SPBT3.0DP1 module: some technical note about the Radio device embedded in the module, displayed in the Module Block Diagram as “STLC2690”.

3 Bluetooth

3.1 Bluetooth functional description

3.1.1 Modem receiver

The Bluetooth subsystem implements a low-IF receiver for Bluetooth modulated input signals. The radio signal is taken from a balanced RF input and amplified by an LNA. The mixers are driven by two quadrature LO signals, which are locally generated from a VCO signal running at twice the frequency. The I and Q mixer output signals are band pass filtered by a poly-phase filter for channel filtering and image rejection. The band pass filter amplifies the signals to the optimal input range for the ADC. Further channel filtering is done in the digital part. The digital part demodulates the GFSK, π/4-DQPSK or 8-DPSK coded bit stream by evaluating the phase information. RSSI data is extracted. Overall automatic gain amplification in the receive path is controlled digitally. The RC time constants for the analog filters are automatically calibrated on chip.

3.1.2 Modem transmitter

The transmitter uses the serial transmit data from the Bluetooth controller. The transmitter modulator converts this data into GFSK, π/4-DQPSK or 8-DPSK modulated I and Q digital signals for respectively 1, 2 and 3 Mbps transmission speed. These signals are then converted to analog signals that are low pass filtered before up-conversion. The carrier frequency drift is limited by a closed loop PLL.

3.1.3 RF PLL

The on-chip VCO is part of a PLL. The tank resonator circuitry for the VCO is completely integrated without need of external components. Variations in the VCO center frequency are calibrated out automatically.

3.1.4 Bluetooth controller

V1.2 and V2.0 + EDR Features

The Bluetooth controller is backward compatible with the Bluetooth specification V1.2 *[4]* and V2.0 + EDR *[3]*. Here below is a list with the main features of those specifications:

- Adaptive Frequency Hopping (AFH)
- Fast connection: interlaced scan for page and inquiry scan, answer FHS at first reception, RSSI used to limit range
- Extended SCO (eSCO) links: supports EV3, EV4 and EV5 packets
- Channel quality driven data rate change (CQDDR)
- QoS flush
- Synchronization: BT clocks are available at HCI level for synchronization of parallel applications on different Slaves
- L2CAP flow & error control
- LMP SCO handling
- Scatternet support
- 2 Mbps packet types
- ACL: 2-DH1, 2-DH3, 2-DH5
- eSCO: 2-EV3, 2-EV5
- 3 Mbps packet types
- ACL: 3-DH1, 3-DH3, 3-DH5

– eSCO: 3-EV3, 3-EV5

Bluetooth controller V2.1 + EDR features

- Encryption pause/resume (EPR)
- Extended inquiry response (EIR)
- Link supervision time out (LSTO)
- Secure simple pairing (SSP)
- Sniff subrating (SSR)
- Quality of service (QoS)
- Packet boundary flag (PBF)
- Erroneous data delivery (ED)

Bluetooth controller V3.0 features

- Enhanced power control
- Read encryption key size

TX output power control

The Bluetooth subsystem supports output power control:

- With the standard TX power control algorithm enabled, the Bluetooth subsystem adapts its output power when a remote BT device supports the RSSI feature; this allows the remote device to measure the link strength and to request the Bluetooth subsystem to decrease/increase its output power. In case the remote device does not support the RSSI feature, the Bluetooth subsystem uses its 'default' output power level

The Bluetooth subsystem supports operation at Class 1 output power levels up to 10 dBm.

3.1.5 Main processor and memory

- ARM7TDMI
- On-chip RAM, including provision for patches
- On-chip ROM preloaded with
- SW up to HCI
- A2DP mediapacket encapsulation
- Patch RAM
- The Bluetooth subsystem includes a HW block that allows patching of the ROM code.
- Additionally, a SW patch mechanism allows replacing complete SW functions without changing the ROM image.
- A part of the RAM memory is used for HW and SW patches.

