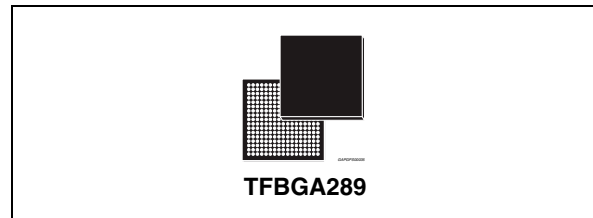


## AM/FM, DAB/DAB+/DMB-A, DRM multi-standard digital radio receiver

Data brief – production data

### Features

- General
  - Multi-standard digital radio channel decoding
  - Multi-standard digital radio source decoding (MPEG-1 AL II, AAC+, BSAC)
  - AM/FM phase diversity
  - Multiple streams parallel processing FM phase diversity plus two DAB channels
  - Audio processing
  - Audio streaming from SD Card, CD ROM (optional)
- Supported radio systems
  - AM, FM including phase diversity
  - DAB, DAB+, DMB-Audio, DRM
  - HD Radio™ (interface to co-processor STA680)
- Hardware
  - ARM946™ core running at 131.328 MHz
  - STxP70 DSP core running at 262.256 or 131.328 MHz
  - Emerald DSP core running at 131.328 MHz
  - Multilayer AMBA architecture (6 AHB + 3 APB)
  - DMA supporting 16 channels on 4 dedicated AHB layers
  - VIC supporting vectored and standard interrupt requests
  - Hardware support for conditional access (one-time programmable 768-bit memory)
  - 2 internal PLLs:
    - System PLL for cores and peripherals
    - Fractional PLL for audio clocks input
- Memories
  - 64 KB Internal ROM
  - 740 KB of Internal RAM available for cores
  - 512 KB configurable DAB de-interleaving memory
  - SPI Flash interface for application code loading running up to 16 MHz (optional SD/MMC)



- External SDR-SDRAM interface: 2 x 512 Mbit, 16-bit data bus
- Turner interface
  - 4 RF Front End LVDS interface
  - 4 master SPI interface for tuners control
- Other interfaces
  - Audio interfaces (up to 8 independent and configurable I<sup>2</sup>S based on 45.6 kHz rate)
  - Enhanced audio interface (fully configurable I<sup>2</sup>S)
  - 2 S/PDIF receiver
  - I<sup>2</sup>C interface
  - 3 UART - GPIO interface (24 dedicated lines)
  - Micro IF (based on 2 RX SPI + 2 TX SPI slave only + 4 audio clocks)
  - 5 timers
  - JTAG and ETM interfaces
- Power supplies
  - Core supply: 1.2 V
  - I/O supply: 3.3 V
  - Triple voltage I/O supply for host processor interface: 1.8 V / 2.5 V / 3.3 V
  - Analog supply: 2.5 V (external or internal LDO)
- Applications
  - Multi-standard smart tuner module
  - Multi-standard car-radio receiver
  - Home receivers

**Table 1. Device summary**

Order code	Temp range	Package	Packing
STA662	-40 °C to +85 °C	TFBGA289	Tray

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# 1 Description

The STA662 from STMicroelectronics is a system-on-chip, based on multiple microcontroller and DSP cores, designed for demodulating and decoding the most common digital radio standards and the legacy AM/FM. The digital radio standards supported by STA662 are: DAB (ETSI EN 300 401), DAB+ (ETSI TS 102 563), DMB (ETSI TS 102 428), DRM (ETSI ES 201 980).

The STA662 implements the three main functions of a Eureka-147 DAB and DRM receiver specification.

The synchronization: including sampling clock and carrier frequency synchronization;

The channel demodulation and decoding: including OFDM demodulation and convolutional decoding;

The source decoding: consisting of audio and data decoding. The source decoding can be moved on an external application processor (a.k.a. SDEC - Source DECoder) so that the additional resources available on the STA662 IC can be used to implement a second DAB demodulation chain.

STA662 can demodulate in parallel two DAB streams and legacy AM or FM phase diversity stream.

AM and FM signal processing and audio functions are implemented on STA662 using dedicated resources, different from the resources used for the digital radio stream demodulation. FM phase diversity is implemented, as an alternative dual FM channels processing is possible, including the possibility to commute seamlessly from FM phase diversity to FM single tuner + FM background channels.

To pursue the best combination in terms of current consumption, flexibility, system and device cost, these functions are implemented by a combination of hardware and software. Functional blocks which are standard and computationally intensive are implemented by custom logic. Functional blocks where flexibility is a key feature are implemented in software.

The STA662 combines it all into a single IC consisting of several hardware blocks implementing custom logic, an ARM946™ microcontroller one 24 bit DSP Emerald core and one 32 bit DSP xP70 core to guarantee the proper level of flexibility, low current consumption.

Such flexibility enables the STA662 to be ready for future evolution, including the possibility to implement new radio standards (i.e. HD-Radio™), and allows the implementation of specific and optional features.

Multiple interfaces such as SPI, UART, I<sup>2</sup>C and I<sup>2</sup>S, allow a flexible utilization of the device and several applications can be addressed, including T-DMB (video), by connecting an additional application co-processor (i.e. STA2165).

The STA662 implements a additional SDR-SDRAM interface thus allowing to implement memory-consuming firmware like DAB middleware and DAB/FM seamless switching.

To build a complete DAB/FM/AM receiver, the STA662 needs to be fed by the STA610 RF Multistandard front-end or from the STA610A RF AM/FM front-end. STA662 supports up to four RF FE connected in parallel.

The STA662 is assembled in TFBGA289 package.

### 1.1 DAB signal processing

The STA662 performs the processing of the DAB signal. It receives a complex digital signal from an DAB RF tuner either from a multi-standard RF tuner. The native sample rate is 2048 kHz. Sample rate conversion hardware is provided on-chip. This feature allows the STA662 to operate with various DAB front-ends.

The STA662 is then responsible for detection, acquisition, and demodulation of the DAB signal. Such functions are primarily implemented by dedicated hardware accelerators. The demodulated signal is then passed to the ARM946 processor, for audio decoding and handling of data services. A digital decompressed audio at different audio rates is output via the Digital Audio Interface.

As an alternative the compressed audio stream can be transferred to an application processor for the audio demodulation.

Figure 1 presents a functional diagram describing the data flow inside STA662 for DAB demodulation and decoding. In some use cases *source and service decoding* can be performed on the external application processor.

