Si4313 Register Descriptions

1. Complete Register Summary

Table 1. Register Descriptions

Addr	R/W	Function/Description	Data								POR Defaul
			D7	D6	D5	D4	D3	D2	D1	D0	
00	R	Device Type	0	0	0	dt[4]	dt[3]	dt[2]	dt[1]	dt[0]	08h
01	R	Device Version	0	0	0	vc[4]	vc[3]	vc[2]	vc[1]	vc[0]	06h
02	R	Device Status	ffovfl	ffunfl	rxffem	Reserved	Reserved	Reserved	cps[1]	cps[0]	
03	R	Interrupt Status 1	ifferr	Reserved	Reserved	irxffafull	iext	Reserved	Reserved	Reserved	
04	R	Interrupt Status 2	iswdet	ipreaval	ipreainval	irssi	iwut	ilbd	ichiprdy	ipor	
05	R/W	Interrupt Enable 1	enfferr	Reserved	Reserved	enrxffafull	enext	Reserved	Reserved	Reserved	00h
06	R/W	Interrupt Enable 2	enswdet	enpreaval	enpreainval	enrssi	enwut	enlbd	enchiprdy	enpor	03h
07	R/W	Operating & Function Control 1	swres	enlbd	enwt	x32ksel	Reserved	rxon	pllon	xton	01h
08	R/W	Operating & Function Control 2	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	ffclrrx	Reserved	00h
09	R/W	Crystal Oscillator Load Capacitance	xtalshft	xlc[6]	xlc[5]	xlc[4]	xlc[3]	xlc[2]	xlc[1]	xlc[0]	7Fh
0A	R/W	Microcontroller Output Clock	Reserved	Reserved	clkt[1]	clkt[0]	enlfc	mclk[2]	mclk[1]	mclk[0]	06h
0B	R/W	GPIO0 Configuration	gpio0drv[1]	gpio0drv[0]	pup0	gpio0[4]	gpio0[3]	gpio0[2]	gpio0[1]	gpio0[0]	00h
0C	R/W	GPIO1 Configuration	gpio1drv[1]	gpio1drv[0]	pup1	gpio1[4]	gpio1[3]	gpio1[2]	gpio1[1]	gpio1[0]	00h
0D	R/W	GPIO2 Configuration	gpio2drv[1]	gpio2drv[0]	pup2	gpio2[4]	gpio2[3]	gpio2[2]	gpio2[1]	gpio2[0]	00h
0E	R/W	I/O Port Configuration	Reserved	extitst[2]	extitst[1]	extitst[0]	itsdo	dio2	dio1	dio0	00h
0F	R/W	ADC Configuration	adcstart / *adcdone*	adcsel[2]	adcsel[1]	adcsel[0]	adcref[1]	adcref[0]	adcgain[1]	adcgain[0]	00h
10	R/W	ADC Sensor Amplifier Offset	Reserved	Reserved	Reserved	Reserved	adcoffs[3]	adcoffs[2]	adcoffs[1]	adcoffs[0]	00h
11	R	ADC Value	adc[7]	adc[6]	adc[5]	adc[4]	adc[3]	adc[2]	adc[1]	adc[0]	
12	R/W	Temperature Sensor Control	tsrange[1]	tsrange[0]	entsoffs	entstrim	tstrim[3]	tstrim[2]	tstrim[1]	tstrim[0]	20h
13	R/W	Temperature Value Offset	tvoffs[7]	tvoffs[6]	tvoffs[5]	tvoffs[4]	tvoffs[3]	tvoffs[2]	tvoffs[1]	tvoffs[0]	00h
14	R/W	Wake-Up Timer Period 1	Reserved	Reserved	Reserved	wtr[4]	wtr[3]	wtr[2]	wtr[1]	wtr[0]	03h
15	R/W	Wake-Up Timer Period 2	wtm[15]	wtm[14]	wtm[13]	wtm[12]	wtm[11]	wtm[10]	wtm[9]	wtm[8]	00h
16	R/W	Wake-Up Timer Period 3	wtm[7]	wtm[6]	wtm[5]	wtm[4]	wtm[3]	wtm[2]	wtm[1]	wtm[0]	01h
17	R	Wake-Up Timer Value 1	wtv[15]	wtv[14]	wtv[13]	wtv[12]	wtv[11]	wtv[10]	wtv[9]	wtv[8]	
18	R	Wake-Up Timer Value 2	wtv[7]	wtv[6]	wtv[5]	wtv[4]	wtv[3]	wtv[2]	wtv[1]	wtv[0]	
1A	R/W	Low Battery Detector Threshold	Reserved	Reserved	Reserved	lbdt[4]	lbdt[3]	lbdt[2]	lbdt[1]	lbdt[0]	14h
1B	R	Battery Voltage Level	0	0	0	vbat[4]	vbat[3]	vbat[2]	vbat[1]	vbat[0]	
1C	R/W	IF Filter Bandwidth	dwn3_ bypass	ndec[2]	ndec[1]	ndec[0]	filset[3]	filset[2]	filset[1]	filset[0]	01h
1D	R/W	AFC Loop Gearshift Override	afcbd	enafc	afcgearh[2]	afcgearh[1]	afc-gearh[0]	1p5 bypass	matap	ph0size	44h
1E	R/W	AFC/ AntDiv Timing Control	swant_- timer[1]	swant_timer[0]	shwait[2]	shwait[1]	shwait[0]	anwait[2]	anwait[1]	anwait[0]	0Ah
1F	R/W	Clock Recovery Gearshift Override	Reserved	Reserved	crfast[2]	crfast[1]	crfast[0]	crslow[2]	crslow[1]	crslow[0]	03h

