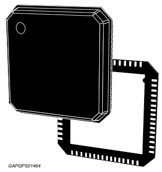
STA610

Highly integrated tuner for AM/FM/HD/DRM/DAB car radio

Data brief — production data

Features

- Quad-band: MW Band, Band II-III, L-Band
- Enables high performance HD-Radio/DAB/ DAB+/DMB implementation
- DAB L-band and Band III antenna buffers for multi-standard multi-tuner configuration
- Fully integrated low-phase noise VCO for world tuning
- High performance PLL tuning system for fast RDS reception
- Integrated AM-LNA
- Automatic self-alignment for pre-selection and image rejection through Base-Band
- SPI bus controlled
- ULVDS I/Q bit-stream digital interface
- Single 5 V supply



VFQFPN64

Description

The STA610 is a state-of-the-art quad-band, RF front-end receiver designed for any analog and digital terrestrial radio broadcasting receiver.

When combined with STMicroelectronics' STA662 digital baseband IC, the STA610 is a complete optimized RF and baseband AM/FM/HD/DAB solution for automotive grade receivers and other applications.

Table 1. Device summary

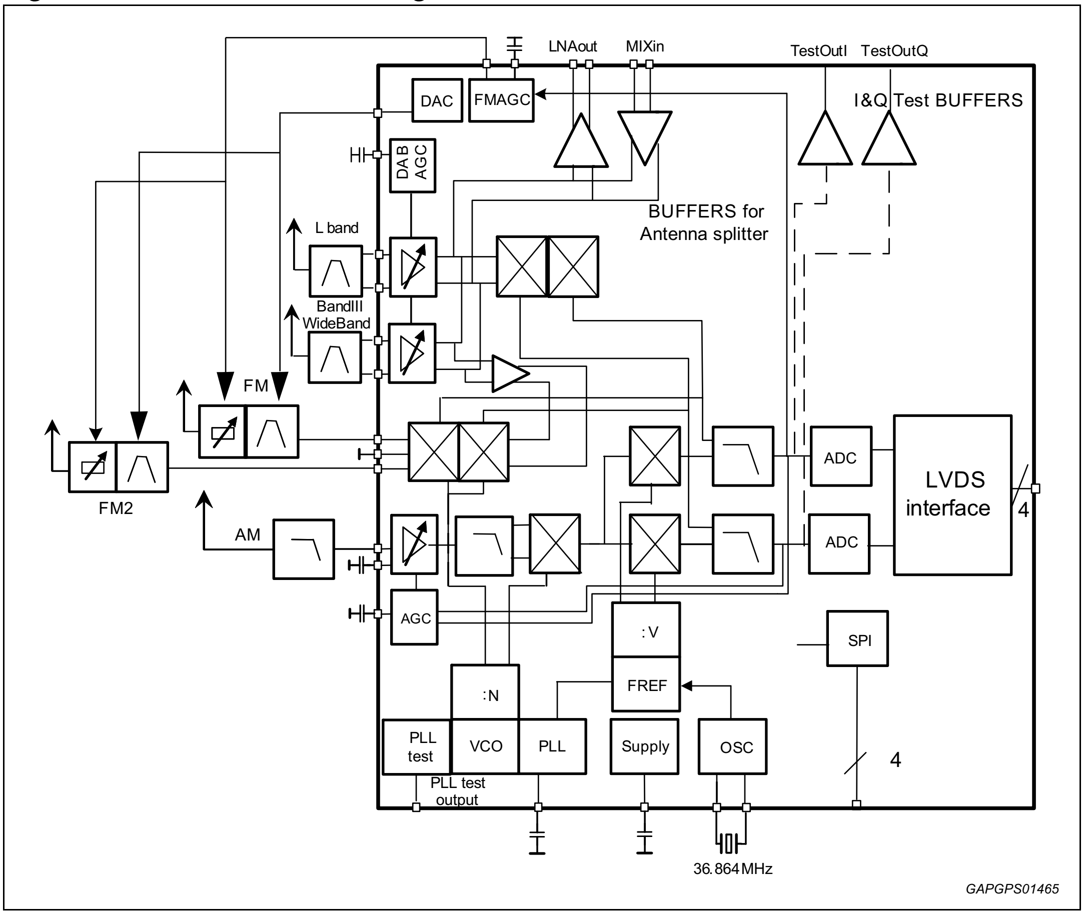
Order code	Package	Packing
STA610	VFQFPN64	Tray

