ZETA Codec RF SPI interface
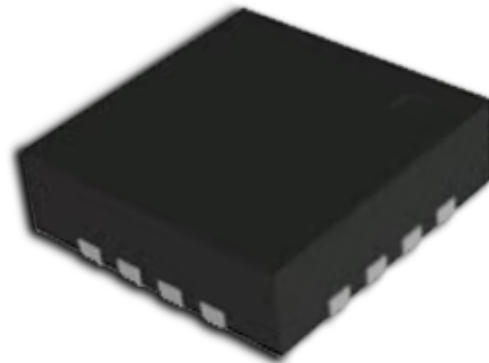
Features

- RF gateway via SPI interface

- No configuration necessary

- Simple SPI bus comms over RF

- Miniature 3mm^2 package

- Range up to 2km

- RF data rates to 500Kbps

- No external components

- Low voltage 2.2- 3.6V

- Low BOM cost

- Fast and effective RF development

Applications

- Remote networking

- USB/RS232 cable replacement

- Remote data log

- Meter reading

Description

The ZETA Codec chipset is an ultra simple way to communicate wirelessly without the hassle research required to configure hundreds of registers and layout an RF matching network.

Combine the ZETA Codec with RF Solutions' low cost ZETA module using your chosen frequency and start sending and receiving data without any the RF knowledge using an SPI or UART interface for simple and robust communication.
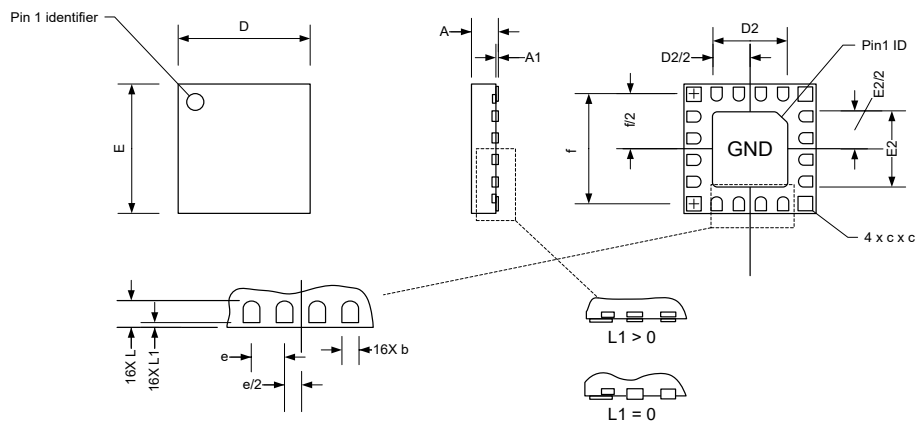
Ordering Information

Part No	Description
ZETA-COD-QFN	Codec IC for ZETA module SMT QFN package
ZETA-COD-QSOP	Codec IC for ZETA module QSOP package

ZETA Codec

Connections - QFN package
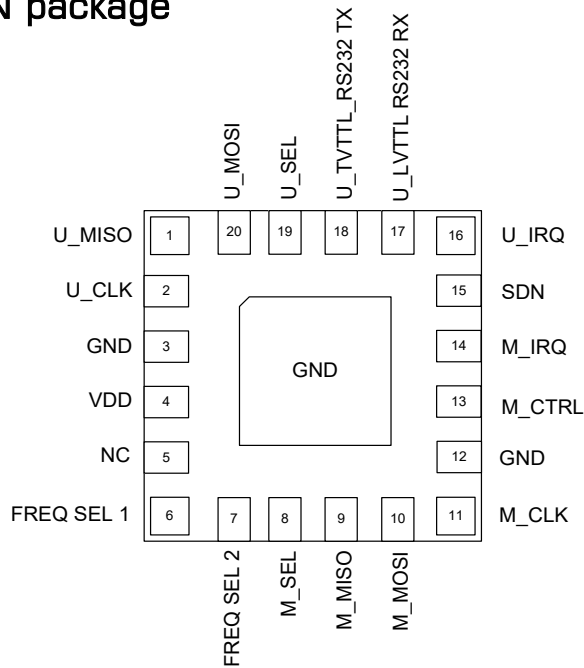
Mechanical dimensions

Dimension	Min.	Typ.	Max.
A	0.50	0.55	0.60
A1	0.00	0.02	0.05
b	0.20	0.25	0.30
c	0.27	0.32	0.37
D	3.00 BSC		
D2	1.60	1.70	1.80
e	0.50 BSC		
E	3.00 BSC		
E2	1.60	1..70	1.80
f	2.53 BSC		
L	0.30	0.40	0.50
L1	0.00	-	0.10

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ZETA Codec

Connections - QSOP package

Pin	Name	Pin	Name
1	U_MOSI	24	U_SEL
2	U_MISO	23	U_LVTTL_RS232 TX
3	U_CLK	22	U_LVTTL_RS232 RX
4	NC	21	U_IRQ
5	GND	20	SDN
6	VDD	19	M_IRQ
7	NC	18	M_CTRL
8	NC	17	M_CLK
9	NC	16	M_MOSI
10	NC	15	M_ISO
11	FREQ SEL 1	14	M_SEL
12	FREQ SEL 2	13	NC