3.1.6 CoProcessor

- Audio processor
- RAM, including provision for patches
- ROM, preloaded with
- SBC encoding/decoding
- Patch RAM
- a SW patch mechanism allows replacing complete SW functions without changing the ROM image.
- A part of the RAM memory is used for SW patches.

Download of the SW parameter file

To change the device configuration a set of customizable parameters have been defined and put together in one file, the SW Parameter File. This SW Parameter File is downloaded at start-up into the Bluetooth subsystem.

Examples of parameters are: radio configuration, PCM settings etc.

The same HCI command is used to download the file containing the patches (both those for the SW and HW mechanism).

For a more detailed description of the SW Parameter File refer to *[16]*.

3.1.8 Pitch period error concealment (PPEC)

PPEC stands for pitch period error concealment. It is an algorithm and associated hardware used in the STLC2690 chip to improve the quality of voice transfer over the Bluetooth air channel. It provides for increased speech quality in the vicinity of interference, and improves the coexistence with WLAN. The

algorithm works at the receiver side and has no implications at all on the implementation of the Bluetooth specification.
PPEC works as follows: whenever a received packet is completely lost, instead of muting the output some previously received CVSD samples are inserted. These inserted samples are retrieved from a buffer. The PPEC algorithm continuously analyzes the samples that were previously received, and it uses fundamental speech properties to determine which samples from the buffer need to be inserted. As samples are just replaced, the PPEC algorithm does not add any latency to the voice transfer.

3.1.9 Bluetooth – WLAN/WiMAX coexistence in collocated scenario

The coexistence interface uses up to 4 WLAN control signal pins, which can be mapped via the SW Parameter File download on different pins of the Bluetooth subsystem (see *Section 4.1.7: "Download of the SW parameter file"*).
The functionality of the 4 WLAN control signal pins depends on the selected algorithm, as explained below and summarized in *Table 24: "WLAN HW signal assignment"*.
Bluetooth and WLAN 802.11 technologies occupy the same 2.4 GHz ISM band. The Bluetooth subsystem implements a set of mechanisms to avoid interference in a collocated scenario.
The Bluetooth subsystem supports 5 different algorithms in order to provide efficient and flexible simultaneous functionality between the two technologies in collocated scenarios:

- **Algorithm 1:** PTA (packet traffic arbitration) based coexistence algorithm defined in accordance with the IEEE 802.15.2 recommended practice *[7]*.
- **Algorithm 2:** the WLAN is the Master and it indicates to the Bluetooth subsystem when not to operate in case of simultaneous use of the air interface.
- **Algorithm 3:** the Bluetooth subsystem is the Master and it indicates to the WLAN chip when not to operate in case of simultaneous use of the air interface.
- **Algorithm 4:** Two-wire mechanism
- **Algorithm 5:** Alternating wireless medium access (AWMA), defined in accordance with the WLAN 802.11 technologies.

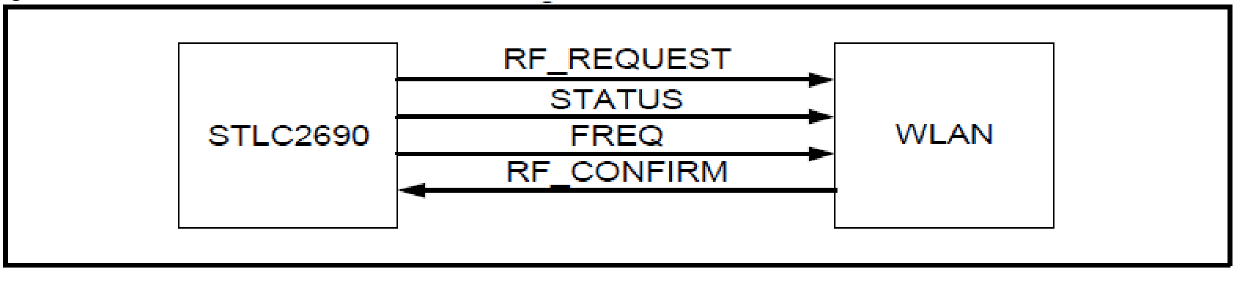
The algorithm is selected via an HCI command. The default algorithm is algorithm 1.