Table 1. Register Descriptions

20	R/W	Clock Recovery Oversampling Ratio	rxosr[7]	rxosr[6]	rxosr[5]	rxosr[4]	rxosr[3]	rxosr[2]	rxosr[1]	rxosr[0]	64h
21	R/W	Clock Recovery Offset 2	rxosr[10]	rxosr[9]	rxosr[8]	skip2phth	ncoff[19]	ncoff[18]	ncoff[17]	ncoff[16]	01h
22	R/W	Clock Recovery Offset 1	ncoff[15]	ncoff[14]	ncoff[13]	ncoff[12]	ncoff[11]	ncoff[10]	ncoff[9]	ncoff[8]	47h
23	R/W	Clock Recovery Offset 0	ncoff[7]	ncoff[6]	ncoff[5]	ncoff[4]	ncoff[3]	ncoff[2]	ncoff[1]	ncoff[0]	AEh
24	R/W	Clock Recovery Timing Loop Gain 1	Reserved	Reserved	Reserved	rxncocomp	cgainx2	crgain[10]	crgain[9]	crgain[8]	02h
25	R/W	Clock Recovery Timing Loop Gain 0	crgain[7]	crgain[6]	crgain[5]	crgain[4]	crgain[3]	crgain[2]	crgain[1]	crgain[0]	8Fh
26	R	Received Signal Strength Indicator	rssi[7]	rssi[6]	rssi[5]	rssi[4]	rssi[3]	rssi[2]	rssi[1]	rssi[0]	
27	R/W	RSSI Threshold for Clear Channel Indicator	rssith[7]	rssith[6]	rssith[5]	rssith[4]	rssith[3]	rssith[2]	rssith[1]	rssith[0]	1Eh
2A	R/W	AFC Limiter	afclim[7]	afclim[6]	aAfclim[5]	afclim[4]	afclim[3]	afclim[2]	afclim[1]	afclim[0]	00h
2B	R	AFC Correction Read	afc_corr[9]	afc_corr[8]	afc_corr[7]	afc_corr[6]	afc_corr[5]	afc_corr[4]	afc_corr[3]	afc_corr[2]	00h
2C	R/W	OOK Counter Value 1	afc_corr[1]	afc_corr[0]	ookfrzen	peakdeten	madeten	ookcnt[10]	ookcnt[9]	ookcnt[8]	18h
2D	R/W	OOK Counter Value 2	ookcnt[7]	ookcnt[6]	ookcnt[5]	ookcnt[4]	ookcnt[3]	ookcnt[2]	ookcnt[1]	ookcnt[0]	BCh
2E	R/W	Slicer Peak Hold	reserv.	attack[2]	attack[1]	attack[0]	decay[3]	decay[2]	decay[1]	decay[0]	26h
30	R/W	FIFO config	fiforx	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	8Dh
35	R/W	Preamble Detection Control	preath[4]	preath[3]	preath[2]	preath[1]	preath[0]	rssi_off[2]	rssi_off[1]	rssi_off[0]	2Ah
36	R/W	Sync Word 3	sync[31]	sync[30]	sync[29]	sync[28]	sync[27]	sync[26]	sync[25]	sync[24]	2Dh
37	R/W	Sync Word 2	sync[23]	sync[22]	sync[21]	sync[20]	sync[19]	sync[18]	sync[17]	sync[16]	D4h
38	R/W	Sync Word 1	sync[15]	sync[14]	sync[13]	sync[12]	sync[11]	sync[10]	sync[9]	sync[8]	00h
39	R/W	Sync Word 0	sync[7]	sync[6]	sync[5]	sync[4]	sync[3]	sync[2]	sync[1]	sync[0]	00h
60	R/W	Channel Filter Coefficient Address	Inv_pre_th[3]	Inv_pre_t[2]	Inv_pre_th[1]	Inv_pre_th[0]	chfiladd[3]	chfiladd[2]	chfiladd[1]	chfiladd[0]	A0h
62	R/W	Crystal Oscillator / Control Test	pwst[2]	pwst[1]	pwst[0]	clkhyst	enbias2x	enamp2x	bufovr	enbuf	04h
69	R/W	AGC Override 1	Reserved	sgin	agcen	lnagain	pga3	pga2	pga1	pga0	20h
70	R/W	Modulation Mode Control 1	Reserved	Reserved	Reserved	Reserved	manppol	enmaninv	enmanch	Reserved	0Ch
71	R/W	Modulation Mode Control 2	rxrclk[1]	rxclk[0]	dtmod[1]	dtmod[0]	eninv	fd[8]	modtyp[1]	modtyp[0]	00h
73	R/W	Frequency Offset 1	fo[7]	fo[6]	fo[5]	fo[4]	fo[3]	fo[2]	fo[1]	fo[0]	00h
74	R/W	Frequency Offset 2	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	fo[9]	fo[8]	00h
75	R/W	Frequency Band Select	Reserved	sbsel	hbsel	fb[4]	fb[3]	fb[2]	fb[1]	fb[0]	75h
76	R/W	Nominal Carrier Frequency 1	fc[15]	fc[14]	fc[13]	fc[12]	fc[11]	fc[10]	fc[9]	fc[8]	BBh
77	R/W	Nominal Carrier Frequency 0	fc[7]	fc[6]	fc[5]	fc[4]	fc[3]	fc[2]	fc[1]	fc[0]	80h
79	R/W	Frequency Hopping Channel Select	fhch[7]	fhch[6]	fhch[5]	fhch[4]	fhch[3]	fhch[2]	fhch[1]	fhch[0]	00h
7A	R/W	Frequency Hopping Step Size	fhs[7]	fhs[6]	fhs[5]	fhs[4]	fhs[3]	fhs[2]	fhs[1]	fhs[0]	00h
7E	R/W	RX FIFO Control	Reserved	Reserved	rxafthr[5]	rxafthr[4]	rxafthr[3]	rxafthr[2]	rxafthr[1]	rxafthr[0]	37h
7F	R/W	FIFO Access	fifod[7]	fifod[6]	fifod[5]	fifod[4]	fifod[3]	fifod[2]	fifod[1]	fifod[0]	