Contents

1 Block diagram and pins description

1.1 Block diagram

Figure 1. Functional block diagram



1.2 Pin description

Figure 2. Pin out diagram

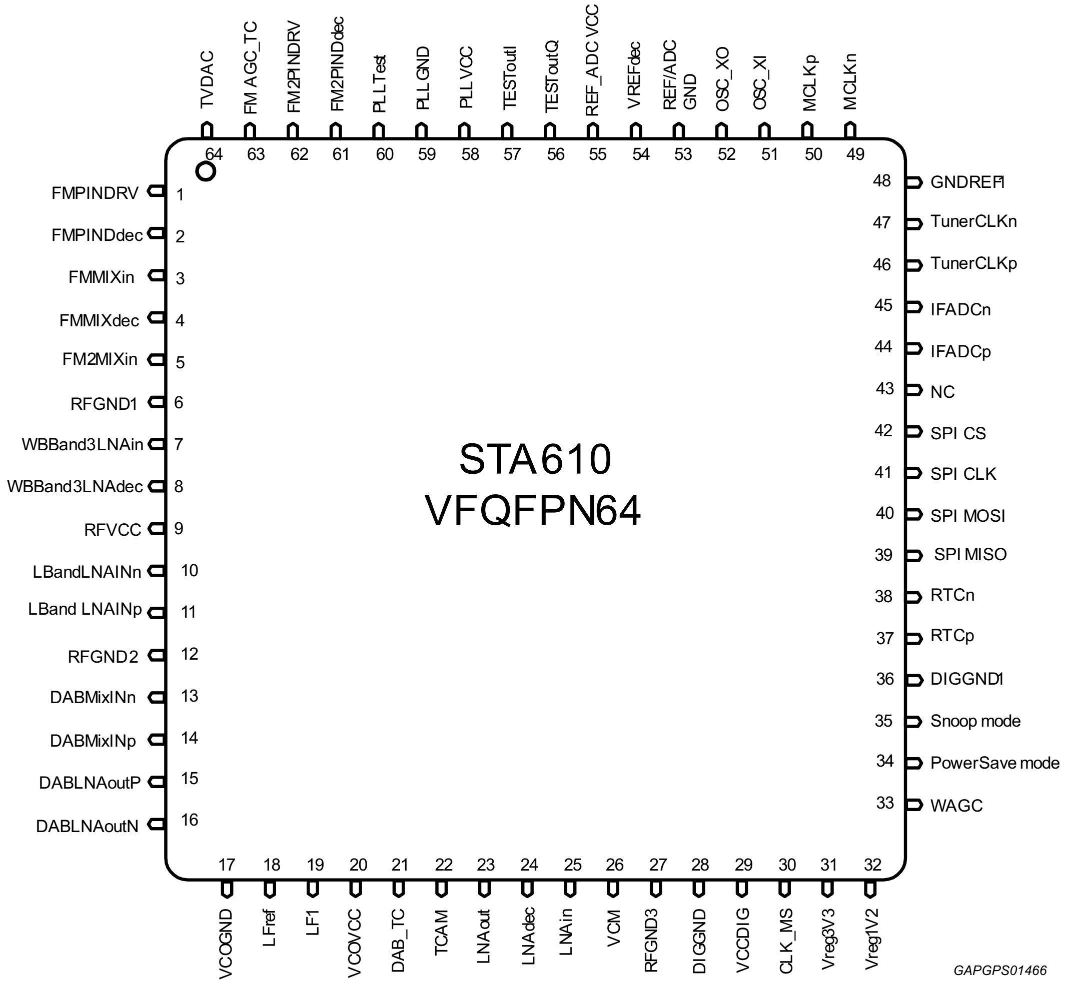


Table 2. Pin description

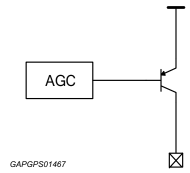
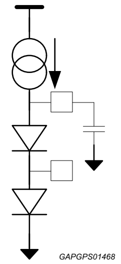
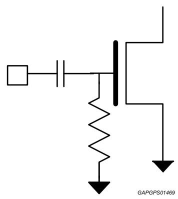
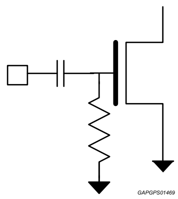
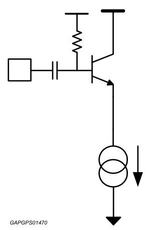
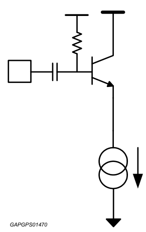
Pin #	Pin name	I/O	Function	Description	Equivalent circuit
1	FMPINDRV	O	FM	FM PIN diode driver output	
2	FMPINDdec	-	FM	FM Internal PIN diode decoupling	
3	FMMIXin	I	FM	FM mixer input (AC coupling)	
4	FMMIXdec	-	-	FM mixer decoupling	-
5	FM2MIXin	I	FM	FM mixer input (AC coupling)	
6	RFGND1	-	-	M auxiliary RF ground	-
7	WBBand3LNAin	I	DAB	Band3 50Ohm input with wideband pre-selector	
8	WBBand3LNAdec	I	DAB	WideBand Band3 50Ohm input LNA decoupling	