Algorithm 1: PTA (packet traffic arbitration)

The algorithm is based on a bus connection between the Bluetooth subsystem and the WLAN chip

Bluetooth STLC2690
44/79 DocID022051 Rev 3 Figure 18: PTA

Figure 18: PTA



By using this coexistence interface it is possible to dynamically allocate bandwidth to the two devices when simultaneous operations are required while the full bandwidth can be allocated to one of them in case the other one does not require activity.
The algorithm involves

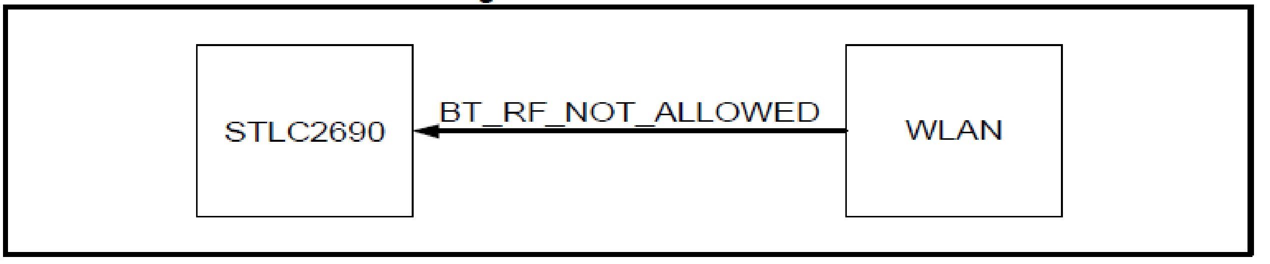
- a priority mechanism, which allows preserving the quality of certain types of link.
- a mechanism to indicate that a periodic communication is ongoing.

A typical application would be to guarantee optimal quality to the Bluetooth voice communication while an intensive WLAN communication is ongoing.
Several algorithms have been implemented in order to provide a maximum of flexibility and efficiency for the priority handling. ST specific HCI commands are implemented to select the algorithm and to tune the priority handling.
The combination of time division multiplexing and the priority mechanism avoids the interference due to packet collision. It also allows the maximization of the 2.4 GHz ISM bandwidth usage for both devices while preserving the quality of some critical types of link.

Algorithm 2: WLAN master

In case the Bluetooth subsystem has to cooperate, in a collocated scenario, with a WLAN chip not supporting a PTA based algorithm, it is possible to put in place a simpler mechanism.
The interface is reduced to 1 line:

Figure 19: WLAN master



When the WLAN has to operate, it alerts high the BT_RF_NOT_ALLOWED signal and the Bluetooth subsystem does not operate while this signal stays high.
This mechanism permits to avoid packet collision in order to make an efficient use of the bandwidth but cannot provide guaranteed quality over the Bluetooth links.

Algorithm 3: Bluetooth Master

This algorithm represents the symmetrical case of algorithm 2. Also in this case the interface is reduced to 1 line:

When the Bluetooth subsystem has to operate it alerts high the WLAN_RF_NOT_ALLOWED signal and the WLAN does not operate while this signal stays high.
This mechanism permits to avoid packet collision in order to make an efficient use of the bandwidth, it provides high quality for all Bluetooth links but cannot provide guaranteed quality over the WLAN links.

Algorithm 4: Two-wire mechanism

Based on algorithm 2 and 3, the Host decides, on a case-by-case basis, whether WLAN or Bluetooth is Master. The Master role can be checked and changed at run-time by the Host via an HCI command.