2. Detailed Register Descriptions

Register 00h. Device Type Code (DT)

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved			dt[4:0]				
Type	R			R				

Reset value = 00001000

Bit	Name	Function
7:5	Reserved	**Reserved.**
4:0	dt[4:0]	**Device Type Code.** This internally hardwired code identifies the type or family of chip. EZRadioPRO devices = 01000 = 08h.

Register 01h. Version Code (VC)

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved			vc[4:0]				
Type	R			R				

Reset value = xxxxxxxx

Bit	Name	Function
7:5	Reserved	**Reserved.**
4:0	vc[4:0]	**Version Code.** This internally hardwired code identifies the chip revision. For EZRadioPRO devices, V2 revision = 00010 = 02h, A0 revision = 00100 = 04h, B1 revision = 00110 = 06h.

Register 02h. Device Status

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	ffovfl	ffunfl	rxffem	Reserved			cps[1:0]	
Type	R	R	R	R			R	

Reset value = xxxxxxxx

Bit	Name	Function
7	ffovfl	**RX FIFO Overflow Status.**
6	ffunfl	**RX FIFO Underflow Status.**
5	rxffem	**RX FIFO Empty Status.**
4:2	Reserved	**Reserved.**
1:0	cps[1:0]	**Chip Power State.** 00: Idle State 01: RX State

Register 03h. Interrupt/Status 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	ifferr	Reserved		irxffafull	iext	Reserved		
Type	R	R		R	R	R		

Reset value = xxxxxxxx

Bit	Name	Function
7	ifferr	**FIFO Underflow/Overflow Error.** When set to 1 the RX FIFO has overflowed or underflowed.
6:5	Reserved	**Reserved.**
4	irxffafull	**RX FIFO Almost Full.** When set to 1 the RX FIFO has met its almost full threshold and needs to be read by the microcontroller.
3	iext	**External Interrupt.** When set to 1 an interrupt occurred on one of the GPIO's if it is programmed so. The status can be checked in register 0Eh. See GPIOx Configuration section for the details.
2:0	Reserved	**Reserved.**

When any of the Interrupt/Status 1 bits change state from 0 to 1 the device will notify the microcontroller by setting the nIRQ pin LOW if it is enabled in the Interrupt Enable 1 register. The nIRQ pin will go to HIGH and all the **enabled** interrupt bits will be cleared when the microcontroller reads this address. If any of these bits is not enabled in the Interrupt Enable 1 register then it becomes a status signal that can be read anytime in the same location and will not be cleared by reading the register.

Table 2. When Individual Status Bits are Set/Cleared if not Enabled as Interrupts

Bit	Status Name	Set/Clear Conditions
7	ifferr	Set if there is a FIFO Overflow or Underflow. It is cleared only by applying FIFO reset to the specific FIFO that caused the condition.
6:5	Reserved	**Reserved.**
4	irxffafull	Will be set when the number of bytes received (and not yet read-out) in RX FIFO is greater than the Almost Full threshold set by SPI. It is automatically cleared when we read enough data from RX FIFO so that the number of data bytes not yet read is below the Almost Full threshold.
3	iext	External interrupt source.
2:0	Reserved	**Reserved.**

Register 04h. Interrupt/Status 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	iswdet	ipreaval	ipreainval	irssi	iwut	ilbd	ichiprdy	ipor
Type	R	R	R	R	R	R	R	R

Reset value = xxxxxxxx

Bit	Name	Function
7	iswdet	**Sync Word Detected.** When a sync word is detected this bit will be set to 1.
6	ipreaval	**Valid Preamble Detected.** When a preamble is detected this bit will be set to 1.
5	ipreainval	**Invalid Preamble Detected.** When the preamble is not found within a period of time set by the invalid preamble detection threshold in Register 60h, this bit will be set to 1.
4	irssi	**RSSI.** When RSSI level exceeds the programmed threshold this bit will be set to 1.
3	iwut	**Wake-Up-Timer.** On the expiration of programmed wake-up timer this bit will be set to 1.
2	ilbd	**Low Battery Detect.** When a low battery event has been detected this bit will be set to 1. This interrupt event is saved even if it is not enabled by the mask register bit and causes an interrupt after it is enabled.
1	ichiprdy	**Chip Ready (XTAL).** When a chip ready event has been detected this bit will be set to 1.
0	ipor	**Power-on-Reset (POR).** When the chip detects a Power on Reset above the desired setting this bit will be set to 1.

When any of the Interrupt/Status Register 2 bits change state from 0 to 1 the control block will notify the microcontroller by setting the nIRQ pin LOW if it is enabled in the Interrupt Enable 2 register. The nIRQ pin will go to HIGH and all the **enabled** interrupt bits will be cleared when the microcontroller reads this address. If any of these bits is not enabled in the Interrupt Enable 2 register then it becomes a status signal that can be read anytime in the same location and will not be cleared by reading the register.

