United Monolithic Semiconductors

CHR2270-QRG

5.8GHz Transponder

SiGe Monolithic Microwave IC in SMD leadless package

Description

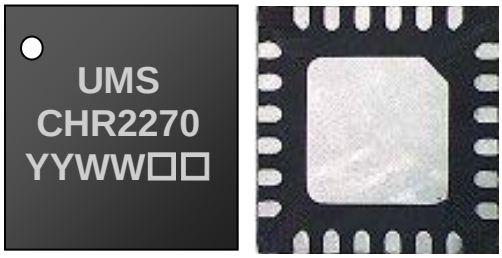
The CHR2270-QRG is an integrated transponder circuit, manufactured in SiGe technology and designed to be compatible with ETSI ES 200 674 and EN 300 674 dedicated to short-range communications at 5.8GHz. It includes all the RF functions for bi-directional transmission and digital interfaces to controller, with high flexibility for performances customization.

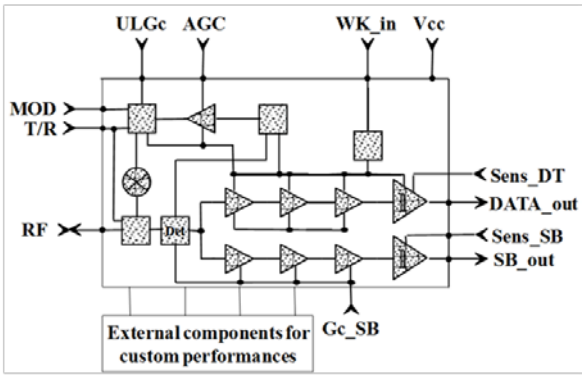
Three modes are implemented:

STANDBY: ultra-low current AM detector, with integrated RF filtering, providing a selective wake-up signal on SB_out & SB_CPT outputs. These outputs are active when an AM modulated RF signal is applied to the RF input with either ETSI ES 200 674 or EN 300 674 patterns.

DOWNLINK: low current AM detector, with optimized IF bandwidth, providing the demodulated data at the Data_out output.

UPLINK: multipliers based on passive reflective mixers operating either in phase or amplitude modulation.





Main Features

- 5.8GHz ISM band operating frequency
- Single RF port and antenna for compact system
- Integrated wake-up circuit with additional selective output
- 3V battery bias voltage range oriented with Ultra low Standby current and IDLE mode
- Adjustable Standby time & threshold parameters with 2 bits wake-up sensitivity digital control
- High wake-up selectivity
- High AM detection sensitivity for Downlink
- Adjustable Downlink parameters
- Downlink RF input power level monitoring
- Digital output interfaces CMOS compatible
- Wide Uplink and Downlink IF bandwidth
- High performance phase and amplitude modulator for low Uplink losses
- Uplink gain control
- Integrated loop for emitted RF spectrum power limitation
- -40°C to +90°C temperature range
- ESD protected

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- High performances small leadless plastic package
- RoHS compliant

Main Electrical Characteristics

Full operating range

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
Vcc	Bias voltage		+2.7	+3	+3.2	V
Top	Operating Temperature range		-25	+25	+90	°C
Fop	Operating RF frequency range		5.72	5.8	5.88	GHz
BW_rf	RF bandwidth		40			MHz
RL_rf (*)	RF return loss	50 Ω (1) UL_Gc_v<0.1V		-12	-8	dB
DP_v	Digital ports input voltage high low		Vcc-0.1 0		Vcc +0.1	V
WK_in_v	WK_in port input voltage high low		+2.7 -0.1	+3 0	+3.2 +0.1	V V
WK_in_imp (*)	WK_in port impedance		1350		 10	Ω pF
WK_in_t_d (*)	WK_in recovery time to receive	WK_in ‘0’ to ‘1’			30	µs
WK_in_t_u (*)	WK_in recovery time to transmit	WK_in ‘0’ to ‘1’			10	µs
T/R_imp (*)	T/R input port impedance		100	 5	 10	kΩ pF
T/R_t (*)	Transmit to Receive recovery time				30	µs
R/T_t (*)	Receive to Transmit recovery time	AGC=’0’ AGC=’1’		0.5 20	1 30	µs