(24pin QSOP)
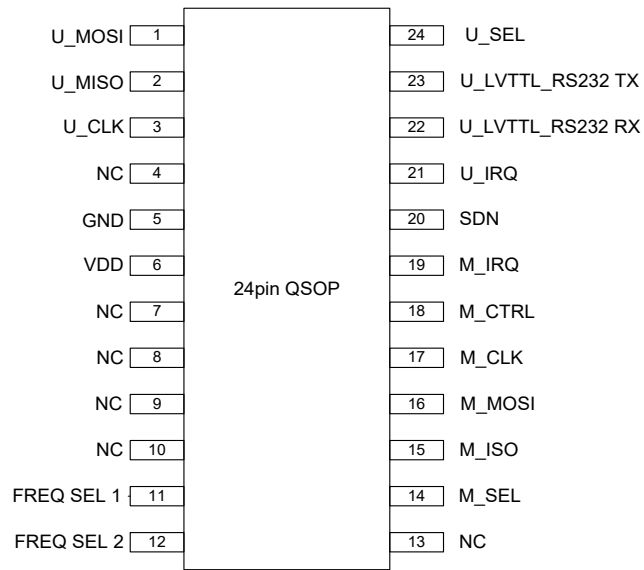
Mechanical dimensions

Dimension	Min.	Typ.	Max.
A	-	-	1.75
A1	0.10	-	0.25
b	0.20	0.25	0.30
c	0.10	-	0.25
D	8.25 BSC		
E	6.00 BSC		
E1	3.90 BSC		
e	0.635 BSC		
L	0.40	-	1.27

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ZETA Codec

Pin Description

Pin No		Name	Direction	Description
QFN	QSOP			
1	2	U_MISO	Output	SPI bus - Master Input Slave Output. Output to controlling master IC
2	3	U_CLK	Input	SPI bus - Clock signal from master controlling micro
3,12	5	GND	-	Ground connection(s)
4	6	VDD	Input	Power input 2.2 - 3.6V
5	4, 7-10, 13	NC		Do not connect
6,7	11,12	FREQ SEL 1/2	Input	Frequency Select to allow operation with ZETA 433, 868 and 915MHz variants.
8	14	M_SEL	-	Connect to ZETA module: pin 12 (Codec to ZETA module SPI bus)
9	15	M_MISO	-	Connect to ZETA module: pin 11 (Codec to ZETA module SPI bus)
10	16	M_MOSI	-	Connect to ZETA module: pin 10 (Codec to ZETA module SPI bus)
11	17	M_CLK	-	Connect to ZETA module: pin 9 (Codec to ZETA module SPI bus)
13	18	M_CTRL	-	Connect to ZETA module: pin 7 (Codec to ZETA module SPI bus)
14	19	M_IRQ	-	Connect to ZETA module: pin 5 (Codec to ZETA module SPI bus)
15	20	SDN	-	Shutdown pin for sleep on both ZETA module and ZETA CODEC (High=Shutdown) When waking device wait for U_IRQ to go high indicating device is ready for coms.
16	21	U_IRQ	Output	SPI bus - data ready interrupt Active Low
17	22	U_LVTTL RX	Input	Low Voltage TTL level (3.3V) UART data / Are capable of 5V TTL
18	23	U_LVTTL TX	Output	Low Voltage TTL level (3.3V) UART data / Are capable of 5V TTL
19	24	U_SEL	Input	SPI bus chip select Active Low
20	1	U_MOSI	Input	SPI bus, Master Output, Slave Input

DS-ZETA-CODEC-1

ZETA Codec

Connections operational description

The ZETA Codec operates using a Serial Peripheral Interface (SPI) for synchronous, simple industry standard communication between two remote points. ZETA Codec makes designing RF into a circuit simpler and faster than ever before.

Simply pass data to the ZETA Codec using the SPI interface and it seamlessly transmits it to a remote counterpart where the data is made ready and extraction notification is given via an interrupt. No external peripheral components are required, simply connect the ZETA Codec to a ZETA RF module as shown the application circuit, add an antenna and start communicating wirelessly at ranges over 2km.

Additionally the ZETA Codec also contains a standard low level UART interface, via its LVTTL TX and RX pins, these allow point to point RS232 communication. This may be used instead of the SPI comms, but not as well as.

SPI interface pins				
U_MISO	U_CLK	U_IRQ	U_SEL	U_MOSI

SPI interface to ZETA module						
M_SEL	M_SEL	M_ISO	M_MOSI	M_CTRL	M_IRQ	M_SDN

The ZETA Codec communicates with the ZETA module via SPI, passing data to the ZETA module in a ready to send via RF format. Only connection to the relevant pin on the ZETA module is required for these lines. The interface between the two is completely handled by the ZETA Codec and the ZETA module.

Shutdown / Sleep Mode for module and codec		
U_SDN	M_SDN	

The U_SDN pin is used to send the ZETA Module and the ZETA Codec into low power sleep mode. The shutdown state is the lowest current consumption state of the device and is entered by driving SDN high. In this state, all register contents are lost and there is no SPI access. Drive low to exit.
The M_SDN pin passes the state of the U_SDN pin to the module.

RS232 Connection and serial data		
U_LVTTL RX	U_LVTTL RX	

The RS232 connections operate in the same way as the SPI comms and use the same command set . The RS232 pins can be used as an alternative form of communication but not as well as the SPI comms.

| FREQUENCY Select pins		
FREQ SEL 1	FREQ SEL 2	

The two frequency selection pins are set such that they tell the CODEC chip which ZETA module it is to work with. Once configured the CODEC will change it's Transmit and Receive mode's altering the available channels to the start points given on pages 6 and 7. The below table defines the settings for each frequency:

	FREQ SEL1	FREQ SEL2
868MHz	NC	NC
915MHz	GND	NC
433MHz	NC	GND

ZETA Codec

SPI command set and interface

Please Note: some terminal programs may require commands in different formats to the examples shown in this document.