Table 3. Detailed Description of Status Registers when not Enabled as Interrupts

Bit	Status Name	Set/Clear Conditions
7	iswdet	Goes high once the Sync Word is detected. Goes low once we are done receiving the current packet.
6	ipreaval	Goes high once the preamble is detected. Goes low once the sync is detected or the RX wait for the sync times-out.
5	ipreainval	Self clearing, user should use this as an interrupt source rather than a status.

Table 3. Detailed Description of Status Registers when not Enabled as Interrupts (Continued)

4	irssi	Should remain high as long as the RSSI value is above programmed threshold level
3	iwut	Wake time timer interrupt. Use as an interrupt, not as a status.
2	ilbd	Low Battery Detect. When a low battery event has been detected this bit will be set to 1. It will remain set as long as the battery voltage is below the threshold but will reset if the voltage returns to a level higher than the threshold.
1	ichiprdy	Chip ready goes high once we enable the xtal, RX, and a settling time for the Xtal clock elapses. The status stay high unless we go back to Idle mode.
0	ipor	Power on status.

Register 05h. Interrupt Enable 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	enfferr	Reserved		enrxffafull	enext	Reserved		
Type	R/W	R/W		R/W	R/W	R/W		

Reset value = 00000000

Bit	Name	Function
7	enfferr	**Enable FIFO Underflow/Overflow.** When set to 1 the FIFO Underflow/Overflow interrupt will be enabled.
6:5	Reserved	**Reserved.**
4	enrxffafull	**Enable RX FIFO Almost Full.** When set to 1 the RX FIFO Almost Full interrupt will be enabled.
3	enext	**Enable External Interrupt.** When set to 1 the External Interrupt will be enabled.
2	Reserved	**Reserved.**

Register 06h. Interrupt Enable 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	enswdet	enpreaval	enpreainval	enrssi	enwut	enlbd	enchiprdy	enpor
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W

Reset value = 00000011

Bit	Name	Function
7	enswdet	**Enable Sync Word Detected.** When set to 1 the Syn Word Detected Interrupt will be enabled.
6	enpreaval	**Enable Valid Preamble Detected.** When set to 1 the Valid Preamble Detected Interrupt will be enabled.
5	enpreainval	**Enable Invalid Preamble Detected.** When set to 1 the Invalid Preamble Detected Interrupt will be enabled.
4	enrssi	**Enable RSSI.** When set to 1 the RSSI Interrupt will be enabled.
3	enwut	**Enable Wake-Up Timer.** When set to 1 the Wake-Up Timer interrupt will be enabled.
2	enlbd	**Enable Low Battery Detect.** When set to 1 the Low Battery Detect interrupt will be enabled.
1	enchiprdy	**Enable Chip Ready (XTAL).** When set to 1 the Chip Ready interrupt will be enabled.
0	enpor	**Enable POR.** When set to 1 the POR interrupt will be enabled.

Register 07h. Operating Mode and Function Control 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	swres	enlbd	enwt	x32ksel	Reserved	rxon	pllon	xton
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W

Reset value = 00000001

Bit	Name	Function
7	swres	**Software Register Reset Bit.** This bit may be used to reset all registers simultaneously to a DEFAULT state, without the need for sequentially writing to each individual register. The RESET is accomplished by setting swres = 1. This bit will be automatically cleared.
6	enlbd	**Enable Low Battery Detect.** When this bit is set to 1 the Low Battery Detector circuit and threshold comparison will be enabled.
5	enwt	**Enable Wake-Up-Timer.** Enabled when enwt = 1. If the Wake-up-Timer function is enabled it will operate in any mode and notify the microcontroller through the GPIO interrupt when the timer expires.
4	x32ksel	**32,768 kHz Crystal Oscillator Select.** 0: RC oscillator 1: 32 kHz crystal
3	Reserved	**Reserved.**
2	rxon	**RX on in Manual Receiver Mode.** Automatically cleared if Multiple Packets config. is disabled and a valid packet received.
1	pllon	**TUNE Mode (PLL is ON).** When pllon = 1 the PLL will remain enabled in Idle State. This allows for faster turn-around time at the cost of increased current consumption in Idle State.
0	xton	**READY Mode (Xtal is ON).**

Register 08h. Operating Mode and Function Control 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved						ffclrrx	Reserved
Type	R/W						R/W	R/W

Reset value = 00000000

Bit	Name	Function
7:2	Reserved	**Reserved.**
1	ffclrrx	**RX FIFO Reset/Clear.** This has to be a two writes operation: Setting ffclrrx =1 followed by ffclrrx = 0 will clear the contents of the RX FIFO.
0	Reserved	**Reserved.**

Register 09h. 30 MHz Crystal Oscillator Load Capacitance

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	xtalshft	xlc[6:0]						
Type	R/W	R/W						

Reset value = 01111111

Bit	Name	Function
7	xtalshft	Additional capacitance to coarse shift the frequency if xlc[6:0] is not sufficient. Not binary with xlc[6:0].
6:0	xlc[6:0]	Tuning Capacitance for the 30 MHz XTAL.