Figure 1. DAB demodulating and decoding functional data flow diagram

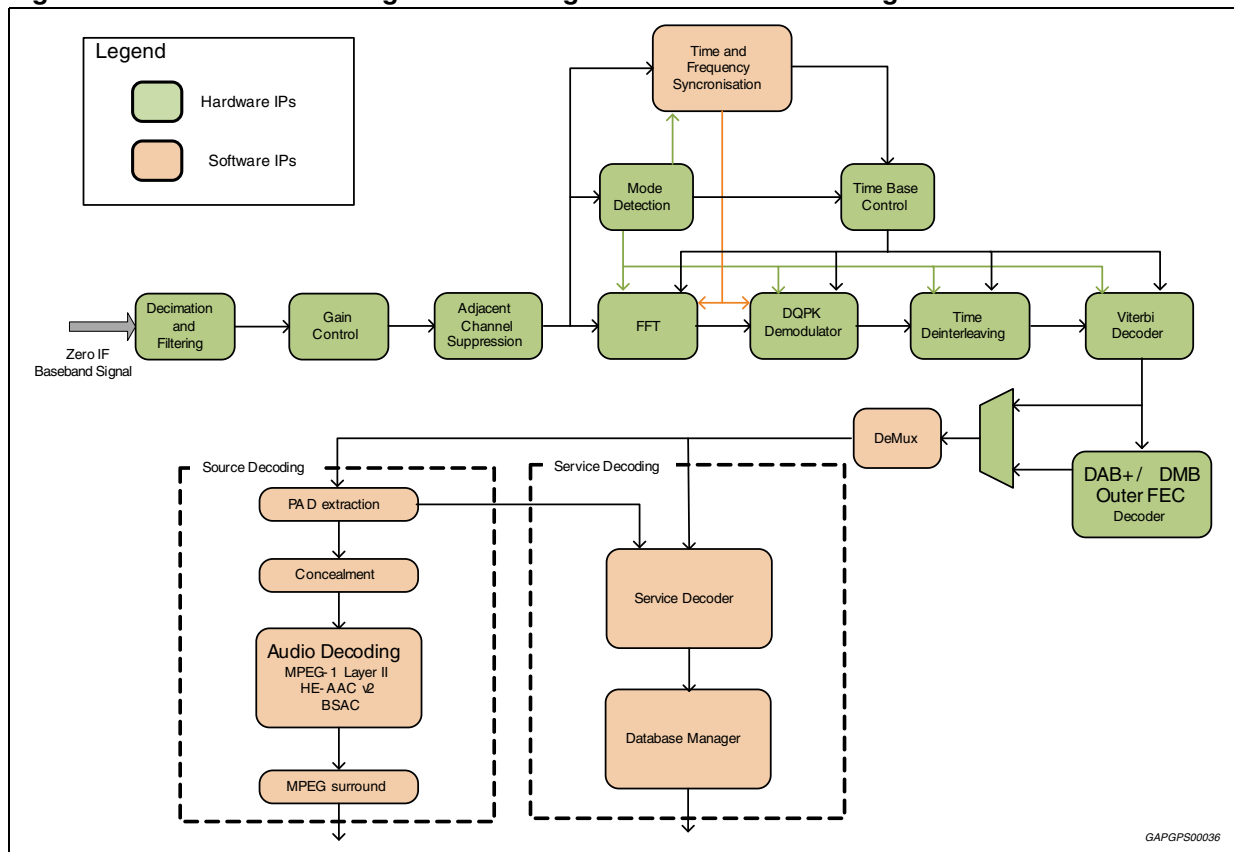
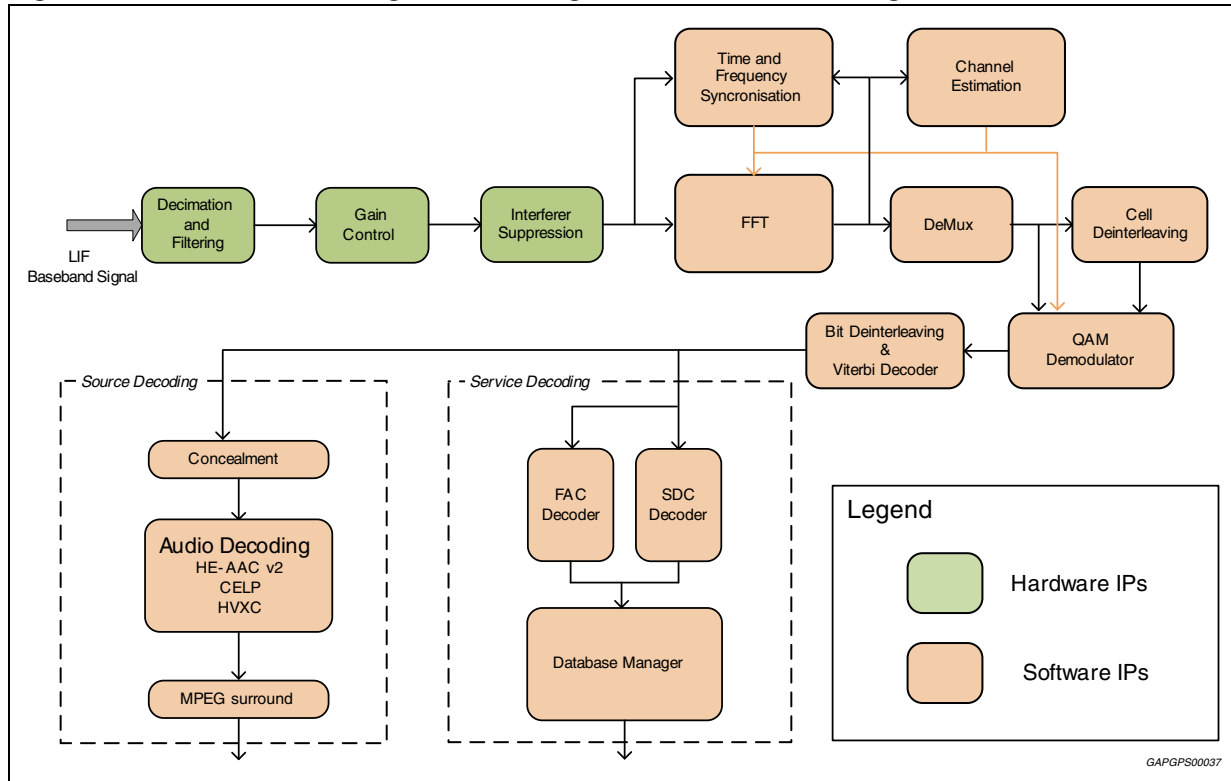


Figure 2 presents a functional diagram describing the data flow inside STA662 for DRM demodulating and decoding.

Figure 2. DRM demodulating and decoding functional data flow diagram



## 1.2 FM signal processing

STA662 features several strategies to improve the reception of FM signals. A DSP controlled variable bandwidth filtering of the complex base-band allows to greatly cope with adjacent channel interferences. Multipath fading distortion is mitigated by exploiting antenna switching (the antenna RF-switch is controlled through Digital pins).

After dynamic filtering, the IFP block demodulates the complex base-band signal; the result of the detection is the composite MPX signal, which carries the stereo-encoded audio and the Radio Data System (RDS) information.

The MPX signal is still affected by the instantaneous spike noise originated by the electromagnetic fields due to fast current variations, and to the high current discharges in the ignition phase of the car engine. Dedicated algorithms for spike detection and suppression have been developed; this processing is supported by a set of dedicated hardware accelerators under the control and supervision of the ARM946 microcontroller.

Audio information is subsequently retrieved from the processed MPX by the mixed hardware/software stereo-decoder, which also performs typical weak-signal processing functions as stereo channel blending, audio soft-muting for low antenna signals, and de-emphasis filtering. After further sample rate reduction, the audio is available for transmission to external devices.

### 1.3 AM signal processing

AM bandwidth is about one-twentieth of the FM, thus additional filtering and decimation is required after the DDC. The hardware demodulator in the IFP block is used for evaluating the amplitude of the complex base-band. Similarly to FM signals, engine-injection-related spikes are a concern; spike detection and noise-blanking are performed on the audio signal, on the contrary since multipath distortion is not a major issue in AM, no antenna switching is necessary.