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All modes

(Full operating range)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
Vcc	Bias voltage		+2.7	3	+3.2	V
Top	Operating Temperature range		-25	25	90	°C
op	Operating RF frequency range		5.72	5.8	5.88	GHz
BW_rf	RF bandwidth		40			MHz
RL_rf (*)	RF return loss	50 Ω (1) UL_Gc_v<0.1V		-12	-8	dB
DP_v	Digital ports input voltage high low		Vcc-0.1 0		Vcc +0.1	V
WK_in_v	WK_in port input voltage high low		+2.7 -0.1	3 0	+3.2 +0.1	V V
WK_in_imp (*)	WK_in port impedance		1350		 10	Ω pF
WK_in_t_d (*)	WK_in recovery time to receive	WK_in ‘0’ to ‘1’			30	µs
WK_in_t_u (*)	WK_in recovery time to transmit	WK_in ‘0’ to ‘1’			10	µs
T/R_imp (*)	T/R input port impedance		100	 5	 10	kW pF
T/R_t (*)	Transmit to Receive recovery time				30	µs
R/T_t (*)	Receive to Transmit recovery time	AGC=’0’ AGC=’1’		0.5 20	1 30	µs

(1) An external matching may be required to optimise performances versus substrate height.

(*) Note : Min & Max values include technological spreads, supply & temperature range effect.

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STANDBY mode:

T/R='0', MT='0', MOD='0', WK_in='low'

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
SB_load	Standby SB_out & SB_CPT output ports load impedance		1		10	MW pF
SB_v (*)	Standby SB_out & SB_CPT output ports DC voltage high level (1) low level		Vcc-0.2 0		Vcc +0.2	V
RF_sb_out_bw	Amplitude modulation frequency of RF for SB_out wake-up		250		500	kHz
RF_sb_CPT_am	Amplitude modulation frequency of RF for SB_CPT wake-up		240	250	260	kHz
RF_sb_cf (*)	Amplitude modulation frequency of RF on RF port for non-wake-up at any Fop	RF_sb_p_max<0dBm m=1 C_Delay=any pF	DC		10	kHz
RF_sb_p_min (*)	Amplitude modulated RF minimum input power on RF port for wake-up	(2) IDLE="0" (4)	-49	-44	-39	dBm
RF_sb_p_ds (*)	RF_sb_p_min digital step	IDLE="0"	1.5	2	2.5	dB
SB_Sn_imp	RF_sb_p digital setting ports impedance		10		3	MW pF
RF_sb_p_max (*)	Amplitude modulated RF maximum input power on RF port for wake-up (2)		-10	-6		dBm
SB_wk_delay (*)	Time delay for wake-up	-3	12.5	25	50	µs
SB_CPT_delay (*)	Time delay for CPT wake-up		35	70	140	µs
IDLE_imp	IDLE setting port impedance		10		3	MW pF
IDLE_delay (*)	IDLE recovery delay "1" to "0"	@ RF_sb_p_min			1	ms
Vcc_sb_i (*)	Standby DC current	Without RF input signal (RF_sb_p<-35dBm & SB_out='1') (RF_sb_p >-20dBm & SB_out='0') IDLE="1" any RF		3.8 40 80 1.8	8 60 120 4	µA

(1) Wake-up signal is given by a transition on SB_v from low level to high-level state.
(2) Total received power of the modulated signal (modulation index = 0.5).
(3) C_Delay unconnected (no external capacitor).
(4) SB_Sn & R (on Sens_SB) as recommended to match -44dBm typical on a given wafers lot.
(*) Note: Min & Max values include technological spreads, supply & temperature range effect.

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DOWNLINK mode:

IDLE='0', T/R='0', MOD='0', WK_in='high'

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
Data_out_load	Downlink output port load impedance		1		10	MW pF
Data_out_v (*)	Downlink output port DC voltage high level (1) low level (1)		 WK_in -0.2 0		 WK_in +0.2	 V V
Data_out_f	Amplitude demodulation frequency		250		1000	kHz
Data_out_f_3dB	Amplitude demodulation 3dB frequency band		50		2000	kHz
Data_out_dc (*)	Data_out signal duty cycle		42.5	50	57.5	%
RF_dl_p_min (*)	Amplitude modulated RF minimum input power on RF port for downlink	(2) UL_Gc_v<0.1V		-44	-39	dBm
RF_dl_p_max (*)	Amplitude modulated RF maximum input power on RF port for downlink	(2)	-10	-6		dBm
DL_Pd_v (*)	RF port incident power detection voltage (DL_Pd DC voltage) (3)		+0.1		WK_in -0.25	V
Pd_RF_p	RF port incident power detection range		-40		-10	dBm
Pd_delay (*)	RF port incident power detection delay				10	µs
DL_Pd_load	DL_Pd output port load impedance		1		10	MW pF
Pd_Ref_v (*)	Power detection reference voltage (Pd_Ref DC voltage) (3)		WK_in -1.25	WK_in -1	WK_in -0.75	V
Pd_Ref_load	Pd_Ref output port load impedance		1		10	MW pF
Pd_diff_offset (*)	Pd_diff initial offset (3)	RF_dl_p_min		0	+0.15	V
Pd_diff_15 (*)	Pd_diff guaranteed DC detection voltage (3)	RF_dl_p = -15dBm UL_Gc_v<0.1V	+0.2	+0.6		V
WK_in_i (*)	WK_in DC current			0.25	2	mA

(1) Data_out is valid only in the downlink window specified above, and noise may produce inconsistent data below RF_dl_p_min power level.