Register 0Ah. Microcontroller Output Clock

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved		clkt[1:0]		enlfc	mclk[2:0]		
Type	R		R/W		R/W	R/W		

Reset value = xx000110

Bit	Name	Function
7:6	Reserved	**Reserved.**
5:4	clkt[1:0]	**Clock Tail.** If enlfc = 0 then it can be useful to provide a few extra cycles for the microcontroller to complete its operation. Setting the clkt[1:0] register will provide the addition cycles of the clock before it shuts off. 00: 0 cycle 01: 128 cycles 10: 256 cycles 11: 512 cycles
3	enlfc	**Enable Low Frequency Clock.** When enlfc = 1 and the chip is in Sleep mode then the 32.768 kHz clock will be provided to the microcontroller no matter what the selection of mclk[2:0] is. For example if mclk[2:0] = 000, 30 MHz will be available through the GPIO to output to the microcontroller in all Idle or RX states. When the chip is commanded to Sleep mode the 30 MHz clock will become 32.768 kHz.
2:0	mclk[2:0]	**Microcontroller Clock.** Different clock frequencies may be selected for configurable GPIO clock output. All clock frequencies are created by dividing the XTAL except for the 32 kHz clock which comes directly from the 32 kHz RC Oscillator. The mclk[2:0] setting is only valid when xton = 1 except the 111. 000: 30 MHz 001: 15 MHz 010: 10 MHz 011: 4 MHz 100: 3 MHz 101: 2 MHz 110: 1 MHz 111: 32.768 kHz

Register 0Bh. GPIO Configuration 0

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	gpiodrv0[1:0]		pup0	gpio0[4:0]				
Type	R/W		R/W	R/W				

Reset value = 00000000

Bit	Name	Function
7:6	gpiodrv0[1:0]	**GPIO Driving Capability Setting.**
5	pup0	**Pullup Resistor Enable on GPIO0.** When set to 1 a 200 kΩ resistor is connected internally between VDD and the pin if the GPIO is configured as a digital input.
4:0	gpio0[4:0]	**GPIO0 Pin Function Select.** 00000: Power-On-Reset (output) 00001: Wake-Up Timer: 1 when WUT has expired (output) 00010: Low Battery Detect: 1 when battery is below threshold setting (output) 00011: Direct Digital Input 00100: External Interrupt, falling edge (input) 00101: External Interrupt, rising edge (input) 00110: External Interrupt, state change (input) 00111: Reserved 01000: Reserved 01001: Reserved 01010: Direct Digital Output 01011: Reserved 01100: Reserved 01101: Reserved 01110: Reference Voltage (output) 01111: RX Data CLK output to be used in conjunction with RX Data pin (output) 10000: Reserved 10001: Reserved 10010: Reserved 10011: Reserved 10100: RX Data (output) 10101: RX State (output) 10110: RX FIFO Almost Full (output) 10111: Reserved 11000: Reserved 11001: Valid Preamble Detected (output) 11010: Invalid Preamble Detected (output) 11011: Sync Word Detected (output) 11100: Clear Channel Assessment (output) 11101: VDD else : GND

Register 0Ch. GPIO Configuration 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	gpiodrv1[1:0]		pup1	gpio1[4:0]				
Type	R/W		R/W	R/W				

Reset value = 00000000

Bit	Name	Function
7:6	gpiodrv1[1:0]	**GPIO Driving Capability Setting.**
5	pup1	**Pullup Resistor Enable on GPIO1.** When set to 1 a 200 kΩ resistor is connected internally between VDD and the pin if the GPIO is configured as a digital input.
4:0	gpio1[4:0]	**GPIO1 Pin Function Select.** 00000: Inverted Power-On-Reset (output) 00001: Wake-Up Timer: 1 when WUT has expired (output) 00010: Low Battery Detect: 1 when battery is below threshold setting (output) 00011: Direct Digital Input 00100: External Interrupt, falling edge (input) 00101: External Interrupt, rising edge (input) 00110: External Interrupt, state change (input) 00111: Reserved 01000: Reserved 01001: Reserved 01010: Direct Digital Output 01011: Reserved 01100: Reserved 01101: Reserved 01110: Reference Voltage (output) 01111: RX Data CLK output to be used in conjunction with RX Data pin (output) 10000: Reserved 10001: Reserved 10010: Reserved 10011: Reserved 10100: RX Data (output) 10101: RX State (output) 10110: RX FIFO Almost Full (output) 10111: Reserved 11000: Reserved 11001: Valid Preamble Detected (output) 11010: Invalid Preamble Detected (output) 11011: Sync Word Detected (output) 11100: Clear Channel Assessment (output) 11101: VDD else : GND

Register 0Dh. GPIO Configuration 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	gpiodrv2[1:0]		pup2	gpio2[4:0]				
Type	R/W		R/W	R/W				

Reset value = 00000000

Bit	Name	Function
7:6	gpiodrv2[1:0]	**GPIO Driving Capability Setting.**
5	pup2	**Pullup Resistor Enable on GPIO2.** When set to 1 a 200 kΩ resistor is connected internally between VDD and the pin if the GPIO is configured as a digital input.
4:0	gpio2[4:0]	**GPIO2 Pin Function Select.** 00000: Microcontroller Clock 00001: Wake-Up Timer: 1 when WUT has expired (output) 00010: Low Battery Detect: 1 when battery is below threshold setting (output) 00011: Direct Digital Input 00100: External Interrupt, falling edge (input) 00101: External Interrupt, rising edge (input) 00110: External Interrupt, state change (input) 00111: Reserved 01000: Reserved 01001: Reserved 01010: Direct Digital Output 01011: Reserved 01100: Reserved 01101: Reserved 01110: Reference Voltage (output) 01111: RX Data CLK output to be used in conjunction with RX Data pin (output) 10000: Reserved 10001: Reserved 10010: Reserved 10011: Reserved 10100: RX Data (output) 10101: RX State (output) 10110: RX FIFO Almost Full (output) 10111: Reserved 11000: Reserved 11001: Valid Preamble Detected (output) 11010: Invalid Preamble Detected (output) 11011: Sync Word Detected (output) 11100: Clear Channel Assessment (output) 11101: VDD else : GND