SPI bus flow diagram: receiving a data packet:
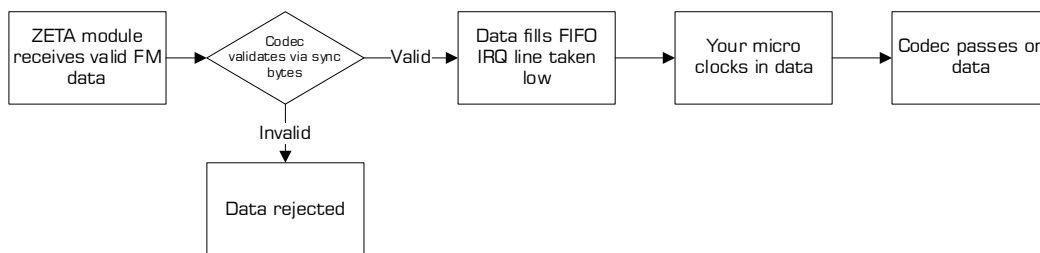
Packet structure:

#R	Packet length	RSSI*	Your data

* RSSI (Received Signal Strength Indicator) value is a single 8 bit byte with value 0 -255.

Mode selection:

Command for MODE select: ATM 1-3		
Command	Name	Description
1	RX	The command enters RX mode using whichever settings were last configured using the #R command below.
2	Ready	Ready is a low power wake state which can be used for fast entry to RX or switching between TX and RX. Time to RX or TX from READY <1ms
3	Sleep	Low power sleep mode with register retention.

Example: Place the codec in receive mode

Command	A	T	M	1
Decimal byte value	65	84	77	1

Note: alternative possible example of mode select for some terminal programs: ATM#001.

Receiver mode:

Command for RECEIVER select: ATR CHANNEL, PACKET LENGTH		
Command	Name	Description
0-15	CHANNEL	Set in 250KHz increments starting at (FREQ dependent): At 433MHz: 0=433.92 At 868MHz: 0=869.50 At 915MHz: 0=915
1-65	PACKET LENGTH	Length of data packet to be sent in 8 bit bytes

Example: Enter receiver mode on channel 2 with a packet length of 10 (8 bit) bytes.

Command	A	T	R	2	10
Decimal byte value	65	84	82	2	10

When a valid packet is received in SPI mode the U_IRQ pin will go low indicating data is ready to be read over SPI. When a valid packet is received in UART mode the data is immediately sent via the U_LVTTL TX pin.

ZETA Codec

Transmit mode

Command for Transmit Mode: ATS CHANNEL, PACKET LENGTH, DATA		
Command	Name	Description
0-15	Channel	Set in 250KHz increments starting at (FREQ dependent): At 433MHz: 0=433.92 At 868MHz: 0=869.50 At 915MHz: 0=915
1-64	Packet length	The length of the data packet to follow. In 8 bit bytes.
	Data	Your data to be transmitted.

Example: send a 13 byte packet on channel 2

Command	A	T	S	2	13	DATA
Decimal byte value	65	84	83	2	13	Your 13 bytes

Sync bytes / addressing

Configure module sync bytes: Command: ATA SYNC1, SYNC2, SYNC3, SYNC4		
Command	Name	Description
1-4	SYNC1-4	Sent sync bytes 1-4. The sync bytes appear directly after the pre-amble in data packet and can be used as a form of addressing to discriminate between required and spurious data. Set these bytes and the module will then only pass on data which contains the correct sync bytes configuration. Set all to AA if not required. NOTE: Reverse order bytes: ie 2D = D4, D4 =2B

Example: Set the sync bytes to 12 34 56 78

Command	A	T	A	12	34	56	78
Decimal byte value	65	84	65	12	34	56	78

RF baud rate

Configure the RF baud rate: Command: ATB 0-19 Note SDN must be toggled high/low for setting to take affect and can take up to 15ms to complete.		
Command	Name	Description
1-19	Baud rate	GFSK RF baud rates in kbps 1=4.8 kbps 2=9.6 kbps 3=38.4 kbps 4=128.0 kbps 5=256.0 kbps 6=500.0 kbps

Example: Set the RF baud rate to 500kbps GFSK:

Command	A	T	B	6
Decimal byte value	65	84	66	6

ZETA Codec

SPI command set continued

RF Output Power

Configure the RF power output: Command: ATP 1-127		
Command	Name	Description
1-127	Power output	Power output in increments from 1-127

Example: Set the power outputs to 32:

Command	A	T	P	15
ASCII	65	84	80	32

Communication with the ZETA Codec via UART interface.

UART configuration:
Baud rate: 19200
Data bits: 8
Parity: none
Stop bits: 1

Note all UART I/O are at Low level and must not exceed 5V.

UART in
Data is sent to the RX pin on the ZETA codec in standard UART format using the correct command set. A 50ms timeout exists to avoid lock-up if not all requested data bytes are sent - in this scenario the packet would be aborted and no data sent.

UART out
Data is output from the TX pin on the ZETA codec.

When in receive mode and an RF packet is received the data packet is automatically send over the UART.

ZETA Codec

Communication with the ZETA Codec via SPI interface.

Maximum SPI data rate: 1.4Mhz

Data is sent over the SPI bus on the ZETA codec in standard SPI format using the correct command set. A 50ms timeout exists to avoid lock-up if not all requested data bytes are sent - in this scenario the packet would be aborted and no data sent.

When in receive mode and an RF packet is received the U_IRQ pin will go low indicating SPI data is ready to be read.

The following two pages show example timing diagrams for the SPI bus communication.

Selecting preferred communication method.

Only one communication method can be used at a time and priority is set by the last access method.

For example if you enable receive mode via SPI it will revert to SPI communication from there on unless you access the device via UART it will then revert to UART communication only from then on.