### 1.4 Multiple DAB radio stream parallel processing

STA662 is capable to simultaneously demodulate two different DAB Radio streams. This unique feature enables the device to decode a DAB Radio audio stream, in parallel with any data service broadcasted by a different radio channel. The implementation of the dual streams DAB Radio processing requires that two DAB or Multi-standard RF tuners are connected to the STA662.

In a single channel implementation a single RF tuner is used. In such configuration STA662 is able to demodulate at the same time both the audio and the data carried inside a single DAB ensemble. This means that the user can listen audio and receive traffic information or data broadcasted on that specific single ensemble.

In a dual DAB channels implementation STA662 can simultaneously demodulate audio and data associated to different ensembles. This means that in the example above it would be still possible to receive traffic information broadcasted on ensemble A while listening audio program broadcasted on ensemble B.

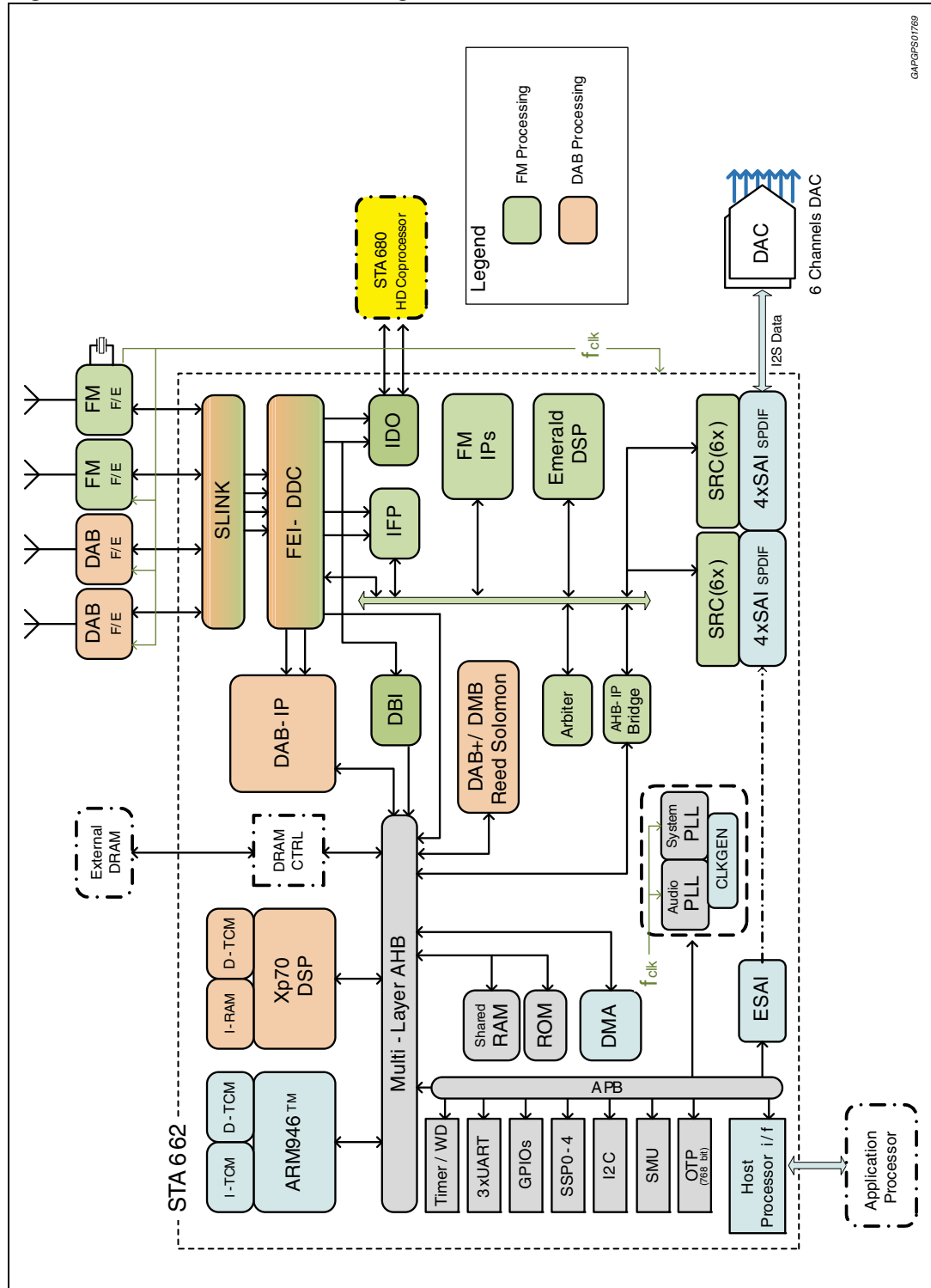
STA662 can always perform FM phase diversity reception in parallel with DAB channels decoding.

The audio coming from any AM/FM/DAB/DRM channel is output in I<sup>2</sup>S digital format. The I<sup>2</sup>S configurable protocol is well-suited for sending data to external audio processors or digital-in power amplifier.

## 1.5 Overview of main functional blocks

### 1.5.1 STA662 architecture

Figure 3. STA662 architecture diagram



### 1.5.2 ARM946 subsystem

A 32-bit ARM946 microcontroller with ITCM and DTCM is embedded into STA662. It controls the I/O peripherals, the hardware accelerator modules, the DSP-Emerald subsystem and the DSP STxP70 subsystem.

The ARM946 is used for:

- System and data flow control
- Peripherals initialisation
- RDS alternate frequency switching strategy

and in some application can be also used for:

- DAB/DAB+ database management
- Seamless linking

The STA662 embeds into the ARM946 subsystem both program and data cache to improve performance during code execution. Also, the amount of Tightly Coupled Memory (TCM) assigned to the core can be defined by the user at start-up.

The ARM946 uses a trace macro-cell (ETM9) with a trace debug port (JTAG) for in-system programming and debugging tools. JTAG is also shared with the DSP-Emerald subsystem and STxp70 subsystem.

An AHB bus matrix is implemented for connecting the 6 AHB masters (ARM, xp70 and 4 DMAs) with all the AHB slaves.

Flexible DMA resources are available for data movement while VIC logic is implemented to managed interrupt requests.

### 1.5.3 DSP-STxP70 subsystem

STA662 includes a 32-bit STxP70- with DTCM and L2Pram. MPx and FPx extensions are connected to the core.

The STxP70 is used for:

- DRM channel decoding
- DAB channel time and frequency synchronization
- Audio decoding

The STxP70 subsystem contains a program cache to improve performance during code execution. AHB master port is used by the DSP to access the STA662 architecture while an AHB slave port is used by DMA to access xp70 subsystem memories.

Debugging of the software running on the DSP-STxp70 is possible through the JTAG interface.

### 1.5.4 DSP-Emerald subsystem

STA662 includes a 24-bit DSP-Emerald core connected to the hardware-accelerator (HAR) modules and to the microcontroller via the IPBUS.

The Emerald core is used for:

- FM processing
- AM processing
- Audio processing



The Emerald DSP is connected to the AHB bus matrix through an AHB slave port. Debugging of the software running on the DSP-Emerald is possible through the JTAG interface.