(2) Total received power of the modulated signal (modulation index = 0.5).

(3) Pd_diff = Pd_Ref_v-DL_Pd_v = function (RF_dl_p), RF input signal modulated or not.

(*) Note: Min & Max values include technological spreads, supply & temperature range effect.

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UPLINK mode:

IDLE='0', T/R='Vcc', WK_in='high'

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
MOD_imp (*)	MOD input port impedance		100k	5	10	Ω pF
MOD_v	MOD input port voltage	Square wave Rise/Fall<50ns	0 to +0.1	0/WK_in	>WK_in-0.1 to Vcc	V
MOD_f	Uplink IF multipliers frequency		1		15	MHz
MOD_f_3dB	Uplink IF multipliers 3dB frequency band		DC		30	MHz
RF_ul_p_max (*)	Maximum amplitude RF input power		-10	-6		dBm
UL_Gc_imp (*)	UL_Gc input port impedance (Conversion gain control)		10k	5	10	Ω pF
UL_Gc_v	UL_Gc input port voltage (1)		0		WK_in	V
MT_imp (*)	MT input port impedance (PM or AM selection)		100k	5	10	Ω pF
MT_v	MT input port voltage		0 to +0.1		>WK_in-0.1 to Vcc	V
G_ul_pm (*)	RF uplink maximum PM mode conversion gain (DSB) (2)	UL_Gc_v<0.1V / NC MT_v<0.1V RF_ul_p<-35dBm	-5.5	-3	-2.5	dB
G_ul_am (*)	RF uplink maximum AM mode conversion gain (DSB) (2)	UL_Gc_v<0.1V / NC MT_v>WK_in-0.1V RF_ul_p<-35dBm	-11.5	-8.25	-6	dB
G_ul_pm_min (*)	Guaranteed minimum G_ul_pm (DSB) (1) with gain control loop OFF	UL_Gc_v>WK_in-0.1V AGC_v<0.1V MT_v<0.1V RF_ul_p = -8dBm	-30	-22	-19	dB
G_ul_am_min (*)	Guaranteed minimum G_ul_am (DSB) (1) with gain control loop OFF	UL_Gc_v>WK_in-0.1V AGC_v<0.1V MT_v>WK_in-0.1V RF_ul_p = -5dBm	-34	-26	-19	dB
AGC_imp (*)	AGC input port impedance (Internal gain control loop command)		100k	5	10	Ω pF
AGC_v_on	AGC input port voltage for loop ON		WK_in -0.1	or NC	WK_in	V
AGC_v_off	AGC input port voltage for loop OFF		0		0.1	V
AGC_delay	AGC hold time / T/R='Vcc' duration	AGC_v>WK_in-0.1V			5	ms

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Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
G_ul_pm_min_l (*)	Guaranteed minimum G_ul_pm (DSB) (1) with gain control loop ON	UL_Gc NC AGC_v>WK_in-0.1V MT_v<0.1V RF_ul_p = -8dBm Appropriate R on DL_Pd to PD_Ref or Sens_AGC for Typ	-32	-25	-15	dB
G_ul_am_min_l (*)	Guaranteed minimum G_ul_am (DSB) (1) with gain control loop ON	UL_Gc NC AGC_v>WK_in-0.1V MT_v>WK_in-0.1V RF_ul_p = -5dBm Appropriate R on DL_Pd to PD_Ref or Sens_AGC for Typ	-33	-26	-16	dB
UL_TSM	RF emitted maximum spurious level in 500kHz Rbw	@ Fop +/- 1.5, 2, 3, 3.5, 6.5, 7 MHz excluding Fop +/- MOD_f UL_Gc_v>WK_in-0.1V Sub - carrier is pseudo random modulated as defined by ETSI			-39	dBm
WK_in_i (*)	WK_in DC current			1	2	mA

(1) G_ul = Function(UL_Gc_v)
(2) G_ul = Emitted_Power(RF port @ (Fop + MOD_f)) + Emitted_Power(RF port @ (Fop - MOD_f)) - Incident_Power(RF port @ Fop)
(*) Note : Min & Max values include technological spreads, supply & temperature range effect.