9	VCCRF	I	-	RF 5V supply	-

Table 2. Pin description (continued)

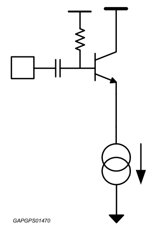
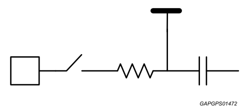
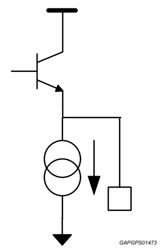
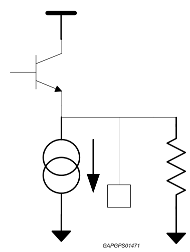
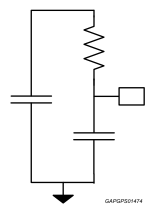
Pin #	Pin name	I/O	Function	Description	Equivalent circuit
10	Lband LNAINPn	I	DAB	L band LNA differential input	
11	Lband LNAINPp			L band LNA positive input	
12	RFGND2	I	DAB	RF ground	-
13	DAB Mix pin	I	DAB	DAB Mixer differential input for Single	
14	DAB Mix nin	-	-	Antenna double tuner application (50 Ohm internal load)	-
15	DABLNAoutp	O	DAB	LNA differential output for single antenna double tuner application	
16	DABLNAoutn				
17	VCOGND	-	-	VCO ground	-
18	LFref	O	PLL	Loop filter reference	
19	LF1	I/O	PLL	Loop filter output	
20	VCCVCO	I	-	VCO 5 V supply	-

Table 2. Pin description (continued)