### 1.5.5 IPBUS subsystem

The IPBUS is a multi-master bus, connecting hardware accelerators for AM/FM and Audio processing, the DSP-Emerald subsystem and the AMBA subsystem. Access to the IPBUS is controlled by a dedicated arbiter module (ARB).

Potential bus masters are:

- The BCO (Bus Control) unit is used for managing the IPBUS transfers. This unit provides one set of programmable (synchronous or isochronous) transfers
- The ARM946 which is intended as STA662 system controller
- The DMA channels for data exchange
- The STxp70 for specific data processing
- The SPI debug interface for debugging and monitoring the subsystem

The IPBUS subsystem is connected to the AHB bus matrix through the AHB2IPBUS Bridge.

### 1.5.6 Embedded memories

STA662 offers a flexible solution for allocating memories to the cores or IPs.

Default configuration is:

- 8KB+128KB of D and I TCMs and 8KB+16KB of D & P caches for the ARM core
- 160KB of DTCM, 8KB Pcache and 64KB L2 program memory for the STxp70 DSP
- 18 KB+18KB X & Y RAM, 24 KB PRAM and 64 KB PROM for the Emerald core
- 64 KB of AHB ROM and 256 KB of AHB RAM
- 2 x 256KB of de-interleaving memory for the DAB-IP

AHB memories are available for both the AHB mapped cores: ARM946 and STxp70.

DAB-IP de-interleaving memory if not used for the DAB channel decoding can be remapped as ARM TCM or AHB memory.

Part of the AHB memory can be remapped as ARM946 TCM.

STxp70 L2 memory and D-TCM are mapped on the AHB and then available for the AHB masters.

Emerald memories are mapped on the AHB and available for the AHB masters.

### 1.5.7 SDR-SDRAM controller

STA662 embeds an SDR-SDRAM controller. The controller is connected to the AHB multi layer architecture so that it expands the memory available for both the AHB mapped cores: ARM946 and STxp70.

SDRAM controller clock is selectable by a top level register between four different possibilities: full rate, which corresponds to the ARM9 core frequency (131.328 MHz), or this frequency divided by a factor 2, 4 or 8.

### 1.5.8 Hardware accelerators

STA662 uses an optimized partitioning of the processing functions among Emerald, ARM946, STxP70 and special-purpose hardware resources. Thanks to this strategy, high CPU-intensive routines take advantage of dedicated hardware processing blocks, though ensuring flexibility and customizability provided by the Emerald and STxP70 DSPs and the ARM946 embedded microcontroller; in fact, ARM946 is monitoring and controlling the processing running both on Emerald, STxP70 and on the dedicated peripherals.

The list of hardware accelerators embedded into the STA662 comprises:

- DAB demodulator compliant with the EUREKA 147 standard for Digital Audio Broadcasting
- RS-DEC DMB
- RS-DEC DAB+
- FM/AM Digital Intelligent Selectivity System (D-ISS)
- FM/AM Stereo matrix separation
- FM/AM Virtual Phase-array Antenna switching strategy
- FM/AM Antenna Switching Diversity control (ASD)
- FM/AM RDS demodulation and decoding (RDS)
- Audio processing programmable filters

### 1.5.9 Audio interface

The Audio Interface (AIF) is used to exchange digital audio data with external devices using different Serial Audio Interface (SAI1-4) or S/PDIF protocols into the IPBUS subsystem.

Two AIF modules have been integrated into STA662.

The 6-channels Stereo Low Pass Filter (LPF6CH) can be used to apply programmable low pass filtering to the audio signal.

The 6-channels Stereo Channel Sample Rate Converter (SRC6) introduces flexibility to the system, since it allows exchanging data with external units whose data rate is different from the STA662 one.

Signal routing to and from the STA662 is ruled by the internal audio Input/Output multiplexer (AIMUX/AOMUX) configurable by software.

### 1.5.10 Enhanced serial audio interface

The Enhanced Serial Audio Interface (ESAI) is a serial synchronous interface intended to give transfer capability of digital audio samples or more generally digital data between the AMBA architecture and external devices.

A clock divider logic gives the flexibility to the macro to generate all the needed audio clock rates. Master TX and slave RX are supported. TX and RX FIFO are available to reduce the load of the data channels inside the AMBA architecture.

### 1.5.11 Serial link and front end interface

The Serial Link (SLINK) and the Front End interface (FEI) blocks have been designed to connect the STA662 with different kind of tuners such as STA606 or STA610. The SLINK block performs serial to parallel conversion of data coming from the tuners while the FEI block performs decimation, filtering and other digital signal processing such as gain control, DC offset cancellation, image rejection and so on.

The Frontend interface is made up of four processing path: two dedicated to DAB and two to AM, FM, HD Radio or DRM baseband signal processing. If the system clock is provided by a frontend tuner then this FE must be connected to interface number 2 or 3.

### 1.5.12 APB peripherals

Three dedicated peripheral bus (APB0, APB1 and APBC) connect the AMBA architecture to several interfaces like 5 x SSP, EFT, MTU, I2C, GPIO, 3 x UART and Host interfaces.

### 1.5.13 System management unit

A system management unit (SMU) has been designed to control all the top level functionalities. These register are mapped on the APBC bus.