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Absolute Maximum Ratings (1)

Tamb.= +25°C

Symbol	Parameter	Values	Unit
Vcc	Bbias voltage	>-0.3 & <4	V
WK_in_v	WK_in input port voltage	>-0.3 & <4 & <Vcc+0.3	V
T/R_v	Transmit / Receive input voltage	>-0.3 & <4 & <Vcc+0.3	V
MOD_v	MOD port input voltage	>-0.3 & <4 & <Vcc+0.3	V
RF_dl_p RF_ul_p	Maximum Standby, Downlink and Uplink RF input power on RF port	+5	dBm
Top	Operating temperature range	-40 to +90	°C
Tstg	Storage temperature range	-50 to +150	°C

(1) Operation of this device above anyone of these parameters may cause permanent damage.

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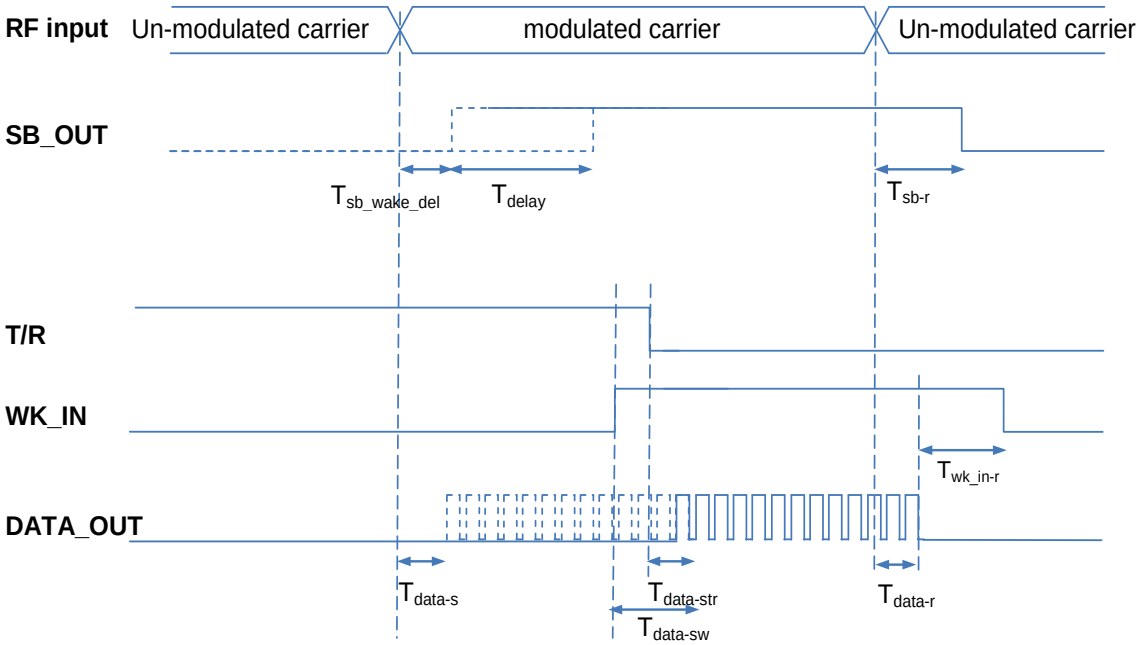
Timing characteristics

Downlink mode



Parameter	MIN	TYP	MAX	UNIT	Condition
$T_{sb\_wake\_delay}$	12.5	25	50	µs	C_{delay} unconnected
T_{delay}	0		t	µs	Capacitor (k*t) pF on C_{delay}
T_{sb-r}			10	µs	
$T_{sb\_cpt\_delay}$	35	70	140	µs	
T_{sb_cpt-r}			10	µs	
T_{wk_in-r}	0			µs	
T_{data-s}			1	µs	
$T_{data-sw}$			30	µs	
$T_{data-str}$			30	µs	
T_{data-r}			1	µs	Data noise filters threshold settled with R on Sens_DT input to GND