ZETA Codec
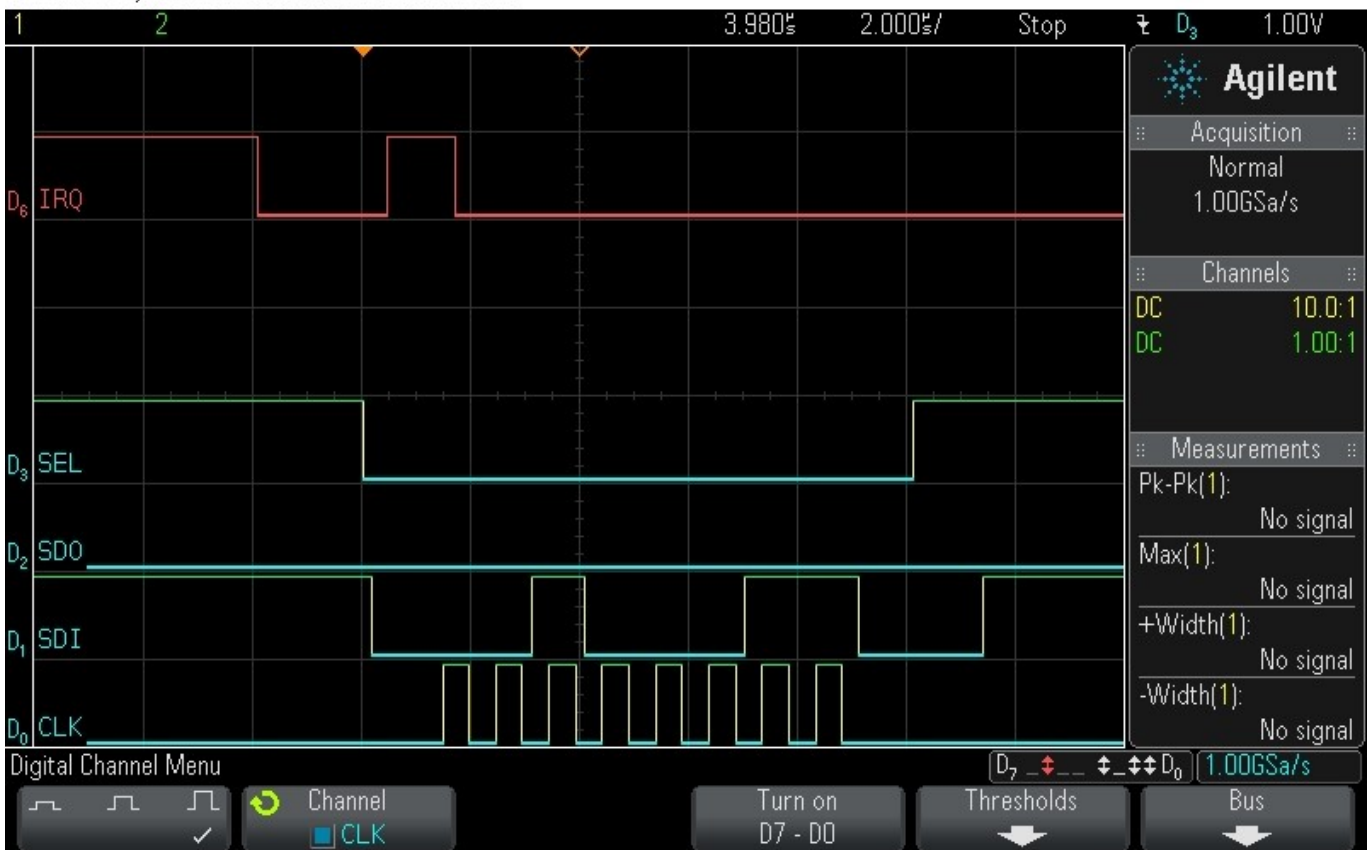
Above is the first byte of SPI data following U_IRQ going low after an RF packet has been received.

Sequence:-
1. IRQ goes low indicating a packet has been received.
2. Read byte over SPI bus.
3. If IRQ remains low then more data is still available to read. Goto 2.

The first two bytes read should be #R followed by the packet length & RSSI value then the packet data.

ZETA Codec

Above is the complete SPI & IRQ Timing diagram for #R<RSSI> <Packet >
plus 12 byte data packet

ZETA Codec

PCB Layout and wave flow guide - 24pin QSOP
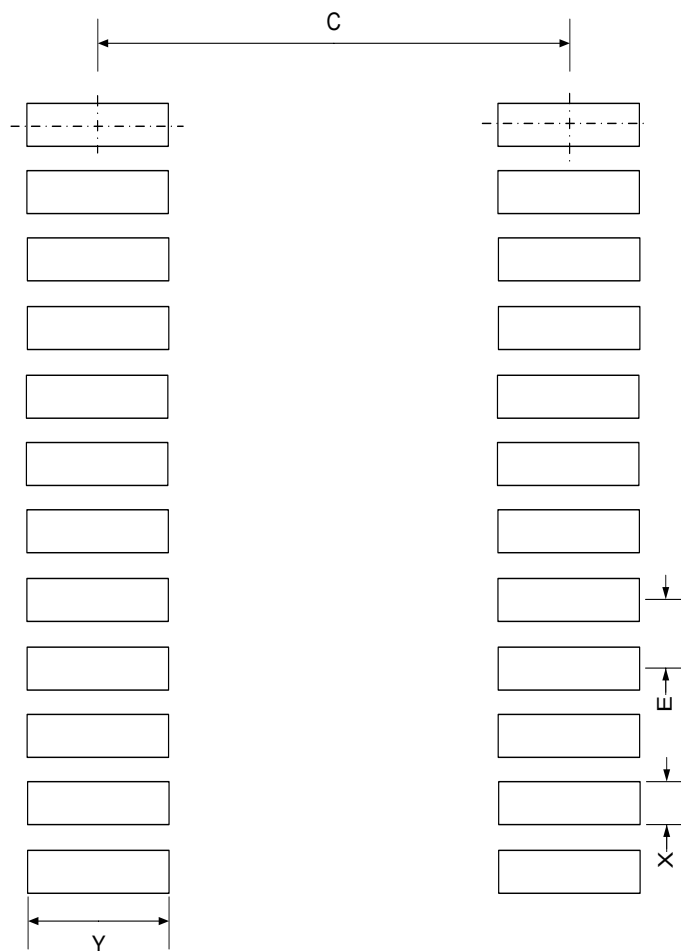
Dimension	Min.	Typ.	Max.
C	5.20	-	5.30
X	0.30	-	0.40
Y	1.50	-	1.60
E	0.635 BSC		