Register 0Eh. I/O Port Configuration

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved	extitst[2]	extitst[1]	extitst[0]	itsdo	dio2	dio1	dio0
Type	R	R	R	R	R/W	R/W	R/W	R/W

Reset value = 00000000

Bit	Name	Function
7	Reserved	**Reserved.**
6	extitst[2]	**External Interrupt Status.** If the GPIO2 is programmed to be an external interrupt source then the status can be read here.
5	extitst[1]	**External Interrupt Status.** If the GPIO1 is programmed to be an external interrupt source then the status can be read here.
4	extitst[0]	**External Interrupt Status.** If the GPIO0 is programmed to be an external interrupt source then the status can be read here.
3	itsdo	**Interrupt Request Output on the SDO Pin.** nIRQ output is present on the SDO pin if this bit is set and the nSEL input is inactive (high).
2	dio2	**Direct I/O for GPIO2.** If the GPIO2 is configured to be a direct output then the value on the GPIO pin can be set here. If the GPIO2 is configured to be a direct input then the value of the pin can be read here.
1	dio1	**Direct I/O for GPIO1.** If the GPIO1 is configured to be a direct output then the value on the GPIO pin can be set here. If the GPIO1 is configured to be a direct input then the value of the pin can be read here.
0	dio0	**Direct I/O for GPIO0.** If the GPIO0 is configured to be a direct output then the value on the GPIO pin can be set here. If the GPIO0 is configured to be a direct input then the value of the pin can be read here.

Register 0Fh. ADC Configuration

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	adcstart/ adcdone	adcsel[2:0]			adcref[1:0]		adcgain[1:0]	
Type	R/W	R/W			R/W		R/W	

Reset value = 00000000

Bit	Name	Function
7	adcstart/ adcdone	**ADC Measurement Start Bit.** Set this bit=1 starts the ADC measurement process. This bit self-clears during the measurement cycle and returns high when the measurement is complete. The conversion process is fast; reading this bit may always appear to return a 1.
6:4	adcsel[2:0]	**ADC Input Source Selection.** The internal 8-bit ADC input source can be selected as follows: 000: Internal Temperature Sensor 001: GPIO0, single-ended 010: GPIO1, single-ended 011: GPIO2, single-ended 100: GPIO0(+) – GPIO1(–), differential 101: GPIO1(+) – GPIO2(–), differential 110: GPIO0(+) – GPIO2(–), differential 111: GND
3:2	adcref[1:0]	**ADC Reference Voltage Selection.** The reference voltage of the internal 8-bit ADC can be selected as follows: 0X: bandgap voltage (1.2 V) 10: VDD/3 11: VDD/2
1:0	adcgain[1:0]	**ADC Sensor Amplifier Gain Selection.** The full scale range of the internal 8-bit ADC in differential mode (see adcsel) can be set as follows: adcref[0]=0 | FS=0.014 x (adcgain[1:0] + 1) x VDD adcref[0]=1 | FS=0.021 x (adcgain[1:0] + 1) x VDD

Register 10h. ADC Sensor Amplifier Offset

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved				adcoffs[3:0]			
Type	R				R/W			

Reset value = xxxx0000

Bit	Name	Function
7:4	Reserved	**Reserved.**
3:0	adcoffs[3:0]	**ADC Sensor Amplifier Offset*.**
***Note:** The offset can be calculated as Offset = adcoffs[2:0] x VDD/1000; MSB = adcoffs[3] = Sign bit.		

Register 11h. ADC Value

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	adc[7:0]							
Type	R							

Reset value = xxxxxxxx

Bit	Name	Function
7:0	adc[7:0]	**Internal 8 bit ADC Output Value.**

Register 12h. Temperature Sensor Calibration

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	tsrange[1:0]		entsoffs	entstrim	tstrim[3:0]			
Type	R/W		R/W	R/W	R/W			

Reset value = 00100000

Bit	Name	Function
7:6	tsrange[1:0]	**Temperature Sensor Range Selection.** (FS range is 0..1024 mV) 00: –64 °C .. 64 °C (full operating range), with 0.5 °C resolution (1 LSB in the 8-bit ADC) 01: –64 °C .. 192 °C, with 1 °C resolution (1 LSB in the 8-bit ADC) 11: 0 °C .. 128 °C, with 0.5 °C resolution (1 LSB in the 8-bit ADC) 10: –40 °F .. 216 °F, with 1 °F resolution (1 LSB in the 8-bit ADC)
5	entsoffs	**Temperature Sensor Offset to Convert from K to ºC.** Default is 1. Test mode only, to use set tsrange and entsoffs to 0.
4	entstrim	**Temperature Sensor Trim Enable.**
3:0	tstrim[3:0]	**Temperature Sensor Trim Value.**

Register 13h. Temperature Value Offset

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	tvoffs[7:0]							
Type	R/W							

Reset value = 00000000

Bit	Name	Function
7:0	tvoffs[7:0]	**Temperature Value Offset.** This value is added to the measured temperature value. (MSB, tvoffs[8]: sign bit).

Note: If a new configuration is needed (e.g., for the WUT or the LDC), proper functionality is required. The function must first be disabled, then the settings changed, then enabled back on.