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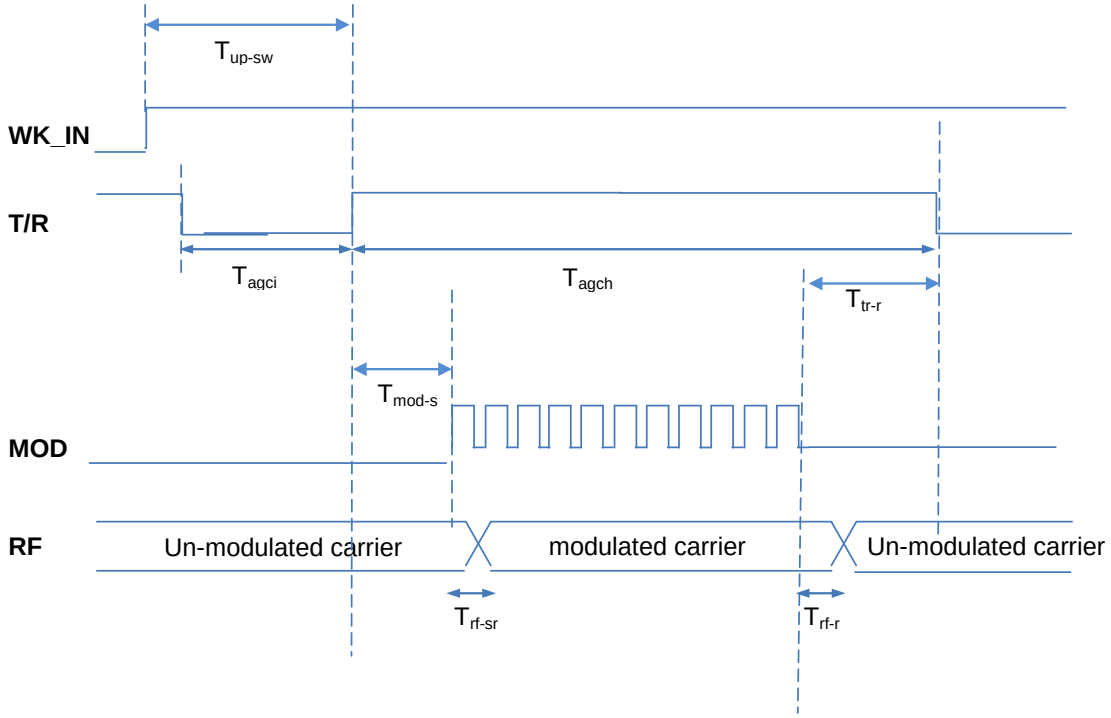
Timing characteristics

Uplink mode



Parameter	MIN	TYP	MAX	UNIT	Condition
T_{up-sw}	10			µs	
T_{agci}	10			µs	
T_{agch}			5000	µs	
T_{mod-s}	30			µs	
T_{rf-sr}			1	µs	
T_{rf-r}			1	µs	
T_{tr-r}	1			µs	

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ADJUSTMENT FEATURES

STANDBY mode:

Wake-up digital sensitivity adjustment:

SB_S1	SB_S0	Typical Sensitivity
0	0	Nominal=RF_SB_P
0	1	RF_SB_P -2dB
1	0	RF_SB_P -4dB
1	1	RF_SB_P -6dB

Wake-up threshold increase:

R on Sens_SB to +Vcc	Typical Sensitivity
390 kΩ	Nominal=RF_SB_P
220 kΩ	RF_SB_P +2dB
100 kΩ	RF_SB_P +4dB
0 Ω	RF_SB_P +6dB

Wake-up Delay increase for filtering enforcement:

C on C_Delay to GND	Typical Time delay for Wake-up
Not Connected	Nominal=SB_wk_delay
10 pF	SB_wk_delay + 35µs
22 pF	SB_wk_delay + 75µs
47 pF	SB_wk_delay + 150µs

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DOWNLINK mode:

DATA Noise filters threshold increase:

R on Sens_DT to GND	Typical Sensitivity
330 kΩ	Nominal=RF_DL_P
180 kΩ	RF_DL_P +2dB
100 kΩ	RF_DL_P +4dB
68 kΩ	RF_DL_P +6dB