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ZETA Codec

PCB Layout - 20pin QFN
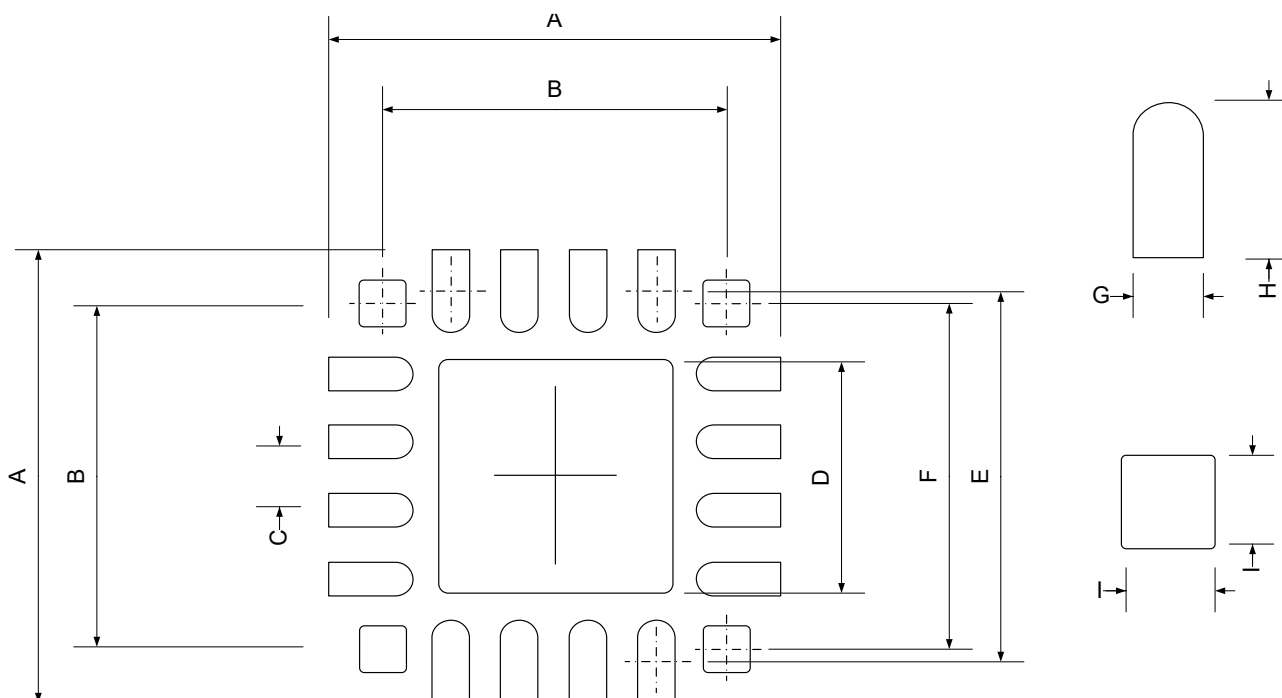
Dimension	Min.	Typ.	Max.
A	-	-	3.31
B		2.53 BSC	
C		0.50 BSC	
D	1.60	-	1.80
E		2.71 BSC	
F		2.53 BSC	
G		-	0.28
H		-	0.61
I		-	0.34

ZETA Codec

Technical Specifications

Absolute Maximums:
Storage temperature range: –50 to +125°C.

Parameter		Min	Max	Units
Voltage on any Input	Vcc > 2.2		5.0	V
	Vcc < 2.2		Vcc +	V
Max Input power (thro Antenna)			+10	dBm

Parameter	Min	Typical	Max	Units
Supply voltage	2.4	3	3.6	V
Operating temperature	-10		+55	°C
ZETA Codec TX supply current: When transmitting (At max power)		26		mA
ZETA Codec RX supply current: Receiving Ready Standby (SDN High)	14.6 5.0 9	15 5.2 10	15.3 5.5 11	mA mA µA

DS-ZETA-CODEC-1

ZETA Codec

Example schematic for connection to ZETA Module (QFN Version)