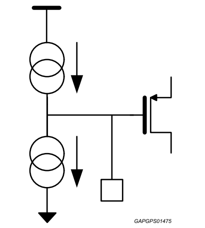
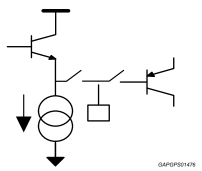
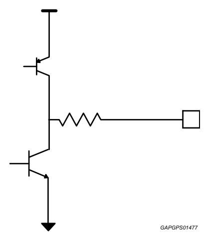
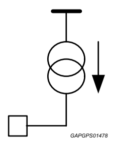
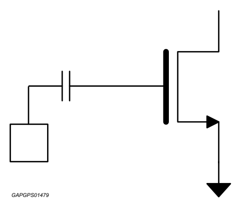
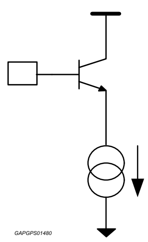
Pin #	Pin name	I/O	Function	Description	Equivalent circuit
21	DAB TC	O	DAB	DAB AGC time constant	
22	TCAM	-	AM	AM AGC time constant	
23	LNAout	O	AM	AM LNA test output	
24	LNAdec	-	-	AM LNA decoupling	
25	LNAin	I	AM	AM LNA input	
26	VCM	I	-	AGC Extenal decoupling	
27	RFGND3	-	AM	RF ground of AM LNA and AM low pass filter	-
28	GNDDIG	-	AM, dig BE	AM AGC, Digital, Mixer and I/O interfaces grounds	-
29	VCCDIG	I	AM, dig BE	Voltage regulator for AM mixer, backend and I/O interface supplies	-

Table 2. Pin description (continued)

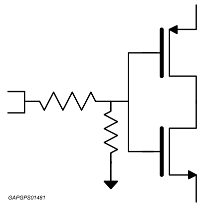
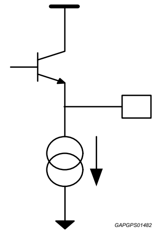
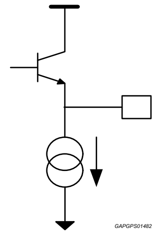
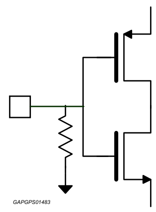
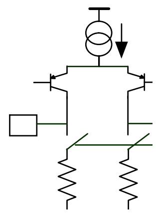
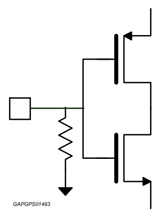
Pin #	Pin name	I/O	Function	Description	Equivalent circuit
30	CLK_MS	I	-	Master/Slave clock operation select Open or GND = master Connect to 5 V = slave	
31	Vreg3v3	O	-	3.3 V regulator output	
32	Vreg1V2	O	-	1.2 V regulator output	
33	WAGC	Pull down I	DAB	WAGC control	
34	Power save mode	Pull up I	DAB	Power save mode	
35	Snoop mode	Pull down I	DAB	Snoop Mode	
36	GNDDIG1	-	AM, dig BE	AM AGC, Digital, Mixer and interfaces grounds (same ground of pin 28)	-

Table 2. Pin description (continued)

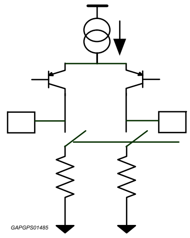
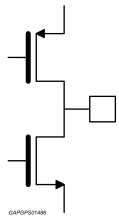
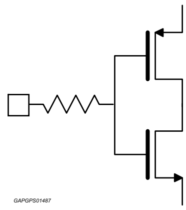
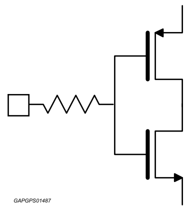
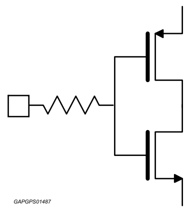
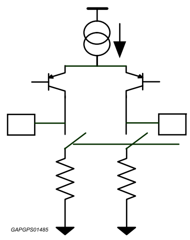
Pin #	Pin name	I/O	Function	Description	Equivalent circuit
37	RTCp	O	RTC interface	Differential real time control output	
38	RTCn				
39	SPI MISO	O	SPI	SPI data output	
40	SPI MOSI	I	SPI	SPI data input	
41	SPIck	I	SPI	SPI clock	
42	SPI CS	I	SPI	SPI Chip select	
43	NC	-	-	This pin has to be left floating	-
44	IFADCp	O	Digital output connectivity	IQ multiplexed differential LVDS data output	
45	IFADCn	O			