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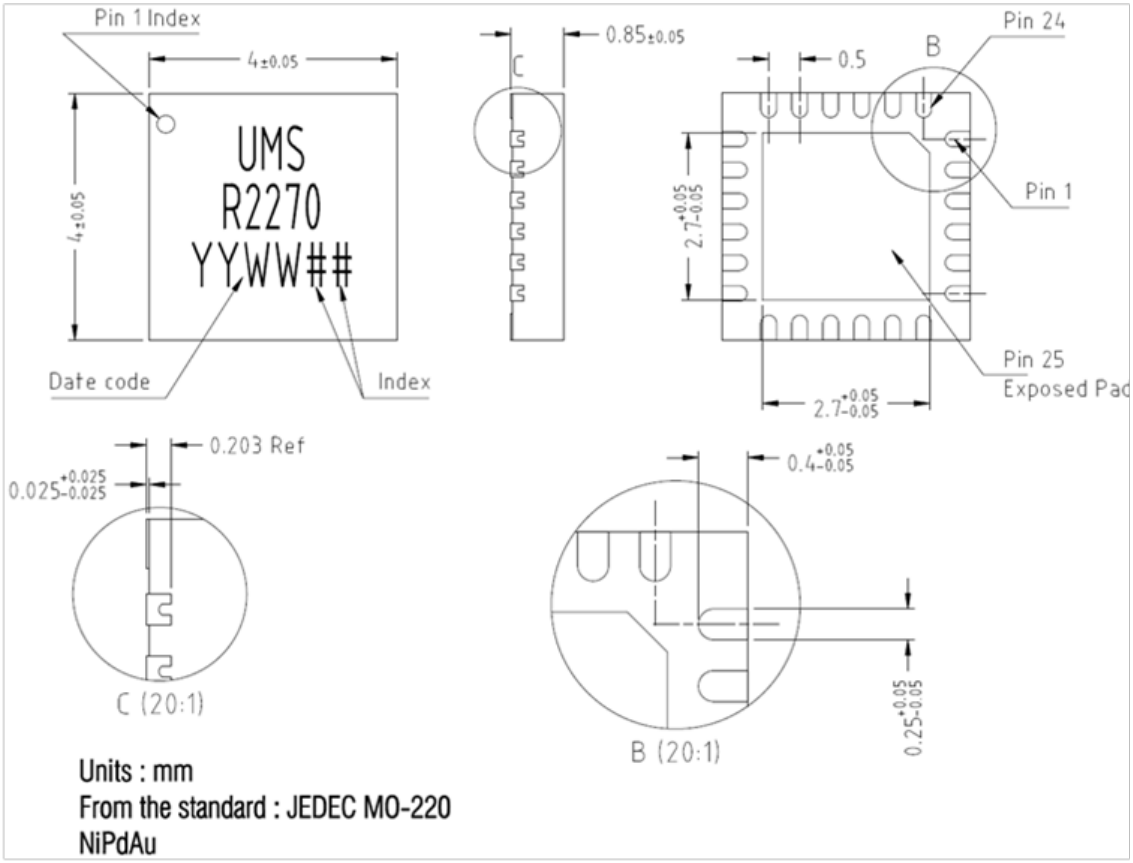
Package outline (1)



Matte tin, Lead Free	(Green)	1- RF	9- SB_S0	17- Nc
Units :	mm	2- T/R	10- SB_S1	18- IDLE
From the standard :	JEDEC MO-220 (VGGD)	3- MOD	11- Vcc	19- Sens_DT
		4- Gnd(2)	12- Sens_SB	20- Nc
25- Gnd(2)		5- Vcc	13- Gc_SB)	21- WK_in
		6- Nc	14- C_delay	22- Cext1
		7- UL-Gc	15- SB_out	23- Nc
		8- Cext2	16- Data_out	24- Nc

(1) The package outline drawing included to this data-sheet is given for indication. Refer to the application note AN0017 (https://www.rf.com/) for exact package dimensions.

(2) It is strongly recommended to ground all pins marked “Gnd” through the PCB board. Ensure that the PCB board is designed to provide the best possible ground to the package.

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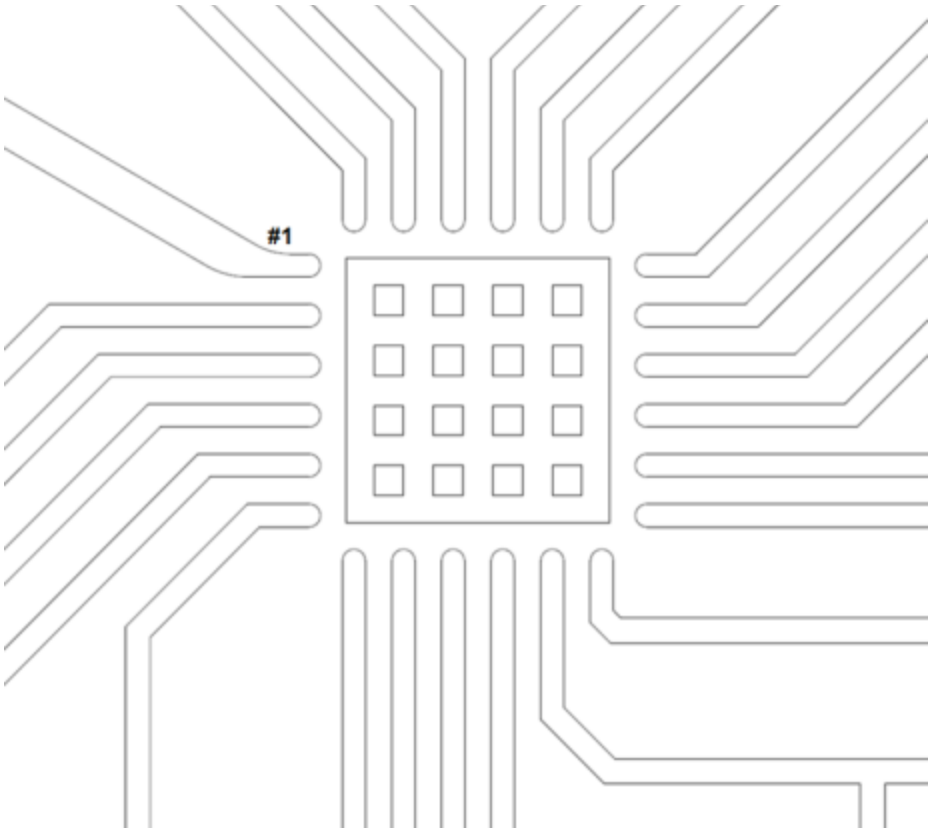
CHR2270 QFN-24L PACKAGE RECOMMENDED PCB FOOT PRINT