Register 14h. Wake-Up Timer Period 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved			wtr[4:0]				
Type	R/W			R/W				

Reset value = xxx00011

Bit	Name	Function
7:5	Reserved	**Reserved.**
4:0	wtr[4:0]	**Wake Up Timer Exponent (R) Value*.** Maximum value for R is decimal 20. A value greater than 20 will yield a result as if 20 were written. R Value = 0 can be written here.
***Note:** The period of the wake-up timer can be calculated as T_{WUT} = (4 x M x 2^R)/32.768 ms. R = 0 is allowed, and the maximum value for R is decimal 20. A value greater than 20 will result in the same as if 20 was written.		

Register 15h. Wake-Up Timer Period 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	wtm[15:8]							
Type	R/W							

Reset value = 00000000

Bit	Name	Function
7:0	wtm[15:8]	**Wake Up Timer Mantissa (M) Value*.**
***Note:** The period of the wake-up timer can be calculated as T_{WUT} = (4 x M x 2^R)/32.768 ms.		

Register 16h. Wake-Up Timer Period 3

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	wtm[7:0]							
Type	R/W							

Reset value = 00000001

Bit	Name	Function
7:0	wtm[7:0]	**Wake Up Timer Mantissa (M) Value*.** M[7:0] = 0 is not valid here. Write at least decimal 1.
***Note:** The period of the wake-up timer can be calculated as T_{WUT} = (4 x M x 2^R)/32.768 ms.		

Register 17h. Wake-Up Timer Value 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	wtv[15:8]							
Type	R							

Reset value = xxxxxxxx

Bit	Name	Function
7:0	wtv[15:8]	**Wake Up Timer Current Mantissa (M) Value.** The value in wtv[15:0] reflects the current count value of the timer.

Register 18h. Wake-Up Timer Value 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	wtv[7:0]							
Type	R							

Reset value = xxxxxxxx

Bit	Name	Function
7:0	wtv[7:0]	**Wake Up Timer Current Mantissa (M) Value.** The value in wtv[15:0] reflects the current value of the timer.

Register 1Ah. Low Battery Detector Threshold

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved			lbdt[4:0]				
Type	R			R/W				

Reset value = xxx10100

Bit	Name	Function
7:5	Reserved	**Reserved.**
4:0	lbdt[4:0]	**Low Battery Detector Threshold.** This threshold is compared to Battery Voltage Level. If the Battery Voltage is less than the threshold the Low Battery Interrupt is set. Default = 2 V.*
***Note:** The threshold can be calculated as $V_{threshold}$ = (1.675 + lbdt x 50 mV) ±25 mV.		

Register 1Bh. Battery Voltage Level

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved			vbat[4:0]				
Type	R			R				

Reset value = xxxxxxxx

Bit	Name	Function
7:5	Reserved	**Reserved.**
4:0	vbat[4:0]	**Battery Voltage Level.** The battery voltage is converted by a 5 bit ADC if the LBD bit D6 of Reg 07h is also set. In Sleep Mode the register is updated in every 1 s. In other states it measures continuously. The measured voltage is calculated by the following formula: V_{bat}_meas=1.7 V + vbat[4:0] x 50 mV

Register 1Ch. IF Filter Bandwidth

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	dwn3_bypass	ndec_exp[2:0]			filset[3:0]			
Type	R/W	R/W			R/W			

Reset value = 00000001

Bit	Name	Function
7	dwn3_bypass	**Bypass Decimator by 3 (if set).**
6:4	ndec_exp[2:0]	**IF Filter Decimation Rates.**
3:0	filset[3:0]	**IF Filter Coefficient Sets.** IF Filter coefficient sets; Defaults are for Rb = 40 kbps and Fd = 20 kHz so Bw = 80 kHz.

The required bandwidth can be approximated from the following equation:

$$BW_{mod} = (Rb \times (1 + enmanch) + 2 \times Fd) \times k$$

Where BW_{mod} is the bandwidth of the modulation bandwidth in kHz, Rb is the payload bit rate in kbps, Fd is the frequency deviation of the received GFSK/FSK signal in kHz, enmanch is Manchester Coding parameter (see Register 70h, enmach is 1 when Manchester coding is enabled, enmanch is 0 when disabled) and k is a correction factor depending if GFSK or FSK is received.

- k = 1 for FSK
- k = 0.9 for GFSK with default Gaussian filter settings (BT = 0.5)

The bandwidth of the channel select filter in the receiver might need some extra bandwidth to cope with tolerances in transmit and receive frequencies which depends on the tolerances of the applied crystals. When the relative frequency error (Ferror) between transmitter and receiver is less than half the modulation bandwidth (BWmod) then the AFC will correct the frequency error without needing extra bandwidth. When the frequency error exceeds BWmod/2 then some extra bandwidth will be needed to assure proper AFC operation under worst case conditions. As a guide line the bandwidth in the channel select filter should be set to the following:

$$F_{error} \leq \frac{BW_{mod}}{2} \Rightarrow BW_{ch-sel} = BW_{mod}$$

$$F_{error} > \frac{BW_{mod}}{2} \Rightarrow BW_{ch-sel} = 2 \times F_{error}$$

For a required IF filter bandwidth, the three filter parameters (ndec_exp, dwn3_bypass, and filset) may be found from the table below. If the desired filter bandwidth is not exactly available, the next higher available bandwidth should be selected.