### 1.5.14 Clock and reset distribution unit

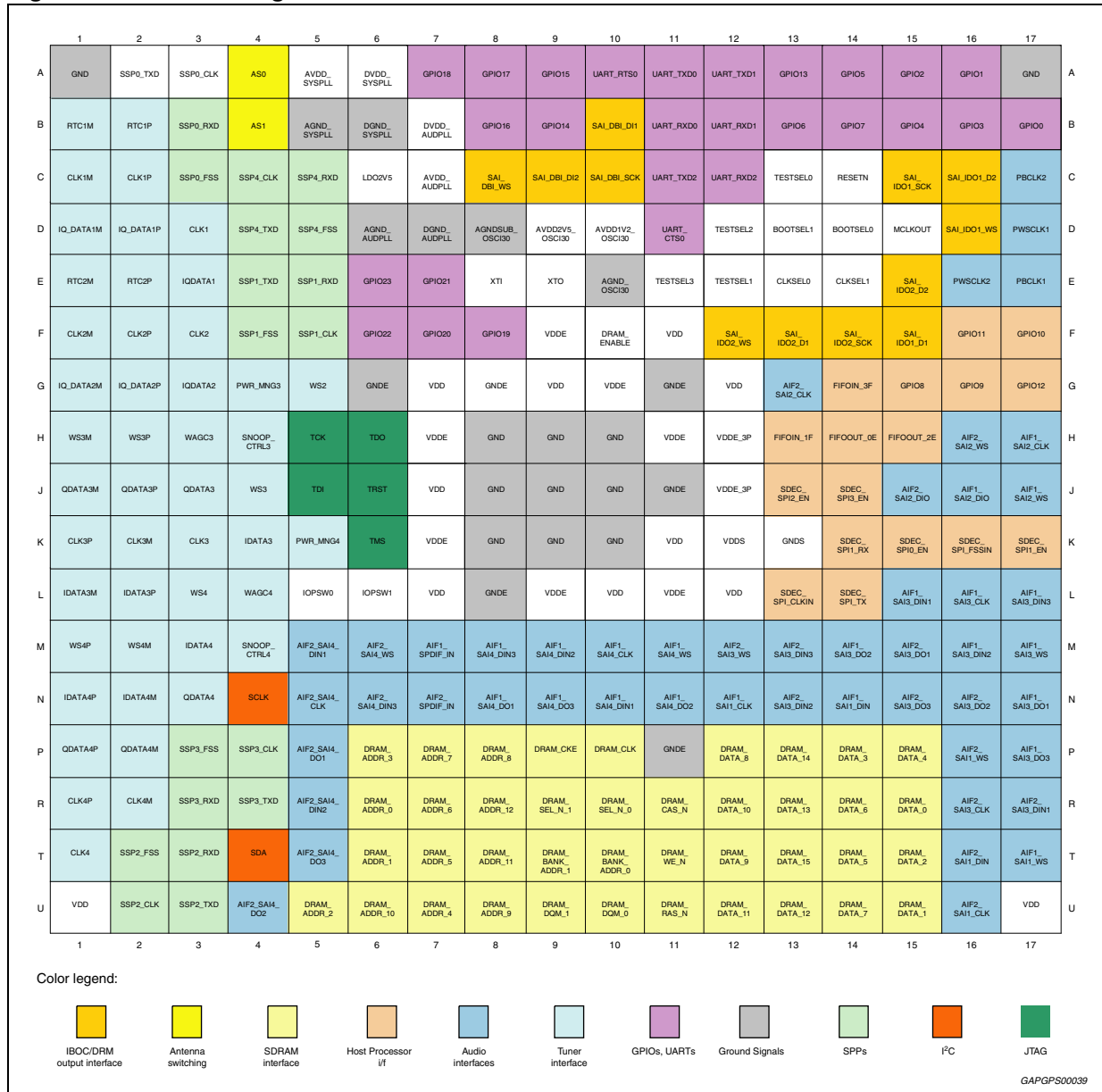
A clock and reset distribution unit (CRDU) is designed to generate and distribute all the needed clocks and resets. A System PLL and an Audio PLL are part of this logic.

# 2 Pin description

The STA662 is available in a 15x15x1.2 mm full matrix TFBGA package with 289 balls. *Figure 4* indicates also basic pin functionality.

## 2.1 Ball out

Figure 4. Ball out diagram



## 2.2 STA662 pin list

Table 2. STA662 pin-out description

Ball name	Description	Type	Supply group	Ball number
<b>Tuner interface</b>				
RTC1P	Tuner IF RTC1 LVDS	I	LVDS	B2
RTC1M		I	LVDS	B1
CLK1P	Tuner IF CLK1 LVDS	I	LVDS	C2
CLK1M		I	LVDS	C1
CLK1	Reserved for future use	I	3.3V	D3
IQ_DATA1P	Tuner IF IQ1 LVDS	I	LVDS	D2
IQ_DATA1M		I	LVDS	D1
IQDATA1	Reserved for future use	I	3.3V	E3
RTC2P	Tuner IF RTC2 LVDS	I	LVDS	E2
RTC2M		I	LVDS	E1
CLK2P	Tuner IF CLK2 LVDS	I	LVDS	F2
CLK2M		I	LVDS	F1
CLK2	Reserved for future use	I	3.3V	F3
IQ_DATA2P	Tuner IF IQ2 LVDS	I	LVDS	G2
IQ_DATA2M		I	LVDS	G1
IQDATA2	Reserved for future use	I	3.3V	G3
WS2	Reserved for future use	I	3.3V	G5
PWR_MNG3	Tuner IF PWR3 (CMOS)	O	3.3V	G4
WAGC3	Tuner IF WAGC3 (CMOS)	O	3.3V	H3
SNOOP_CTRL3	Tuner IF SNOOP CTRL3 (CMOS)	I/O	3.3V	H4
WS3P	Tuner IF RTC3 LVDS	I	LVDS	H2
WS3M		I	LVDS	H1
WS3	Reserved for future use	I	3.3V	J4
IDATA3P	Tuner IF IQ3 LVDS	I	LVDS	L2
IDATA3M		I	LVDS	L1
IDATA3	Reserved for future use	I	3.3V	K4
QDATA3P	Reserved for future use	I	LVDS	J2
QDATA3M		I	LVDS	J1
QDATA3	Reserved for future use	I	3.3V	J3
CLK3P	Tuner IF CLK3 LVDS	I	LVDS	K1
CLK3M		I	LVDS	K2

Table 2. STA662 pin-out description (continued)

Ball name	Description	Type	Supply group	Ball number
CLK3	Reserved for future use	I	3.3V	K3
PWR_MNG4	Tuner IF PWR4 (CMOS)	I/O	3.3V	K5
WAGC4	Tuner IF WAGC4 (CMOS)	I/O	3.3V	L4
SNOOP_CTRL4	Tuner IF SNOOP CTRL4 (CMOS)	I/O	3.3V	M4
WS4P	Tuner IF RTC4 LVDS	I	LVDS	M1
WS4M		I	LVDS	M2
WS4	Reserved for future use	I	3.3V	L3
IDATA4P	Tuner IF IQ4 LVDS	I	LVDS	N1
IDATA4M		I	LVDS	N2
IDATA4	Reserved for future use	I	3.3V	M3
QDATA4P	Reserved for future use	I	LVDS	P1
QDATA4M		I	LVDS	P2
QDATA4	Reserved for future use	I	3.3V	N3
CLK4P	Tuner IF CLK4 LVDS	I	LVDS	R1
CLK4M		I	LVDS	R2
CLK4	Reserved for future use	I	3.3V	T1
<b>DBI Interface</b>				
SAI_DBI_DI1	DRM i2s input (dato1)	I/O	3.3V	B10
SAI_DBI_DI2	DRM i2s input (dato2)	I/O	3.3V	C9
SAI_DBI_WS	DRM i2s input (ws)	I/O	3.3V	C8
SAI_DBI_SCK	DRM i2s input (clock)	I/O	3.3V	C10
<b>IBOC/DRM output interface (IDO i/f)</b>				
SAI_IDO1_D1	HD/DRM i2s output IF1 (dato1)	O	3.3V	F15
SAI_IDO1_D2	HD/DRM i2s output IF1 (dato2)	O	3.3V	C16
SAI_IDO1_WS	HD/DRM i2s output IF1 (ws)	O	3.3V	D16
SAI_IDO1_SCK	HD/DRM i2s output IF1 (clock)	O	3.3V	C15
SAI_IDO2_D1	HD/DRM i2s output IF2 (dato1)	I/O	3.3V	F13
SAI_IDO2_D2	HD/DRM i2s output IF2 (dato2)	I/O	3.3V	E15
SAI_IDO2_WS	HD/DRM i2s output IF2 (ws)	O	3.3V	F12
SAI_IDO2_SCK	HD/DRM i2s output IF2 (clock)	O	3.3V	F14
<b>SSPs</b>				
SSP0_FSS	FSS for SSP0	I/O	3.3V	C3
SSP0_CLK	Clock for SSP0	I/O	3.3V	A3