Table 2. Pin description (continued)

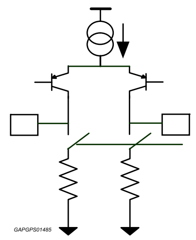
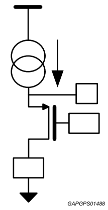
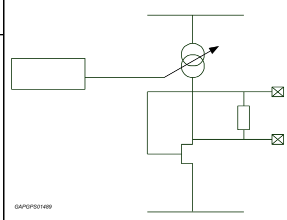
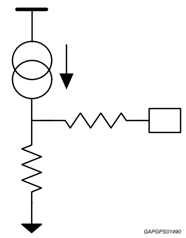
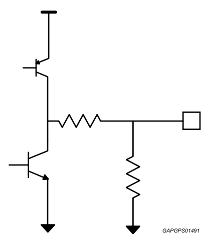
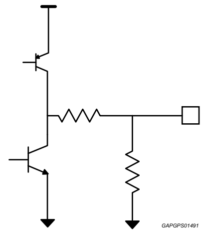
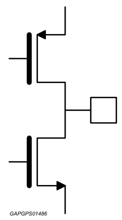
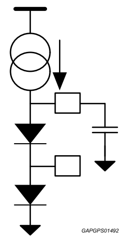
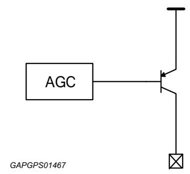
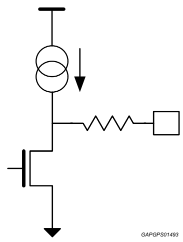
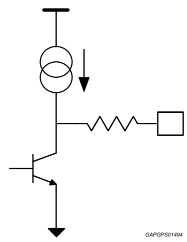
Pin #	Pin name	I/O	Function	Description	Equivalent circuit
46	TunerCLKp	O	-	LVDS differential clock output	
47	TunerCLKn	O	-		
48	GNDREF1	-	Reference oscillator ground	Reference oscillator ground	-
49	MCLKN	O	Oscillator	Master Clock differential output for Multi-tuner application	
50	MCLKP	I			
51	OSCin	I	-	Crystal oscillator input	
52	OSCout	O	-	Crystal oscillator output	
53	REF/ADC GND	-	-	ADC Front-end and regulator grounds	-
54	Vrefdec	I	-	Decoupling of 3.3 V Bias generation	
55	VCC-REF	I	-	5 V supply of reference frequency and Vref	-
56	TestI	O	-	Analog single ended Output for testing purpose	

Table 2. Pin description (continued)

Pin #	Pin name	I/O	Function	Description	Equivalent circuit
57	TestQ	O	-	Analog single ended Output for testing purpose	
58	PLLVCC	I	-	Tuning PLL 5 V supply	-
59	PLLGND	-	-	Tuning PLL 5 V ground	-
60	PLLtest	O	-	PLL test output	
61	FM2 PINDdec	-	FM	FM2 Internal PIN diode decoupling	
62	FM2 PINDRV	O	FM	FM2 PIN diode driver output	
63	FM AGC TC	-	-	FM AGC time constant	
64	TVDAC	O	FM	Tuning voltage output	

2 Function description

2.1 FM

2.1.1 FM - Mixer

The FM Image Rejection mixer has two single ended inputs, selectable through software. These inputs feed stages implemented with different gains, noise figures and IP3, optimized for best performance in both FM and WX frequency bands.

The FM mixer input is designed to achieve the best performance both in case of a passive tuned preselection and a passive fixed band-pass preselection without tuning for lower cost applications.