Algorithm 5: Alternating wireless medium access (AWMA)

AWMA utilizes a portion of the WLAN beacon interval for Bluetooth operations. From a timing perspective, the medium assignment alternates between usage following WLAN procedures and usage following Bluetooth procedures.
The timing synchronization between the WLAN and the Bluetooth subsystem is done by the HW signal MEDIUM_FREE.

WiMax co-existence interface

The WiMax co-existence interface connects a single wire between the STLC2690 and the WiMax controllers. The goal of the WiMax PTA implementation is to protect the traffic in the WiMax licensed bands adjacent to both ends of the 2.4 GHz ISM band used by Bluetooth. The WiMax disable pin is interpreted as a request to immediately shut down any ongoing or scheduled RF activity on the Bluetooth side. The WiMax system should assert this pin each time the Wimax RX activity takes place. The disable pin is directly connected to the BT radio control and BT shutdown can happen in less than 20 µs.

WLAN HW signal assignment

Table 24: WLAN HW signal assignment WLAN control signal	Scenario 1: PTA	Scenario 2: WLAN Master	Scenario 3: BT Master	Scenario 4: 2-wire	Scenario 5: AWMA
WLAN 1	RF_CONFIRM	BT_RF_NOT_ALLOWED	Not used	BT_RF_NOT_ALLOWED	MEDIUM_FREE
WLAN 2	RF_REQUEST	Not used	WLAN_RF_NOT_ALLOWED	WLAN_RF_NOT_ALLOWED	Not used
WLAN 3	STATUS	Not used	Not used	Not used	Not used
WLAN 4	FREQ (optional)	Not used	Not used	Not used	Not used

life.augmented

3.2 Bluetooth RF performance

All the values are provided according to the Bluetooth specification V3.0 unless otherwise specified.

3.2.1 Receiver

All specifications below are given at device pin level and with the conditions as specified. Parameters are given for each of the 3 modulation types supported.

(Typical is defined at T_{amb} = 25 °C, VDD_HV_x = 1.8 V. Minimum and maximum are worst cases over corner lots and temperature. Parameters are given at device pin, except for receiver interferers measured at antenna with a filter having a typical attenuation of 2.3 dB, for filter details see *[12]*. Measured with an impedance of 26+j32 at the IC pins (this impedance is at 25 degrees, at low/high temp the impedance is changing with temperature).)

Table 25: 1 Mbps receiver parameters - GFSK Symbol	**Parameter**	**Test condition**	**Min.**	**Typ.**	**Max.**	**Unit**
RFin	Input frequency range		2402		2480	MHz
RXsensC	Receiver sensitivity (Clean transmitter)	@ BER 0.1%	-92.5	-91	- 86.5	dBm
RXsensD	Receiver sensitivity (Dirty transmitter(1))	@ BER 0.1%	-91.5	-90	-86	dBm
RXmax	Maximum useable input signal level	@ BER 0.1%	10		10	dBm
Receiver blocking performance @ BER 0.1% on channel 58 (without filter)						
CW signal in GSM band 900 MHz (824 MHz to 960 MHz)		@ Input signal strength = -67 dBm	-7			dBm
CW signal in GSM band 1800 MHz (1805 MHz to 1990 MHz)		@ Input signal strength = -67 dBm	-3			dBm
CW signal in WCDMA band (2010 MHz to 2170 MHz)		@ Input signal strength = -67 dBm	-1			dBm
Receiver interferer performance @ BER 0.1%						
$C/I_{co\text{-}channel}$	Co-channel interference	@ Input signal strength = -60 dBm	8.5		10	dB
C/I_{1MHz}	Adjacent (±1 MHz) interference	@ Input signal strength = -60 dBm	-9		0	dB
C/I_{+2MHz}	Adjacent (+2 MHz) interference	@ Input signal strength = -60 dBm	-39		-30	dB
C/I_{-2MHz}	Adjacent (-2 MHz) interference	@ Input signal strength = -67 dBm	-25		-9	dB
C/I_{+3MHz}	Adjacent (+3 MHz) interference	@ Input signal strength = -67 dBm	- 46.5		-40	dB
C/I_{-3MHz}	Adjacent (-3	@ Input	-43		-20	dB

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
	MHz) interference	signal strength = -67 dBm				
C/I≥4MHz	Adjacent (≥ ±4 MHz) interference	@ Input signal strength = -67 dBm	-45	-40		dB

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Receiver inter-modulation						
IMD	Inter-modulation	Measured as defined in BT test specification *[6]*	-39	-32.3		dBm

Notes:
(1) Dirty transmitter including carrier frequency drift, as defined in the BT SIG spec *[6]*.