**Table 2. STA662 pin-out description (continued)**

Ball name	Description	Type	Supply group	Ball number
SSP0_RXD	Rxd for SSP0	I	3.3V	B3
SSP0_TXD	Txd for SSP0	O	3.3V	A2
SSP1_FSS	FSS for SSP1	I/O	3.3V	F4
SSP1_CLK	Clock for SSP1	I/O	3.3V	F5
SSP1_RXD	Rxd for SSP1	I	3.3V	E5
SSP1_TXD	Txd for SSP1	O	3.3V	E4
SSP2_FSS	FSS for SSP2	I/O	3.3V	T2
SSP2_CLK	Clock for SSP2	I/O	3.3V	U2
SSP2_RXD	Rxd for SSP2	I/O	3.3V	T3
SSP2_TXD	Txd for SSP2	I/O	3.3V	U3
SSP3_FSS	FSS for SSP3	I/O	3.3V	P3
SSP3_CLK	Clock for SSP3	I/O	3.3V	P4
SSP3_RXD	Rxd for SSP3	I/O	3.3V	R3
SSP3_TXD	Txd for SSP3	I/O	3.3V	R4
SSP4_FSS	FSS for SSP4	I/O	3.3V	D5
SSP4_CLK	Clock for SSP4	I/O	3.3V	C4
SSP4_RXD	Rxd for SSP4	I/O	3.3V	C5
SSP4_TXD	Txd for SSP4	I/O	3.3V	D4
<b>SDRAM interface</b>				
DRAM_BANK_ADDR_1	DRAM bank addr bit 1	O	3.3V	T9
DRAM_BANK_ADDR_0	DRAM bank addr bit 0	O	3.3V	T10
DRAM_ADDR_12	DRAM address bit 12	O	3.3V	R8
DRAM_ADDR_11	DRAM address bit 11	O	3.3V	T8
DRAM_ADDR_10	DRAM address bit 10	O	3.3V	U6
DRAM_ADDR_9	DRAM address bit 9	O	3.3V	U8
DRAM_ADDR_8	DRAM address bit 8	O	3.3V	P8
DRAM_ADDR_7	DRAM address bit 7	O	3.3V	P7
DRAM_ADDR_6	DRAM address bit 6	O	3.3V	R7
DRAM_ADDR_5	DRAM address bit 5	O	3.3V	T7
DRAM_ADDR_4	DRAM address bit 4	O	3.3V	U7
DRAM_ADDR_3	DRAM address bit 3	O	3.3V	P6
DRAM_ADDR_2	DRAM address bit 2	O	3.3V	U5
DRAM_ADDR_1	DRAM address bit 1	O	3.3V	T6
DRAM_ADDR_0	DRAM address bit 0	O	3.3V	R6

Table 2. STA662 pin-out description (continued)

Ball name	Description	Type	Supply group	Ball number
DRAM_WE_N	DRAM write enable	O	3.3V	T11
DRAM_SEL_N_1	DRAM chip selector bit 0	I/O	3.3V	R9
DRAM_SEL_N_0	DRAM chip selector bit 1	O	3.3V	R10
DRAM_DQM_1	DRAM write mask bit 1	O	3.3V	U9
DRAM_DQM_0	DRAM write mask bit 0	O	3.3V	U10
DRAM_CKE	DRAM clock enable	O	3.3V	P9
DRAM_CAS_N	DRAM column address selector	O	3.3V	R11
DRAM_RAS_N	DRAM row addr selector	O	3.3V	U11
DRAM_DATA_15	DRAM data bit 15	IO	3.3V	T13
DRAM_DATA_14	DRAM data bit 14	IO	3.3V	P13
DRAM_DATA_13	DRAM data bit 13	IO	3.3V	R13
DRAM_DATA_12	DRAM data bit 12	IO	3.3V	U13
DRAM_DATA_11	DRAM data bit 11	IO	3.3V	U12
DRAM_DATA_10	DRAM data bit 10	IO	3.3V	R12
DRAM_DATA_9	DRAM data bit 9	IO	3.3V	T12
DRAM_DATA_8	DRAM data bit 8	IO	3.3V	P12
DRAM_DATA_7	DRAM data bit 7	I/O	3.3V	U14
DRAM_DATA_6	DRAM data bit 6	IO	3.3V	R14
DRAM_DATA_5	DRAM data bit 5	IO	3.3V	T14
DRAM_DATA_4	DRAM data bit 4	IO	3.3V	P15
DRAM_DATA_3	DRAM data bit 3	IO	3.3V	P14
DRAM_DATA_2	DRAM data bit 2	IO	3.3V	T15
DRAM_DATA_1	DRAM data bit 1	IO	3.3V	U15
DRAM_DATA_0	DRAM data bit 0	IO	3.3V	R15
DRAM_CLK	DRAM clock	O	3.3V	P10
<b>Host Processor i/f (SDEC i/f)</b>				
SDEC_SPI_CLKIN	SSI interface	I	1.8V/2.5V/3.3V	L13
SDEC_SPI_TX	SSI interface	O	1.8V/2.5V/3.3V	L14
SDEC_SPI_FSSIN	SSI interface	I	1.8V/2.5V/3.3V	K16
SDEC_SPI0_EN	SSI interface	I	1.8V/2.5V/3.3V	K15
SDEC_SPI1_RX	SSI interface	I	1.8V/2.5V/3.3V	K14
SDEC_SPI1_EN	SSI interface	I	1.8V/2.5V/3.3V	K17
SDEC_SPI2_EN	SSI interface	I	1.8V/2.5V/3.3V	J13
SDEC_SPI3_EN	SSI interface	I	1.8V/2.5V/3.3V	J14



**Table 2. STA662 pin-out description (continued)**

Ball name	Description	Type	Supply group	Ball number
FIFOOUT_0E	SSI 0 fifo empty signal	I/O	1.8V/2.5V/3.3V	H14
FIFOIN_1F	SSI 1 fifo full signal	I/O	1.8V/2.5V/3.3V	H13
FIFOOUT_2E	SSI 2 fifo empty signal	I/O	1.8V/2.5V/3.3V	H15
FIFOIN_3F	SSI 3 fifo full signal	I/O	1.8V/2.5V/3.3V	G14
GPIO8	GPIO line	I/O	1.8V/2.5V/3.3V	G15
GPIO9	GPIO line	I/O	1.8V/2.5V/3.3V	G16
GPIO10	GPIO line	I/O	1.8V/2.5V/3.3V	F17
GPIO11	GPIO line	I/O	1.8V/2.5V/3.3V	F16
GPIO12	GPIO line	I/O	1.8V/2.5V/3.3V	G17
<b>Audio Clock Output Interface</b>				
PBCLK1	CLK GEN channel1 (bit clock)	O	1.8V/2.5V/3.3V	E17
PWSCLK1	CLK GEN channel1 (ws clock)	O	1.8V/2.5V/3.3V	D17
PBCLK2	CLK GEN channel2 (bit clock)	O	1.8V/2.5V/3.3V	C17
PWSCLK2	CLK GEN channel2 (ws clock)	O	1.8V/2.5V/3.3V	E16
<b>Audio interface</b>				
AIF1_SAI1_CLK	SAI1 CLK	I/O	3.3V	N12
AIF1_SAI1_WS	SAI1 WS	I/O	3.3V	T17
AIF1_SAI1_DIN	SAI1 DATA IN	I/O	3.3V	N14
AIF1_SAI2_CLK	SAI2 CLK	I/O	1.8V/2.5V/3.3V	H17
AIF1_SAI2_WS	SAI2 WS	I/O	1.8V/2.5V/3.3V	J17
AIF1_SAI2_DIO	SAI2 DATA IN-OUT	I/O	1.8V/2.5V/3.3V	J16
AIF1_SAI3_CLK	SAI3 CLK	I/O	3.3V	L16
AIF1_SAI3_WS	SAI3 WS	I/O	3.3V	M17
AIF1_SAI3_DIN1	SAI3 DATA1 IN	I/O	3.3V	L15
AIF1_SAI3_DIN2	SAI3 DATA2 IN	I/O	3.3V	M16
AIF1_SAI3_DIN3	SAI3 DATA3 IN	I/O	3.3V	L17
AIF1_SAI3_DO1	SAI3 DATA1 OUT	I/O	3.3V	N17
AIF1_SAI3_DO2	SAI3 DATA2 OUT	I/O	3.3V	M14
AIF1_SAI3_DO3	SAI3 DATA3 OUT	I/O	3.3V	P17
AIF1_SAI4_CLK	SAI4 CLK	I/O	3.3V	M10
AIF1_SAI4_WS	SAI4 WS	I/O	3.3V	M11
AIF1_SAI4_DIN1	SAI4 DATA1 IN	I/O	3.3V	N10
AIF1_SAI4_DIN2	SAI4 DATA2 IN	I/O	3.3V	M9
AIF1_SAI4_DIN3	SAI4 DATA3 IN	I/O	3.3V	M8

