AA14,AA15,AA16,AA17,AA18,AA19,AA20,AA21,AA25,AA26,AA27,AA28,AA29,	Digital Ground	156 balls

6. Electrical Specifications

EDHS BGA DC Characteristics

6.1. Recommended Operating Conditions

Table 3.   Recommended Operating Conditions of EDHS BGA

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Voltage on Input (5V tolerance)	V_{IN}	-1		5	V
Supply Voltage	PVCC	3.14	3.30	3.47	V
DDR Voltage	1.5V_DDR	1.43	1.5	1.57	V
Core Power On Voltage	VCCK_ON	1.05	1.1	1.15	V
Core Power Off Voltage	VCCK_OFF	1.05	1.1	1.15	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		110	ºC
Thermal Resistance (Junction to Air)	θ_{JA}		13.85		ºC/W
Thermal Resistance (Junction to Case)	θ_{JC}		5.07		ºC/W
Junction Acceptable Temperature	T_j			125	ºC

6.2. Absolute Maximum Ratings

Table 4.   Absolute Maximum Ratings of EDHS BGA

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Supply Voltage	PVCC			3.6	V
Storage Temperature (plastic)	T_{STG}			150	ºC
Junction Acceptable Temperature	T_j			125	ºC

Note : Operation under the absolute maximum ratings does not imply well-functioning. Long-term stress to the absolute maximum ratings would probably affect the device reliability or further cause permanent damage.

6.3. Reset Period

Table 5.   Reset Period of EDHS BGA

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(1/14.3Mhz)
2. 65536*16*2*Xtal_cycle(1/14.3Mhz)

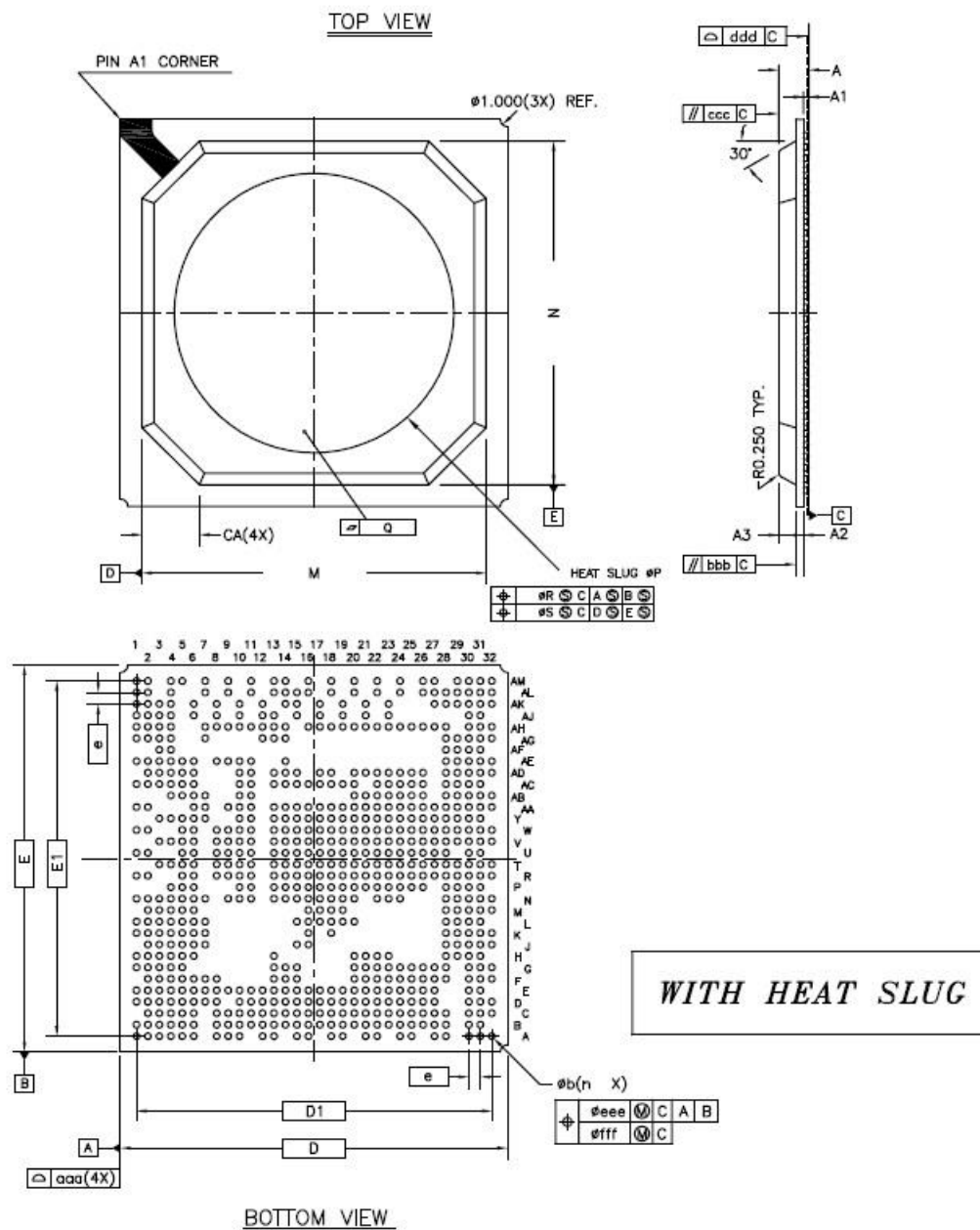# 7. Mechanical Specifications

EDHS BGA

Figure 2. Mechanical Specification of EDHS BGA (1)

		Symbol	Common Dimensions		
			MIN.	NOM.	MAX.
Package :			HS FBGA		
Body Size:	X	D	27.000		
	Y	E	27.000		
Ball Pitch :		e	0.800		
Total Thickness :		A	1.982	2.100	2.218
Mold Thickness :		A3	1.170 Ref.		
Substrate Thickness :		A2	0.560 Ref.		
Ball Diameter :			0.450		
Stand Off :		A1	0.320	–	0.420
Ball Width :		b	0.375	–	0.525
Mold Area :	X	M	24.000		
	Y	N	24.000		
H/S Exposed Size:		P	19 ~ 20		
H/S Flatness		Q	0.100		
H/S Shift With Substrate Edge:		R	0.300		
H/S Shift With Mold Area:		S	0.500		
Chamfer		CA	4.000 Ref.		
Package Edge Tolerance :		aaa	0.150		
Substrate Parallelism :		bbb	0.100		
Mold Parallelism :		ccc	0.200		
Coplanarity:		ddd	0.150		
Ball Offset (Package) :		eee	0.150		
Ball Offset (Ball) :		fff	0.080		
Ball Count :		n	702		
Edge Ball Center to Center :	X	D1	24.800		
	Y	E1	24.800		

Figure 3.   Mechanical Specification of EDHS BGA (2)

8. Ordering Information

Table 6.   Ordering Information

Part Number	Package	Status
RTD2786-CG	702-ball EDHS BGA (green package)	-

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