LL RS232 to host

SPI to host

FREQUENCY BAND SELECT

ZETA Codec
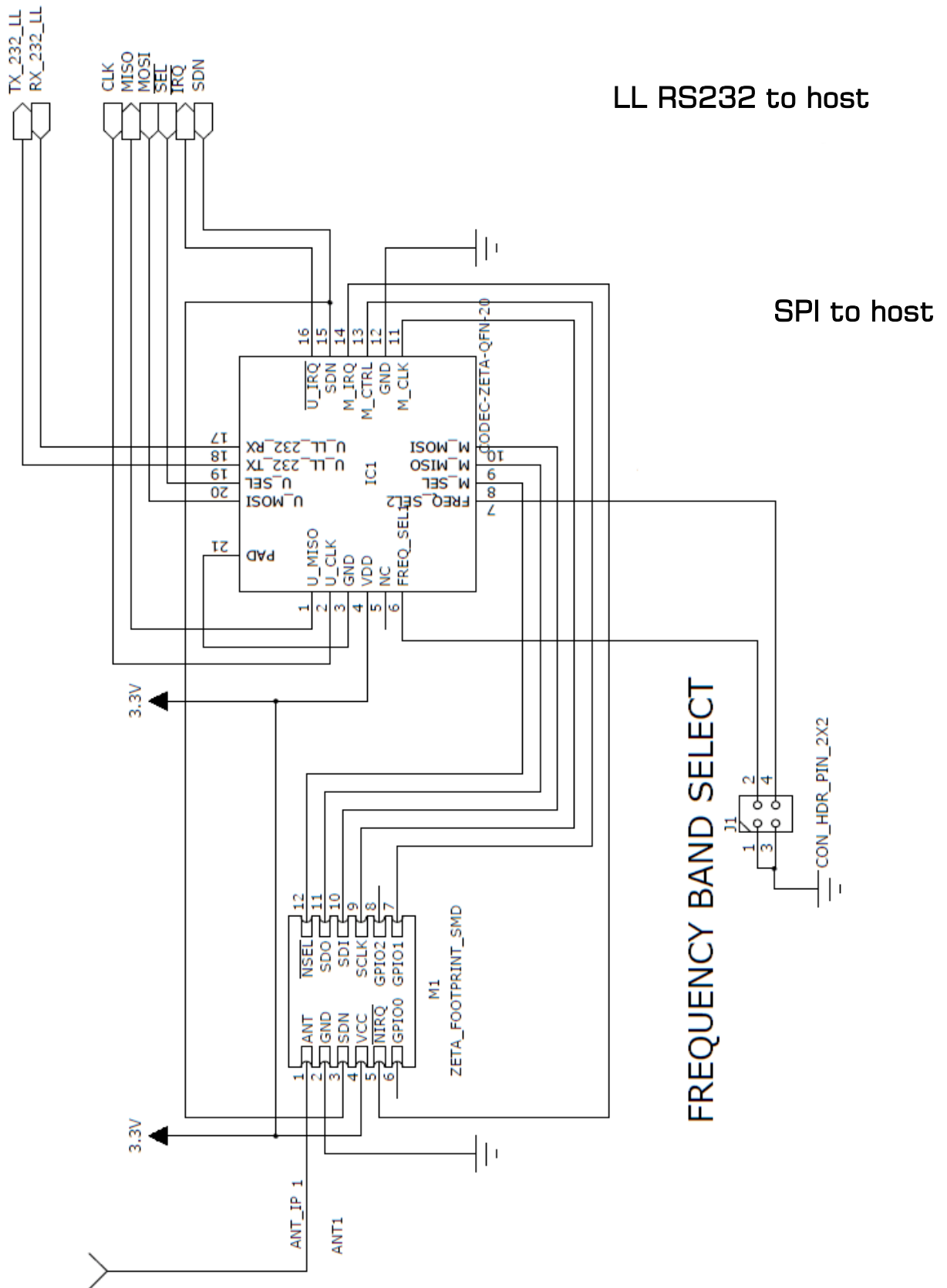
Example schematic for connection to ZETA Module (SSOP Version)