Table 2. STA662 pin-out description (continued)

Ball name	Description	Type	Supply group	Ball number
AIF1_SAI4_DO1	SAI4 DATA1 OUT	I/O	3.3V	N8
AIF1_SAI4_DO2	SAI4 DATA2 OUT	I/O	3.3V	N11
AIF1_SAI4_DO3	SAI4 DATA3 OUT	I/O	3.3V	N9
AIF1_SPDIF_IN	SPDIF in	I/O	3.3V	M7
AIF2_SAI1_CLK	SAI1 CLK	I/O	3.3V	U16
AIF2_SAI1_WS	SAI1 WS	I/O	3.3V	P16
AIF2_SAI1_DIN	SAI1 DATA IN	I/O	3.3V	T16
AIF2_SAI2_CLK	SAI2 CLK	I/O	1.8V/2.5V/3.3V	G13
AIF2_SAI2_WS	SAI2 WS	I/O	1.8V/2.5V/3.3V	H16
AIF2_SAI2_DIO	SAI2 DATA IN-OUT	I/O	1.8V/2.5V/3.3V	J15
AIF2_SAI3_CLK	SAI3 CLK	I/O	3.3V	R16
AIF2_SAI3_WS	SAI3 WS	I/O	3.3V	M12
AIF2_SAI3_DIN1	SAI3 DATA1 IN	I/O	3.3V	R17
AIF2_SAI3_DIN2	SAI3 DATA2 IN	I/O	3.3V	N13
AIF2_SAI3_DIN3	SAI3 DATA3 IN	I/O	3.3V	M13
AIF2_SAI3_DO1	SAI3 DATA1 OUT	I/O	3.3V	M15
AIF2_SAI3_DO2	SAI3 DATA2 OUT	I/O	3.3V	N16
AIF2_SAI3_DO3	SAI3 DATA3 OUT	I/O	3.3V	N15
AIF2_SAI4_CLK	SAI4 CLK	I/O	3.3V	N5
AIF2_SAI4_WS	SAI4 WS	I/O	3.3V	M6
AIF2_SAI4_DIN1	SAI4 DATA1 IN	I/O	3.3V	M5
AIF2_SAI4_DIN2	SAI4 DATA2 IN	I/O	3.3V	R5
AIF2_SAI4_DIN3	SAI4 DATA3 IN	I/O	3.3V	N6
AIF2_SAI4_DO1	SAI4 DATA1 OUT	O	3.3V	P5
AIF2_SAI4_DO2	SAI4 DATA2 OUT	O	3.3V	U4
AIF2_SAI4_DO3	SAI4 DATA3 OUT	O	3.3V	T5
AIF2_SPDIF_IN	SPDIF in	I/O	3.3V	N7
<b>I<sup>2</sup>C</b>				
SCLK	I2C clock signal	I/O	3.3V	N4
SDA	I2C data signal	I/O	3.3V	T4
<b>GPIOs</b>				
GPIO14	GPIO line	I/O	3.3V	B9
GPIO15	GPIO line	I/O	3.3V	A9
GPIO16	GPIO line	I/O	3.3V	B8

**Table 2. STA662 pin-out description (continued)**

Ball name	Description	Type	Supply group	Ball number
GPIO17	GPIO line	I/O	3.3V	A8
GPIO18	GPIO line	I/O	3.3V	A7
GPIO19	GPIO line	I/O	3.3V	F8
GPIO20	GPIO line	I/O	3.3V	F7
GPIO21	GPIO line	I/O	3.3V	E7
GPIO22	GPIO line	I/O	3.3V	F6
GPIO23	GPIO line	I/O	3.3V	E6
<b>UARTs</b>				
UART_RXD0	Rxd for UART0	I	3.3V	B11
UART_TXD0	Txd for UART0	O	3.3V	A11
UART_CTS0	Cts for UART0	I/O	3.3V	D11
UART_RTS0	Rts for UART0	I/O	3.3V	A10
UART_RXD1	Rxd for UART1	I/O	3.3V	B12
UART_TXD1	Txd for UART1	I/O	3.3V	A12
UART_RXD2	Rxd for UART2	I/O	3.3V	C12
UART_TXD2	Txd for UART2	I/O	3.3V	C11
<b>Debug Interface</b>				
GPIO0	GPIO line	I/O	3.3V	B17
GPIO1	GPIO line	I/O	3.3V	A16
GPIO2	GPIO line	I/O	3.3V	A15
GPIO3	GPIO line	I/O	3.3V	B16
GPIO4	GPIO line	I/O	3.3V	B15
GPIO5	GPIO line	I/O	3.3V	A14
GPIO6	GPIO line	I/O	3.3V	B13
GPIO7	GPIO line	I/O	3.3V	B14
GPIO13	GPIO line	I/O	3.3V	A13
<b>JTAG</b>				
TCK <sup>(1)</sup>	JTAG Test Clock	I	3.3V	H5
TDI <sup>(1)</sup>	JTAG Test Data In	I	3.3V	J5
TDO	JTAG Test Data Out	O	3.3V	H6
TMS <sup>(1)</sup>	JTAG Test Mode Select	I	3.3V	K6
TRST <sup>(1)</sup>	JTAG Test Circuit Reset	I	3.3V	J6

Table 2. STA662 pin-out description (continued)