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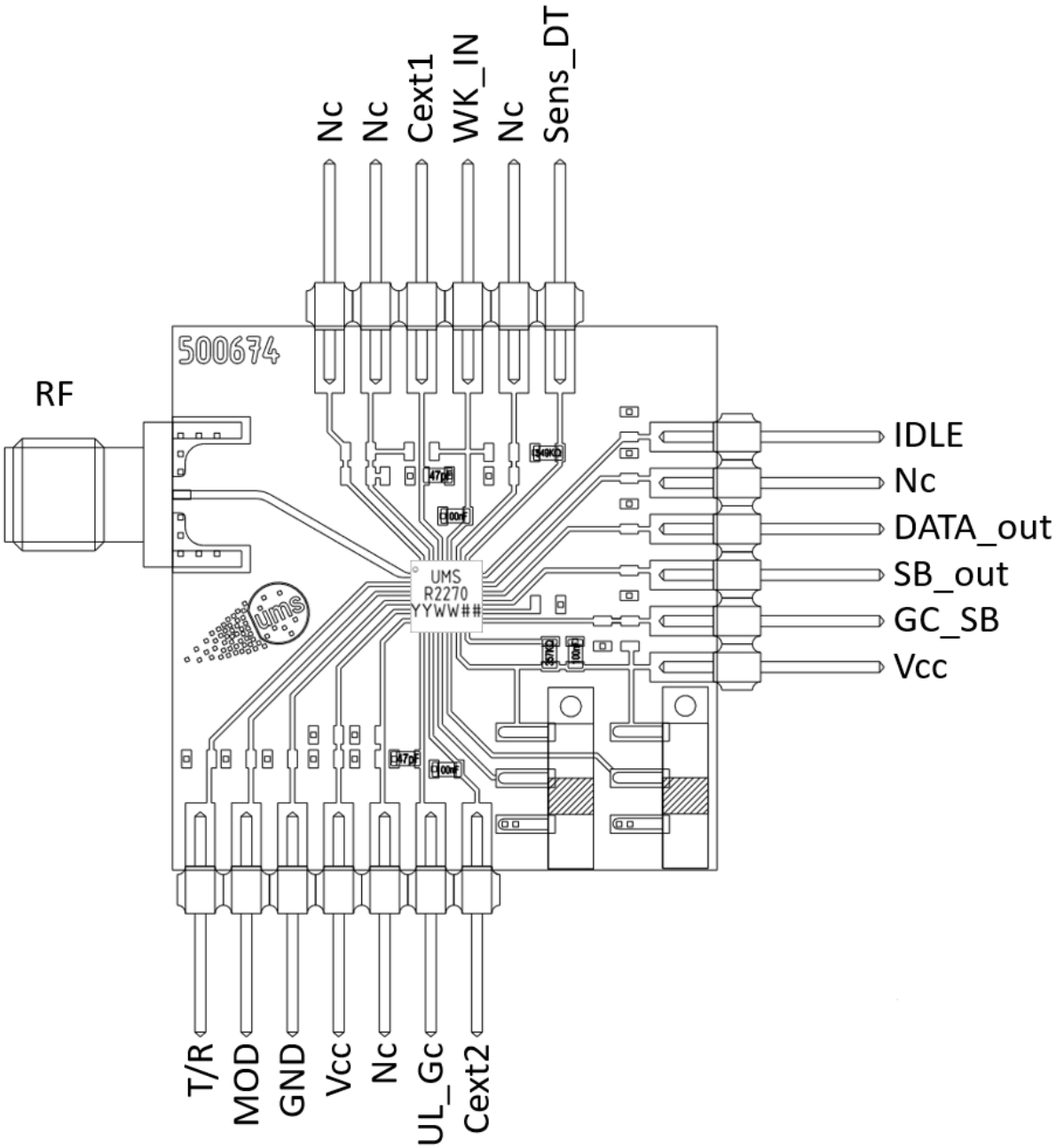
Evaluation mother board

- Compatible with the proposed footprint.
- Based on typically Ro4003 / 8mils or equivalent.
- Using a micro-strip to coplanar transition to access the package.
- Recommended for the implementation of this product on a module board.
- Decoupling capacitors of 10nF ±10% are recommended for all DC accesses.
- See application note AN0017 for details.