(Typical is defined at T_{amb} = 25 °C, VDD_HV_x = 1.8 V. Minimum and maximum are worst cases over corner lots and temperature. Parameters are given at device pin, except for receiver interferers measured at antenna with a filter having a typical attenuation of 2.3 dB, for filter details see *[12]*. Measured with an impedance of 26+j32 at the IC pins (this impedance is at 25 degrees, at low/high temp the impedance changes with temperature).

Table 27: 3 Mbps receiver parameters - 8-DPSK

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
RFin	Input frequency range		2402		2480	MHz
RXsensC	Receiver sensitivity (Clean transmitter)	@ BER 0.01%	-85	-83	-78.5	dBm
RXsensD	Receiver sensitivity (Dirty transmitter(1))	@ BER 0.01%	-84	-82	-77.5	dBm
RXmax	Maximum useable input signal level	@ BER 0.1%	-3			dBm
Receiver blocking performance @ BER 0.1% on channel 58 (without filter)						
CW signal in GSM band 900 MHz (824 MHz to 960 MHz)		@ Input signal strength = -67 dBm	-11			dBm
CW signal in GSM band 1800 MHz (1805 MHz to 1990 MHz)		@ Input signal strength = -67 dBm	-7			dBm
CW signal in WCDMA band (2010 MHz to 2170 MHz)		@ Input signal strength = -67 dBm	-9			dBm

Receiver interferer performance @ BER 0.1%

C/I$_{co\text{-}channel}$	Co-channel interference	@ Input signal strength = -60 dBm	19	21	dB
C/I$_{1MHz}$	Adjacent (±1 MHz) interference	@ Input signal strength = -60 dBm	-5	5	dB
C/I$_{+2MHz}$	Adjacent (+2 MHz) interference	@ Input signal strength = -60 dBm	-37	-25	dB
C/I$_{-2MHz}$	Adjacent (-2 MHz) interference	@ Input signal strength = -67 dBm	-12	0	dB
C/I$_{+3MHz}$	Adjacent (+3 MHz) interference	@ Input signal strength = -67 dBm	-46	-33	dB
C/I$_{-3MHz}$	Adjacent (-3 MHz) interference	@ Input signal strength = -67 dBm	-40	-13	dB
C/I$_{\geq 4MHz}$	Adjacent (≥ ±4 MHz) interference	@ Input signal strength = -67 dBm	-42	-33	dB

Notes:

(1) Dirty transmitter including carrier frequency drift, as defined in the BT SIG spec *[6]*.

3.2.2 Transmitter

(Unless otherwise stated, typical is defined at T_{amb} = 25 °C, VDD_HV_x = 1.8 V. Minimum and maximum are worst cases over corner lots and temperature. Parameters are given at device pin, except for in-band spurious measured at antenna with a filter having a typical attenuation of 2.3 dB, for filter details see *[12]*. Measured with an impedance of 26+j32 at the IC pins (this impedance is at 25 degrees, at low/high temp the impedance changes with temperature).)