Ball name	Description	Type	Supply group	Ball number
<b>Antenna switching</b>				
AS0	Antenna switching selector bit 0	O	3.3V	A4
AS1	Antenna switching selector bit 1	O	3.3V	B4
<b>System level signals</b>				
CLKSEL0	Clock mode selector bit 0	I	3.3V	E13
CLKSEL1	Clock mode selector bit 1	I	3.3V	E14
MCLKOUT	System clock out	O	3.3V	D15
BOOTSEL0	Boot selector bit 0	I	3.3V	D14
BOOTSEL1	Boot selector bit 1	I	3.3V	D13
RESET_N <sup>(1),(2)</sup>	System reset input	I	3.3 V	C14
IOPSW0	Pad ring power supply selector bit 0	I	3.3V	L5
IOPSW1	Pad ring power supply selector bit 1	I	3.3V	L6
TESTSEL0	Test mode selector bit 0	I	3.3V	C13
TESTSEL1	Test mode selector bit 1	I	3.3V	E12
TESTSEL2	Test mode selector bit 2	I	3.3V	D12
TESTSEL3	Test mode selector bit 3	I	3.3V	E11
DRAM_ENABLE <sup>(3)</sup>	Dram interface enable	I	3.3V	F10
<b>XTAL</b>				
XTI	OSCI input	Analog	-	E8
XTO	OSCI output	Analog	-	E9
AVDD2V5_OSCI30	OSCI analog power supply	PWR	2.5V	D9
AGNDSUB_OSCI30	OSCI analog ground	GND	-	D8
AVDD1V2_OSCI30	OSCI digital power supply	PWR	1.2V	D10
AGND_OSCI30	OSCI digital ground	GND	-	E10
<b>2.5 Volt LDO</b>				
LDO2V5	LDO regulator 2.5 V output power supply	PWR	-	C6
<b>PLLs Power supply and ground signal</b>				
DVDD_SYSPLL	PLLs Digital Power supply	PWR	1.2V	A6
DGND_SYSPLL	PLLs Digital Power ground	GND	-	B6
AVDD_SYSPLL	PLLs Analog Power supply	PWR	2.5V	A5
AGND_SYSPLL	PLLs Analog Power ground	GND	-	B5
DVDD_AUDPLL	PLLs Digital Power supply	PWR	1.2V	B7

**Table 2. STA662 pin-out description (continued)**

Ball name	Description	Type	Supply group	Ball number
DGND_AUDPLL	PLLs Digital Power ground	GND	-	D7
AVDD_AUDPLL	PLLs Analog Power supply	PWR	2.5V	C7
AGND_AUDPLL	PLLs Analog Power ground	GND	-	D6
<b>Power Supply and Ground Signals (73 I/O)</b>				
GNDE	Pad ring ground	GND	-	G6, G8, G11, J11, L8, P11
VDDE	3.3 V pad power supply	PWR	3.3V	F9, G10, H7, H11, K7, L9, L11
VDDE_3P	Triple voltage pad power supply	PWR	1.8V/2.5V/3.3V	H12, J12
GND / GNDS	Digital ground	GND	-	A1, A17, H8, H9, H10, J8, J9, J10, K8, K9, K10, K13
VDD / VDDS	Digital power supply	PWR	1.2V	F11, G7, G9, G12, J7, K11, K12, L7, L10, L12, U1, U17

1. Smidth trigger input pad.
2. Pull down pad.
3. The DRAM\_ENABLE pin must be set to logical one at PCB level.

### 2.3 Pins termination

In order to guarantee the correct behavior of an STA662 based application it is mandatory to properly terminate unused input and inout pins.

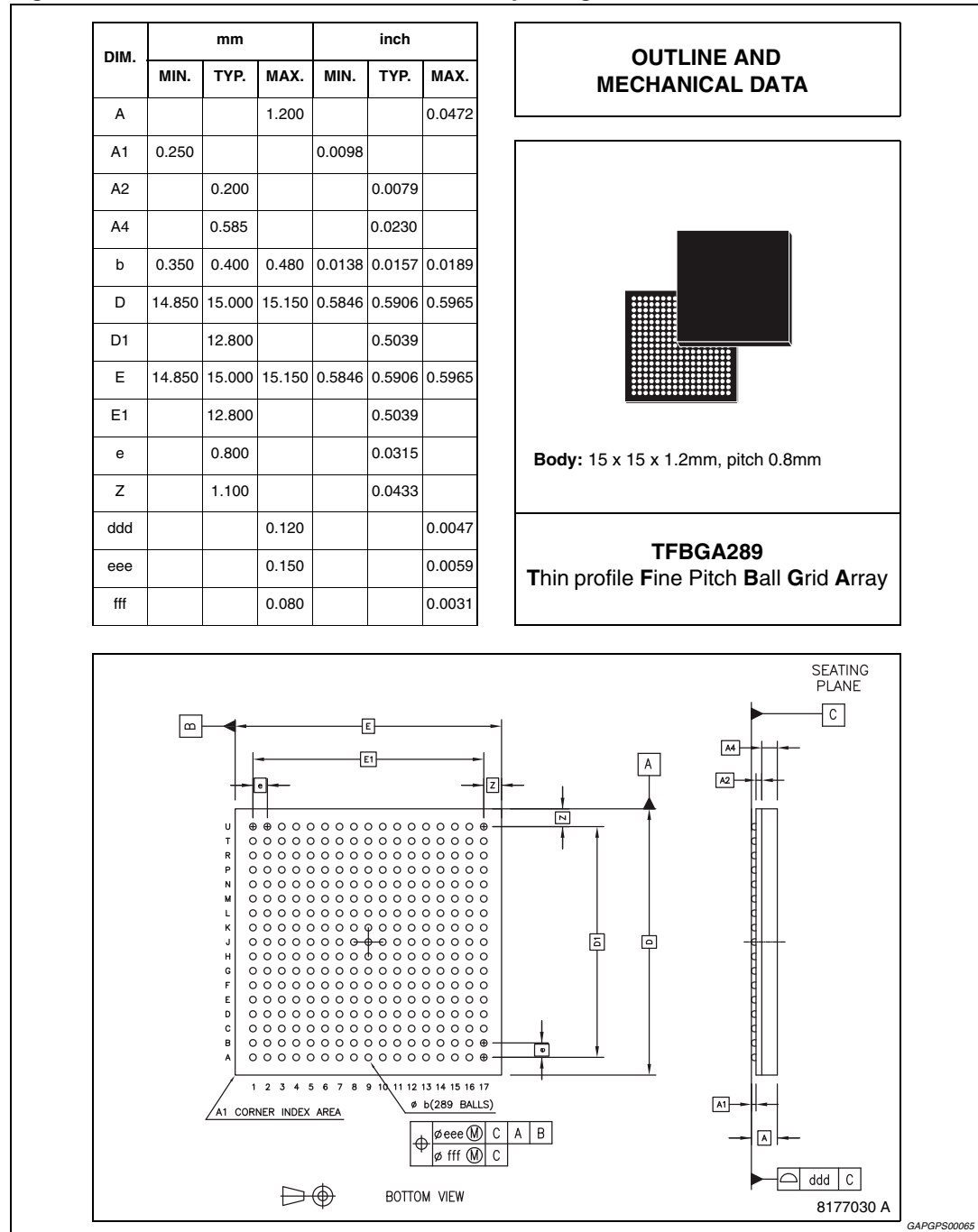
Since many of the STA662 pins have secondary/tertiary functions which depend on the specific firmware configuration, it is strongly suggested to review the final application's schematic with ST application engineer.

### 3 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com).

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**Figure 5. TFBGA289 mechanical data and package dimensions**



## 4 Revision history

**Table 3. Document revision history**

Date	Revision	Changes
06-Jul-2012	1	Initial release.
16-Sept-2013	2	Updated Disclaimer

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