LL RS232 to host

SPI to host

FREQUENCY BAND SELECT

DS-ZETA-CODEC-1

ZETA Codec
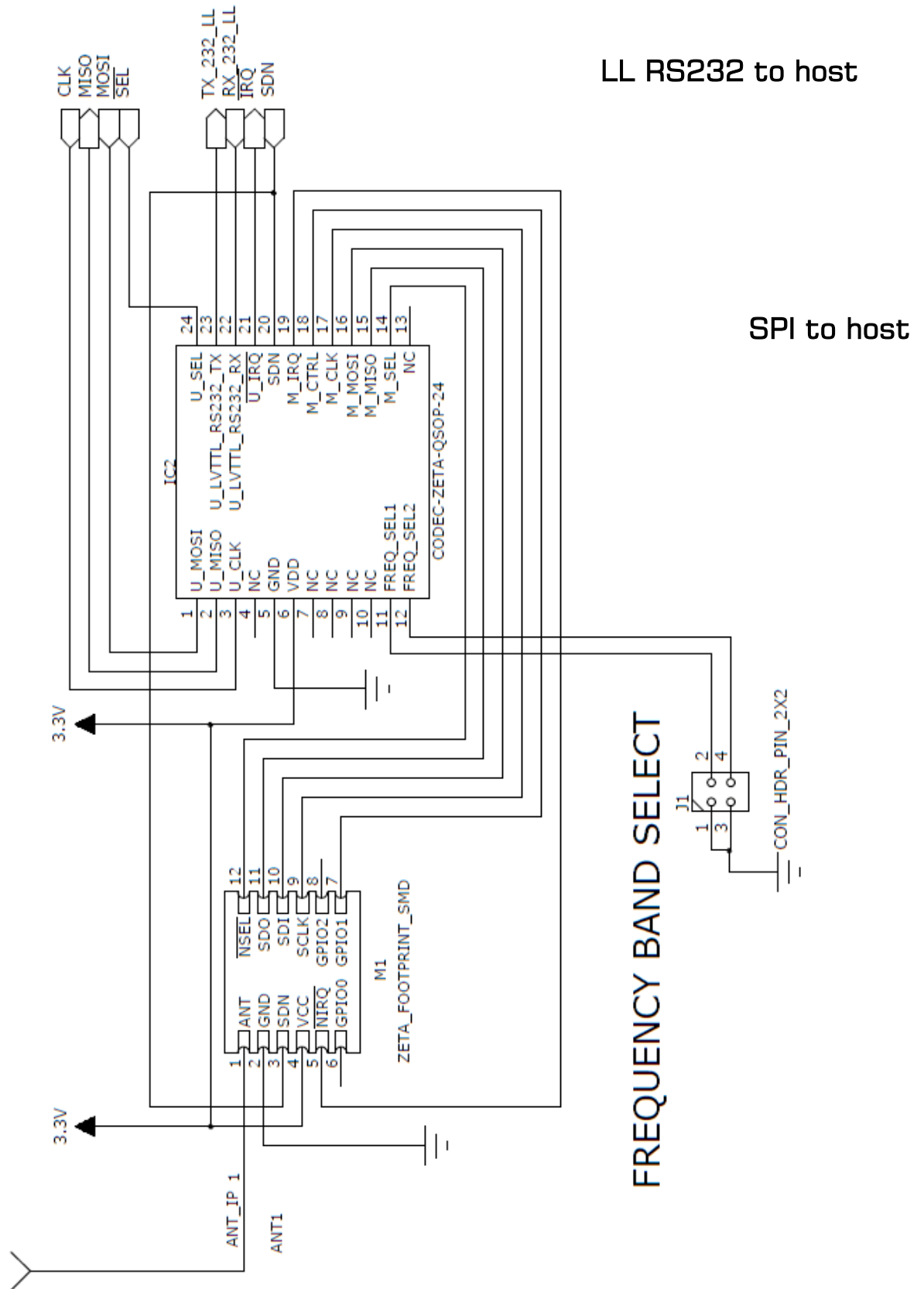
ZETA module and CODEC re-flow guide
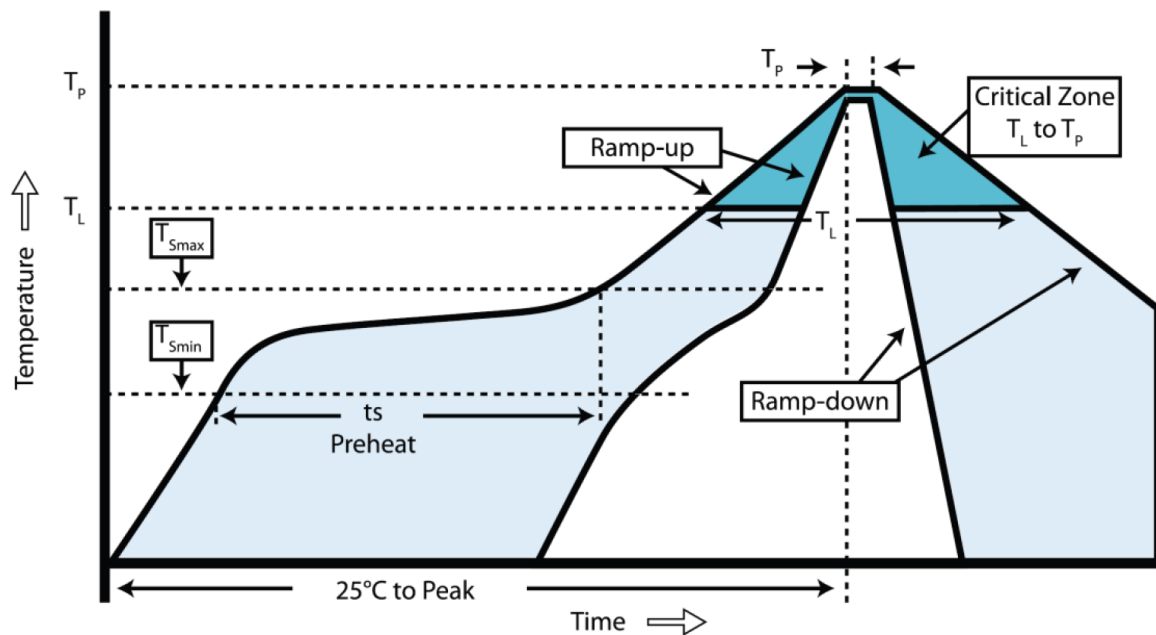
ZETA MODULE is a 2 layer PCB, re-flow is based on IPC/JEDEC JSTD020C July 2004

Profile feature	Value (lead free)
Ramp up rate	$3^{\circ}C$ /s

Pre-heat temperature
    - Temperature Min (T_{Smin})
    - Temperature Max (T_{smax})
    - Pre-heat time
	
	$150^{0}C$
	$200^{0}C$
	60-100s

Peak temperature (T_P)	$240^{0}C$
Time at T_P	10-20sec
Ramp down rate	$6^{0}C$/s
Time from $25^{0}C$ to peak	8 mins max.

ZETA Codec

Range Testing

RF Solutions range tested the ZETA module using the CODEC chipset 2 range tests were carried out in different locations to prove the range consistently

Range test 1
Location: Ditchling Beacon, Sussex UK
Conditions: Light wind, overcast, dry.
Result: 2.2km (this is more than, would be expect in an urban environment).

Range test 2
Location: Hove, Sussex, UK
Conditions: Light wind, overcast, dry.

ZETA Codec

Simplified Declaration of Conformity (RED)

BG - С настоящото RF Solutions Limited декларира, че този тип радиосъоръжение Carlton-8T16 е в съответствие с Директива 2014/53/ЕС. Цялостният текст на ЕС декларацията за съответствие може да се намери на следния интернет адрес: www.rfsolutions.co.uk

CS -Tímto RF Solutions Limited prohlašuje, že typ rádiového zařízení Carlton-8T16 je v souladu se směrnicí 2014/53/EU. Úplné znění EU prohlášení o shodě je k dispozici na této internetové adrese: www.rfsolutions.co.uk

DA - Hermed erklærer RF Solutions Limited , at radioudstyrstypen Carlton-8T16 er i overensstemmelse med direktiv 2014/53/EU. EU-overensstemmelseserklæringens fulde tekst kan findes på følgende internetadresse: www.rfsolutions.co.uk