Table 28: Transmitter Parameters Symbol	**Parameter**	**Test condition**	**Min.**	**Typ.**	**Max.**	**Unit**
RFout	Output frequency range		2400		2483. 5	MHz
RF transmit power						
TXpout (GFSK)	Maximum output power(1)	@ 2402 - 2480 MHz @ 25 °C	8	10	12	dBm
TXpout (GFSK)	Maximum output power(1)	@ 2402 - 2480 MHz @ worst cases over corner lots and temperature	7	10	13	dBm
TXprange (GFSK, π/4-DQPSK, 8- DPSK)	Power control range	@ 2402 - 2480 MHz	40			dB
Resolution of power control(2)			0.25			dB
TXpout (π/4-DQPSK)	Maximum output power(1) (3)	@ 2402 - 2480 MHz @ 25 °C	5	7	9	dBm
TXpoutrel (π/4-DQPSK)	Relative transmit power(4)	@ 2402 - 2480 MHz	0	-0.5	-1	dB
TXpout (8-DPSK)	Maximum output power(1) (2)	@ 2402 - 2480 MHz @ 25 °C	5	7	9	dBm
TXpoutrel (8-DPSK)	Relative transmit power(3)	@ 2402 - 2480 MHz	0	-0.5	-1	dB
In-band spurious emissions(5)						
FCC	FCC’s 20 dB BW		935		970	kHz
ACP_2	Channel offset = ±2 MHz		-39		-20	dBm
ACP_3	Channel offset = ±-3 MHz		-47		-40	dBm
ACP_4	Channel offset ≥ ±4 MHz		-50		-40	dBm
EDR_IBS_1	Channel offset = ±1 MHz (2 and 3 Mbps)		-27		-26	dBc
EDR_IBS_2	Channel offset = ±2 MHz (2 and 3 Mbps)		-28		-20	dBm

Symbol	**Parameter**	**Test condition**	**Min.**	**Typ.**	**Max.**	**Unit**
EDR_IBS_3	Channel offset = ±3 MHz (2 and 3 Mbps)		-44		-40	dBm
EDR_IBS_4	Channel offset = ±4 MHz (2 and 3 Mbps)		-47		-40	dBm
Initial carrier frequency tolerance (for an exact reference)						
ΔF	|f_TX-f0|		-75	0(6)	75	kHz
Carrier frequency stability(7)						
|Δf_s|	Carrier frequency stability		3.2		10	kHz
Carrier frequency drift(8)						
|Δf_p1|	One slot packet		12(5)		25	kHz
|Δf_p3|	Three slots packet		14(5)		40	kHz
|Δf_p5|	Five slots packet		14(5)		40	kHz

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Carrier frequency drift rate(7)						
|Δf/50us|	Frequency drift rate			8	20	kHz/50µs
Modulation accuracy(6) (7) (9)						
Δf1avg	Maximum modulation		140	163	175	kHz
Δf2avg	Minimum modulation		115	140		kHz
Δf2avg/ Δf1avg			0.8	0.9		
2-DH5 RMS DEVM				7.2	20	%
2-DH5 99% DEVM					30	%
2-DH5 Peak DEVM				17.5	35	%
3-DH5 RMS DEVM				7.2	13	%
3-DH5 99% DEVM					20	%
3-DH5 Peak DEVM				15	25	%
TX out of band emissions						
E100	Emission in FM band (76-108 MHz)	(7) (10)		-123		dBm/Hz
E700	Emission in CDMA2000 band (776-794 MHz)	(7) (9)		-135		dBm/Hz
E850	Emission in GSM band (869-960 MHz)	(7) (9)		-134		dBm/Hz
E900	Emission in GSM band (925-960 MHz)	(7) (9)		-134		dBm/Hz
E1500	Emission in GPS band (1570-1580 MHz)	(7) (9)		-140		dBm/Hz
E1800	Emission in GSM band (1805-1880 MHz)	(7) (9)		-136		dBm/Hz
E1900	Emission in GSM band (1930-1990 MHz)	(7) (9)		-136		dBm/Hz

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
E2100	Emission in WCDMA band (2110- 2170 MHz)	(7) (9)		-136		dBm/Hz
E2600	Emission in WCDMA band (2620-2690 MHz)	(7) (9)		-135		dBm/Hz
E5000	Emission in WLAN band (5150-5825 MHz)	(7) (9)		-130		dBm/Hz

Notes:

(1) Lower transmit power (i.e. Class 2) can be obtained by programming the radio init power table via the SW Parameter File download or an HCI command.