The input frequency is down-converted to very low IF with high image rejection.

The tuned application is supported by an 8-bit tuning DAC. The alignment of the DAC can be automatically performed by STA662 baseband processor.

2.1.2 FM - AGC

The programmable RFAGC senses the mixer input, the IFAGC senses the IFADC input to avoid overload.

When the RFAGC or the IFAGC thresholds are reached, the PIN diode output is activated in order to attenuate the incoming RF signal

The PIN diode driver is able to drive external PIN diodes with up to 15 mA current.

The time constant of the FM AGC is defined by the combination of an external capacitor and internal currents. There are two programmable attack and decay time constants.

2.2 AM

2.2.1 AM - LNA

The AM LNA is integrated with low noise and high IP2 and IP3. The gain of the LNA is digitally controlled by the internal AGC, which acts with steps of 6 dB gain attenuation. The maximum gain can be adjusted by off-chip components: its typical value is 41 dB.

2.2.2 AM - AGC

The programmable RFAGC senses the LNA output, the IFAGC senses the IFADC input to avoid overload. When the RFAGC or the IFAGC thresholds are reached, the LNA gain is changed with steps of 6 dB attenuation. The time constant of the AM AGC is defined by the combination of the choice of an off-chip component and a programmable sampling rate.

The AGC control is completely autonomous. Whenever a change occurs in the AM AGC, its actual status is sent, properly coded, to the baseband processor through the RTC (real time control) interface.

2.2.3 AM - Mixers

The input frequency is converted to low IF with high image rejection.

2.3 DAB

2.3.1 50 Ohm RF input (Band III Wideband input with external band-pass filter)

This 50 Ohm matched input comprises an LNA with very low noise figure, high IIP3 and variable gain, followed by a high linearity down conversion mixer that performs the down-conversion of the DAB signals directly to zero IF.

The programmable RFAGC senses the mixer input, the IFAGC senses the IFADC input to avoid overload.

When the IFAGC threshold is reached, the mixer gain is reduced with 6 dB steps of gain attenuation. When the RF AGC threshold is reached, the LNA gain is decreased.

The time constant of the RFAGC is defined with an external capacitor and an internal reference current. There are different programmable values for attack and decay time.

2.3.2 L-Band

The L-band input LNA has very low noise figure, high IIP3 and variable gain. It is followed by a high linearity down conversion mixer that down-converts the DAB signals directly to zero IF.

The programmable RFAGC senses the mixer input, the IFAGC senses the IFADC input to avoid overload.

When the IFAGC threshold is reached, the mixer gain is reduced with 6 dB steps of gain attenuation. When the RF AGC threshold is reached, the LNA gain is decreased.

The time constant of the RFAGC is defined with an external capacitor and an internal reference current. There are different programmable values for attack and decay time.

2.3.3 Single antenna and double tuner application

Two different high linearity buffers are implemented inside the IC to allow the use of a single antenna in a double tuner configuration, avoiding the need for an additional external splitter. The two buffers are used to transfer the RF signal, amplified by the LNA of the foreground tuner, to the mixer input of background tuner. A degradation of the noise figure for the background tuner has to be accepted in case of single-antenna and double tuner configuration.

2.3.4 AGC

The programmable RFAGCs sense the mixer input, the IFAGC senses the IFADC input to avoid overload. When the IFAGC threshold is reached, the mixer gain is reduced with 6 dB steps of gain attenuation. When the RF AGC threshold is reached, the LNA gain is linearly decreased. The time constant of the IFAGC is defined by the combination of the choice of an off-chip component and a programmable sampling rate.

The AGC control is completely autonomous. Whenever a change occurs in the IFAGC, its actual status is sent, properly coded, to the baseband processor through the RTC (real time control) interface.