DE - Hiermit erklärt RF Solutions Limited , dass der Funkanlagentyp Carlton-8T16 der Richtlinie 2014/53/EU entspricht. Der vollständige Text der EU-Konformitätserklärung ist unter der folgenden Internetadresse verfügbar: www.rfsolutions.co.uk

EL - Με την παρούσα o/η RF Solutions Limited , δηλώνει ότι ο ραδιοεξοπλισμός Carlton-8T16 πληροί την οδηγία 2014/53/ΕΕ. Το πλήρες κείμενο της δήλωσης συμμόρφωσης ΕΕ διατίθεται στην ακόλουθη ιστοσελίδα στο διαδίκτυο: www.rfsolutions.co.uk

EN - Hereby, RF Solutions Limited declares that the radio equipment type Carlton-8T16 is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: www.rfsolutions.co.uk

ES - Por la presente, RF Solutions Limited declara que el tipo de equipo radioeléctrico Carlton-8T16 es conforme con la Directiva 2014/53/UE. El texto completo de la declaración UE de conformidad está disponible en la dirección Internet siguiente: www.rfsolutions.co.uk

ET -Käesolevaga deklareerib RF Solutions Limited , et käesolev raadioseadme tüüp Carlton-8T16 vastab direktiivi 2014/53/EL nõuetele. ELi vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil: www.rfsolutions.co.uk

FI -RF Solutions Limited vakuuttaa, että radiolaitetyyppi Carlton-8T16 on direktiivin 2014/53/EU mukainen. EU-vaatimustenmukaisuusvakuutuksen täysimittainen teksti on saatavilla seuraavassa internetosoitteessa: www.rfsolutions.co.uk

FR - Le soussigné, RF Solutions Limited , déclare que l'équipement radioélectrique du type Carlton-8T16 est conforme à la directive 2014/53/UE. Le texte complet de la déclaration UE de conformité est disponible à l'adresse internet suivante: www.rfsolutions.co.uk

HR - RF Solutions Limited ovime izjavljuje da je radijska oprema tipa Carlton-8T16 u skladu s Direktivom 2014/53/EU. Cjeloviti tekst EU izjave o sukladnosti dostupan je na sljedećoj internetskoj adresi: www.rfsolutions.co.uk

HU - RF Solutions Limited igazolja, hogy a Carlton-8T16 típusú rádióberendezés megfelel a 2014/53/EU irányelvnek. Az EU-megfelelőségi nyilatkozat teljes szövege elérhető a következő internetes címen: www.rfsolutions.co.uk

IT - Il fabbricante, RF Solutions Limited , dichiara che il tipo di apparecchiatura radio Carlton-8T16 è conforme alla direttiva 2014/53/UE. Il testo completo della dichiarazione di conformità UE è disponibile al seguente indirizzo Internet: www.rfsolutions.co.uk

LT - Aš, RF Solutions Limited , patvirtinu, kad radijo įrenginių tipas Carlton-8T16 atitinka Direktyvą 2014/53/ES. Visas ES atitikties deklaracijos tekstas prieinamas šiuo interneto adresu: www.rfsolutions.co.uk

LV - Ar šo RF Solutions Limited deklarē, ka radioiekārta Carlton-8T16 atbilst Direktīvai 2014/53/ES. Pilns ES atbilstības deklarācijas teksts ir pieejams šādā interneta vietnē: www.rfsolutions.co.uk

MT - B'dan, RF Solutions Limited , niddikjara li dan it-tip ta' tagħmir tar-radju Carlton-8T16 huwa konformi mad-Direttiva 2014/53/UE. It-test kollu tad-dikjarazzjoni ta' konformità tal-UE huwa disponibbli fdan l-indirizz tal-Internet li ġej: www.rfsolutions.co.uk

NL - Hierbij verklaar ik, RF Solutions Limited , dat het type radioapparatuur Carlton-8T16 conform is met Richtlijn 2014/53/EU. De volledige tekst van de EU-conformiteitsverklaring kan worden geraadpleegd op het volgende internetadres: www.rfsolutions.co.uk

PL - RF Solutions Limited niniejszym oświadcza, że typ urządzenia radiowego Carlton-8T16 jest zgodny z dyrektywą 2014/53/UE. Pełny tekst deklaracji zgodności UE jest dostępny pod następującym adresem internetowym: www.rfsolutions.co.uk

PT - O(a) abaixo assinado(a) RF Solutions Limited declara que o presente tipo de equipamento de rádio Carlton-8T16 está em conformidade com a Diretiva 2014/53/UE. O texto integral da declaração de conformidade está disponível no seguinte endereço de Internet: www.rfsolutions.co.uk

RO - Prin prezenta, RF Solutions Limited declară că tipul de echipamente radio Carlton-8T16 este în conformitate cu Directiva 2014/53/UE. Textul integral al declarației UE de conformitate este disponibil la următoarea adresă internet: www.rfsolutions.co.uk

SK - RF Solutions Limited týmto vyhlasuje, že rádiové zariadenie typu Carlton-8T16 je v súlade so smernicou 2014/53/EÚ. Úplné EÚ vyhlásenie o zhode je k dispozícii na tejto internetovej adrese: www.rfsolutions.co.uk

SL - RF Solutions Limited potrjuje, da je tip radijske opreme Carlton-8T16 skladen z Direktivo 2014/53/EU. Celotno besedilo izjave EU o skladnosti je na voljo na naslednjem spletnem naslovu: www.rfsolutions.co.uk

SV - Härmed försäkrar RF Solutions Limited att denna typ av radioutrustning Carlton-8T16 överensstämmer med direktiv 2014/53/EU. Den fullständiga texten till EU-försäkran om överensstämmelse finns på följande webbadress: www.rfsolutions.co.uk

www.rfsolutions.co.uk