(2) The step size can be controlled via the SW Parameter File.

(3) Power of GFSK part.

(4) Relative power of EDR part compared to the GFSK part.

(5) At antenna with maximum output power, filter attenuation of 2.3 dB.

(6) Phase noise adds maximum [-10 kHz;10 kHz] for worst case clock 200 mVpp at 13 MHz.

(7) Worst case clock 200 mVpp at 13 MHz. Measurement according to EDR RF test spec V2.0.E.3

(8) With maximum output power.

(9) Measured on reference schematic following layout recommendations.

(10) Transmitting DH5 packets.

3.3 Bluetooth interfaces

3.3.1 HCI transport layer

H4 UART transport layer

The HCI transport layer supported on the UART is the H4 transport layer defined by the SIG *[5]*. The HCI UART transport layer assumes that the UART communication is free from line errors.
The UART interface is defined in *Section 3.12.2: "UART interface"*.
Two ways to enter and exit the low power modes are supported (For more details, refer to *[15]*):

- H4 UART: using CLK_REQ_OUT_x, UART_RXD and UART_RTS.
- H4 UART with handshake: using CLK_REQ_OUT_1, BT_WAKEUP and HOST_WAKEUP.

Enhanced H4 SPI transport layer

The HCI transport layer supported on the SPI is the H4 transport layer defined by the SIG *[5]*. The HCI SPI transport layer assumes that the SPI communication is free from line errors.
In addition a messaging protocol is defined for controlling the Deep Sleep mode entry and wake-up. Three messages are defined: SLEEP, WAKEUP and WOKEN. For more details, refer to *[14]*.
The SPI interface is defined in *Section 3.12.4: "FM I2C interface"*.
One way to enter and exit the low power modes is supported (for more details, refer to

- Enhanced H4 SPI: using CLK_REQ_OUT_x and the SPI in band signaling.

(e)SCO over HCI

The STLC2690 supports synchronous data packet transfer ((e)SCO) over HCI.

3.3.2 BT audio interface

The Bluetooth subsystem of STLC2690 supports one audio interface which can be used for (e)SCO voice transmission and reception or for A2DP. This interface can be either the BT PCM or the BT I2S as defined in *Sections 2.12.5* and *2.12.8*
The interface is fully configurable by the Host via the SW Parameter File download and when a SCO connection or A2DP connection is started-up (in order to allow different configuration based on use case).
It is possible to configure 2 SCO connections on the PCM interface taking advantage of the multi-port PCM support. The configuration of the PCM for the second SCO is not disturbing the first SCO connection.
For Bluetooth voice operation (PCM/I2S and (e)SCO), the interface always works at 8 kHz. However, it is possible to configure the interface to other frame rates like 16 or 32 kHz, and link it to an eSCO link operating at the same rate. In I2S mode, it is possible to exchange voice on the left or on the right channel only. When two (e)SCO are active, each SCO uses one of the channels. The channel which is not used is padded with ‘0’ on data out.
For A2DP operation, the I2S sample rate is configurable e.g. 44.1 or 48 kHz. The audio is SBC encoded and A2DP encapsulated in the STLC2690, before being transmitted over the BT link.

3.3.3 WLAN/WiMAX coexistence interface

The WLAN/WiMAX coexistence interface to a WLAN and/or WiMAX chip allows optimal coexistence between the two functions when collocated. This interface can contain 1 to 4 wires (WLAN1, WLAN2, WLAN3 and WLAN4). For more details refer to *Section 4.1.9: "Bluetooth – WLAN/WiMAX coexistence in collocated scenario"*. The 4 control signals are mapped on the pins as indicated in *Section 3.4.3: "Pin mapping"*.