2.3.5 Null symbol detection

During null symbol condition the RFAGC and the IFAGC are both set in hold mode. In case of a wanted signal, the AGC is locked with the WAGC signal, generated by the baseband processor and controlled through its dedicated pin (WAGC).

2.4 IF A/D converters

A high performance IQ-IFADC converts the IF signal to the digital domain for subsequent digital signal processing.

Two fully differential, binary continuous-time Sigma-Delta ($\Sigma\Delta$) IF-ADCs are used for both the "I" and "Q" signal paths. For each IFADC, two fully differential input nodes are fed with an input signal having a bandwidth up to 1.5 MHz. The fully differential approach provides good suppression of even-order harmonics. For complex filtering, the input signals of the "I" path and the "Q" paths have a 90-degree phase shift. The IFADC sampling frequency is 36.864 MHz.

2.5 VCO

The VCO is fully integrated without any external tuning component. It covers all the FM frequency bands (including EU, US, Japan, East-Europe, Weather-Band), AM-bands (including LW, MW and SW) and DAB (including Band III and L-band). Its center frequency is approximately 2.7 GHz.

2.6 Tuner PLL

The very high speed PLL is able to tune within about 100 µs for fast RDS applications. The frequency step can be as low as 5 kHz in FM and 500 Hz in AM.

2.7 Crystal oscillator

The device works with a 36.864 MHz fundamental tone crystal.

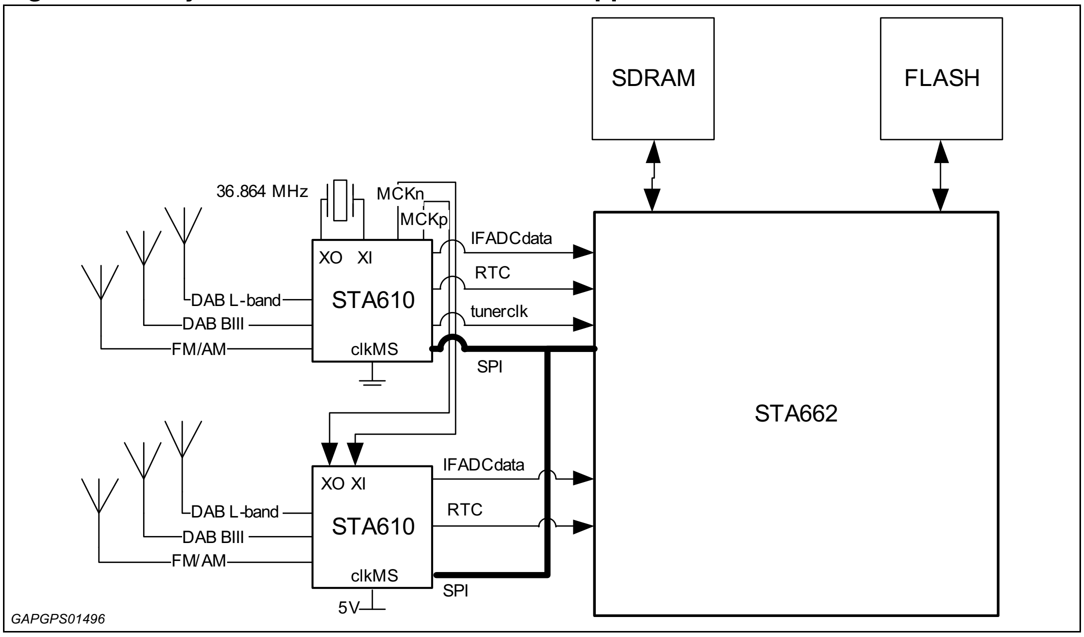
By suitably configuring pin #30 (CLK_MS), the device can be operated as either a clock master or a clock slave. In case the device is configured as clock slave, the internal crystal oscillator is switched off and the device needs to be fed with a differential reference signal on the OSC_XI, OSC_XO pins.