Note: All board measurements are performed using shielded cables, even for DC bias, to ensure safe operation.

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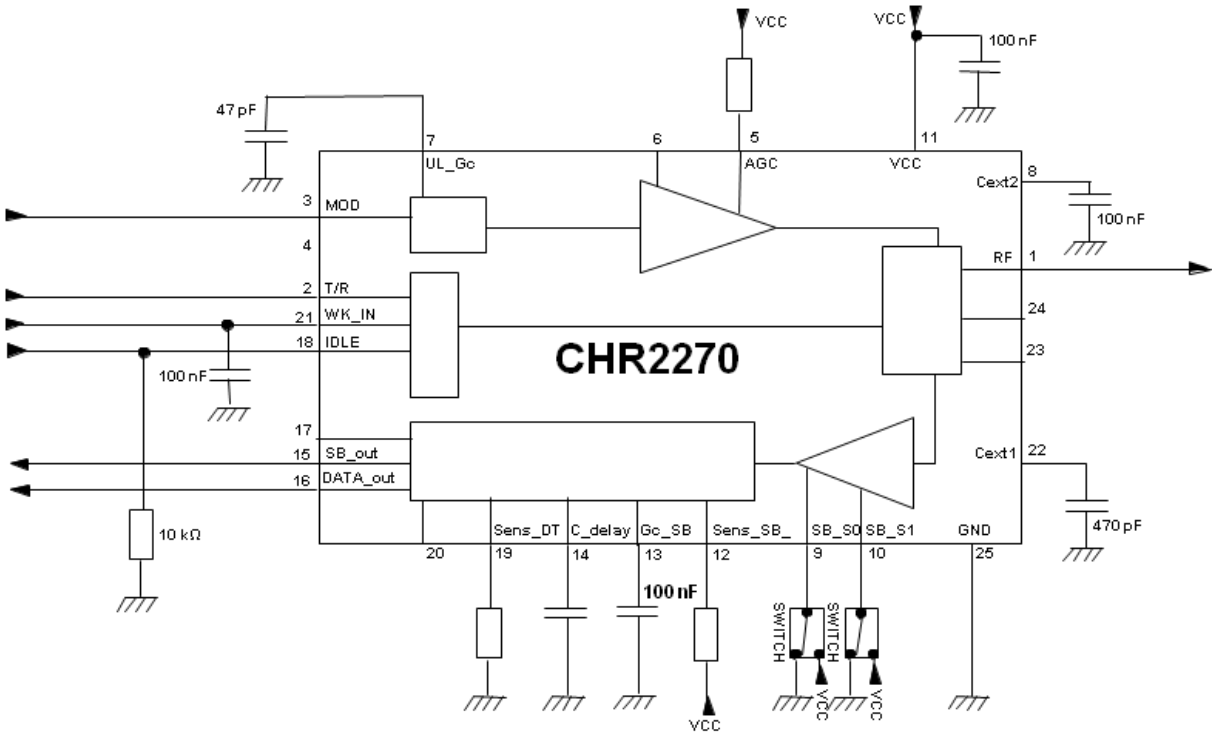
CHR2270 EXTERNAL COMPONENTS

See “Specifications” and “ADJUSTMENT FEATURES” for appropriate values.



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Notes

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Recommended package footprint

Refer to the application note AN0017 available at https://www.ums-rf.com for package foot print recommendations.

SMD mounting procedure

For the mounting process standard techniques involving solder paste and a suitable reflow process can be used. For further details, see application note AN0017 at https://www.ums-rf.com.

Recommended environmental management

UMS products are compliant with the regulation in particular with the directives RoHS N°2011/65 and REACh N°1907/2006. More environmental data are available in the application note AN0019 also available at https://www.ums-rf.com.

Recommended ESD management

Refer to the application note AN0020 available at https://www.ums-rf.com for ESD sensitivity and handling recommendations for the UMS package products.

Ordering Information

QFN 4x4 package:	CHR2270-QRG/XY	
	Stick: XY = 20	Tape & reel: XY = 21

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