3.3.4 GPIOs

Up to 22 GPIOs can be mapped to the pins. These GPIOs can be used as a generic output or input (interrupt) signals.

SPBT3.0DP1 module: some technical note about the Antenna device embedded in the module, displayed in the Module Block Diagram as “internal RF antenna”.

ANTENNA DESCRIPTION

Rufa is intended for use with all 2.4 GHz applications. The antenna uses a ground plane in order to radiate efficiently, but this ground plane must not extend underneath the antenna itself.
The antenna is available in two versions with the feed locations on the right or left hand side of the antenna.

Rufa Left: 3030A5839-01

Rufa Right: 3030A5887-01

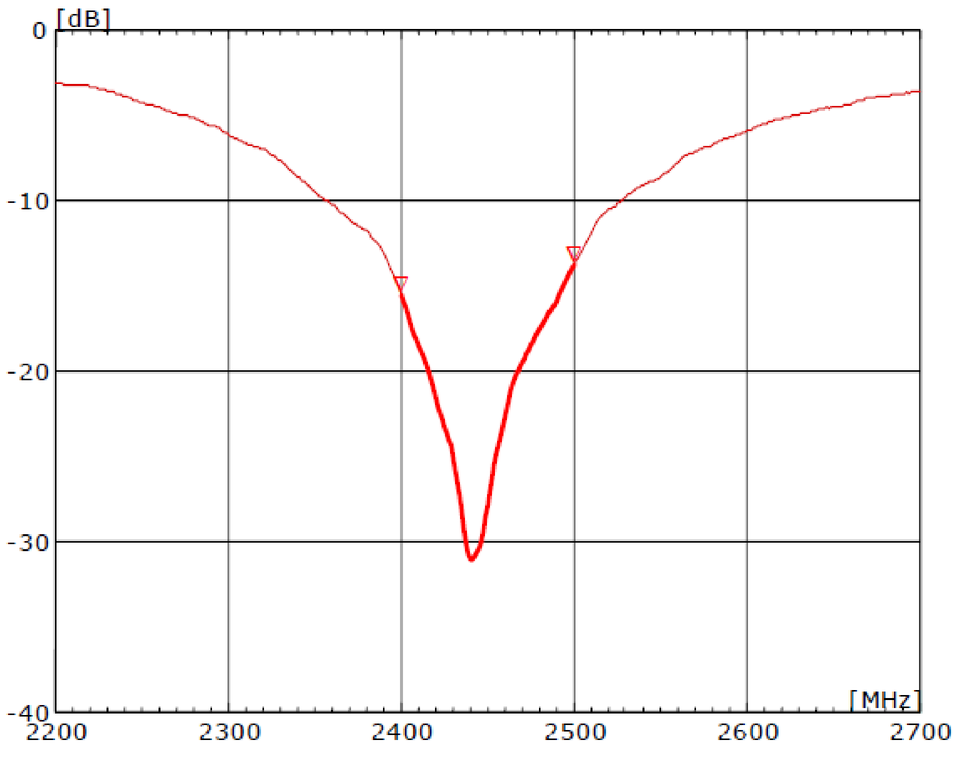
Antenna general data

Product name	Rufa 2.4 GHz
Part Number	3030A5839-01 (Left)
	3030A5887-01 (Right)
Frequency	2.4 – 2.5 GHz
Polarization	Linear
Operating temperature	-40 °C to +85 °C
Impedance with matching	50 Ω
Weight	0.1 g
Antenna type	SMD
Dimensions	12.8 x 3.9 x 1.1 [mm]

Antenna electrical characteristic

	Typical performance	Conditions
Peak gain	2.1 dBi	All data measured on Antenova's reference boards, part numbers AN-1-0543-1 and AN-1-0556-1 Data given for the 2.4 – 2.5 GHz frequency range
Average gain	-1.2 dBi	
Average efficiency	75%	
Maximum Return Loss	-11 dB	
Maximum VSWR	1.8:1	

Antenna return loss



Antenna VSWR