2.7.1 Multi-tuner and multi-standard applications

In a multi-tuner application a single crystal solution has to be preferred. In this case one tuner works as Master and all the others as Slaves, as shown in *Figure 3*. The CLK_MS pin is used to set the tuner as master or slave.

It is possible to use at the same time the AM or FM receiver chain and the DAB L-band or Band III antenna buffers to get a multi-standard multi-tuner configuration.

Figure 3. Crystal connection in multi-tuner application



3 Package information

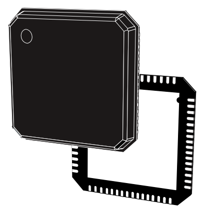
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*.

ECOPACK® is an ST trademark.

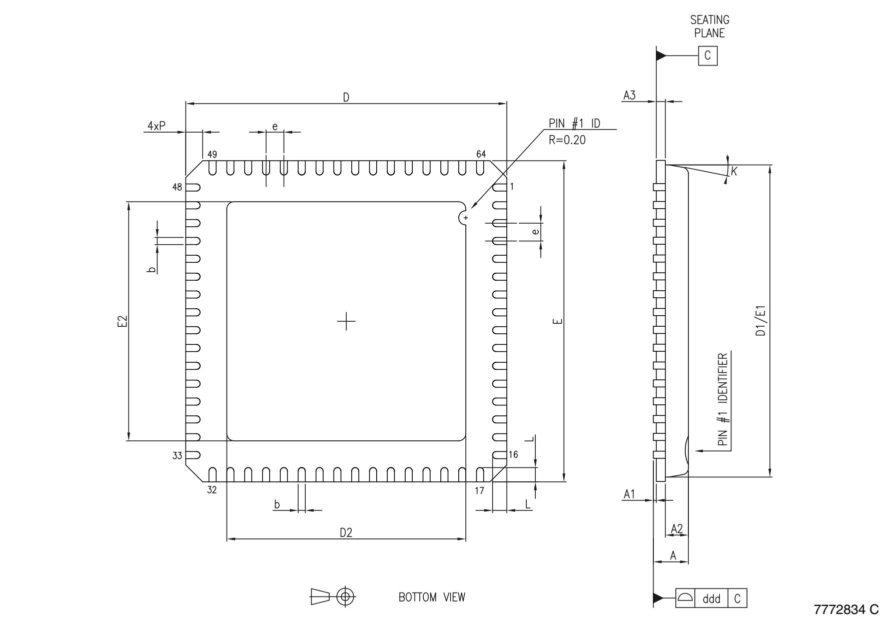
Figure 4. VFQFPN64 (9x9x1 mm) mechanical data and package dimensions

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	0.800	0.900	1.000	0.0315	0.0354	0.0394
A1		0.020	0.050		0.0008	0.0020
A2		0.650	1.000		0.0256	0.0394
A3		0.200			0.0079	
b	0.180	0.250	0.300	0.0071	0.0098	0.0118
D	8.850	9.000	9.150	0.3484	0.3543	0.3602
D1		8.750			0.3445	
D2	4.600	4.750	4.900	0.1811	0.1870	0.1929
E	8.850	9.000	9.150	0.3484	0.3543	0.3602
E1		8.750			0.3445	
E2	5.300	5.450	5.600	0.2087	0.2146	0.2205
e		0.500			0.0197	
L	0.350	0.400	0.450	0.0138	0.0157	0.0177
P			0.600			0.0236
K			12°			12°
ddd			0.080			0.0031

OUTLINE AND MECHANICAL DATA



VFQFPN64 (9x9x1.0mm, pitch 0.50) Very Fine Quad Flat Package No lead



GAPGPS0175

4 Revision history

Table 3. Document revision history

Date	Revision	Changes
06-Jul-2012	1	Initial release.
12-Jul-2012	2	Updated *Figure 1: Functional block diagram on page 3* and *Figure 2: Pin out diagram on page 4*.
16-Sep-2013	3	Updated Disclaimer.