BW [kHz]	ndec_exp	dwn3_bypass	filset
2.6	5	0	1
2.8	5	0	2
3.1	5	0	3
3.2	5	0	4
3.7	5	0	5
4.2	5	0	6
4.5	5	0	7
4.9	4	0	1
5.4	4	0	2
5.9	4	0	3
6.1	4	0	4
7.2	4	0	5
8.2	4	0	6
8.8	4	0	7
9.5	3	0	1
10.6	3	0	2
11.5	3	0	3
12.1	3	0	4
14.2	3	0	5
16.2	3	0	6
17.5	3	0	7
18.9	2	0	1
21.0	2	0	2
22.7	2	0	3
24.0	2	0	4
28.2	2	0	5
32.2	2	0	6
34.7	2	0	7
37.7	1	0	1

BW [kHz]	ndec_exp	dwn3_bypass	filset
41.7	1	0	2
45.2	1	0	3
47.9	1	0	4
56.2	1	0	5
64.1	1	0	6
69.2	1	0	7
75.2	0	0	1
83.2	0	0	2
90.0	0	0	3
95.3	0	0	4
112.1	0	0	5
127.9	0	0	6
137.9	0	0	7
142.8	1	1	4
167.8	1	1	5
181.1	1	1	9
191.5	0	1	15
225.1	0	1	1
248.8	0	1	2
269.3	0	1	3
284.9	0	1	4
335.5	0	1	8
361.8	0	1	9
420.2	0	1	10
468.4	0	1	11
518.8	0	1	12
577.0	0	1	13
620.7	0	1	14

Register 1Dh. AFC Loop Gearshift Override

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	afcbd	enafc	afcgearh[2:0]			1p5bypass	matap	ph0size
Type	R/W	R/W	R/W			R/W		R/W

Reset value = 01000100

Bit	Name	Function
7	afcbd	**AFC wideband enable (active high).** If set, the IF filter bandwidth is reduced after preamble detection, in order to optimize RX sensitivity. The alternate IF filter coefficients must be specified in SPI Reg 60h and 61h; contact Silicon Labs Application Support for details.
6	enafc	**AFC Enable.**
5:3	afcgearh[2:0]	**AFC High Gear Setting.** Feedback loop gain during AFC setting process is proportional to 2^(–afcgearh[2:0]).
2	1p5bypass	**If high (1), select 0dB bias for the second phase antenna selection, if low (0), select 1.5 dB.** The default is (1), selecting 0 dB.
1	matap	**Number of taps for moving average filter during Antenna Diversity RSSI evaluation.** Allows for reduced noise variation on measured RSSI value but with slower update rate. If high (1), filter tap length = 8*Tb. If low (0=default), filter tap length = 8*Tb prior to first PREAMBLE_VALID, and 4*Tb thereafter.
0	ph0size	**If low, we will reset the Preamble detector if there are 5 consecutive zero phases.** If high, the reset will happen after 3 consecutive zero phases.

Register 1Eh. AFC Timing Control

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	swant_timer[1:0]		shwait[2:0]			anwait[2:0]		
Type	R/W		R/W			R/W		

Reset value = xx001010

Bit	Name	Function
7:6	swant_-timer[1:0]	**swant_timer**=additional number of bit periods to wait for RSSI value to stabilize during Antenna Diversity 2nd phase antenna evaluation. If matap=0, total wait time=8 x Tb+swant_timer[1:0]. If matap=1, total wait time=12 x Tb+swant_timer{1:0]. Effective only during Antenna Diversity.
5:3	shwait[2:0]	**shwait[2:0]**=short wait periods after AFC correction used before preamble is detected. Short wait=(RegValue+1) x $2T_b$. If set to '0' then no AFC correction will occur before preamble detect, i.e., AFC will be disabled.
2:0	anwait[2:0]	**anwait[2:0]**=antenna switching wait time. Number of bit periods between toggling selection of antennas=(anwait[2:0] + 2) x 4. Default value = 3'b010=16 bit periods.

Register 1Fh. Clock Recovery Gearshift Override

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved		crfast[2:0]			crslow[2:0]		
Type	R/W		R/W			R/W		

Reset value = 00000011

Bit	Name	Function
7:6	Reserved	**Reserved.**
5:3	crfast[2:0]	**Clock Recovery Fast Gearshift Value.**
2:0	crslow[2:0]	**Clock Recovery Slow Gearshift Value.**

The gear-shift register controls BCR loop gain. Before the preamble is detected, BCR loop gain is as follows:

$$BCRLoopGain = \frac{crgain}{2^{crfast}}$$

Once the preamble is detected, internal state machine automatically shift BCR loop gain to the following:

$$BCRLoopGain = \frac{crgain}{2^{crslow}}$$

crfast = 3'b000 and crslow = 3'b101 are recommended for most applications. The value of "crslow" should be greater than "crfast".

Register 20h. Clock Recovery Oversampling Rate

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	rxosr[7:0]							
Type	R/W							

Reset value = 01100100

Bit	Name	Function
7:0	rxosr[7:0]	**Oversampling Rate.** 3 LSBs are the fraction, default = 0110 0100 = 12.5 clock cycles per data bit

The oversampling rate can be calculated as rxosr = 500 kHz/(2^{ndec_exp} x RX_DR). The *ndec_exp* and the *dwn3_bypass* values found at Address: 1Ch–IF Filter Bandwidth register together with the receive data rate (Rb) are the parameters needed to calculate rxosr:

$$rxosr = \frac{500 \times (1 + 2 \times dwn3\_bypass)}{2^{ndec\_exp-3} \times Rb \times (1 + enmanch)}$$

The *Rb* unit used in this equation is in kbps. The *enmanch* is the Manchester Coding parameter (see Reg. 70h, *enmach* is 1 when Manchester coding is enabled, *enmanch* is 0 when disabled). The number found in the equation should be rounded to an integer. The integer can be translated to a hexadecimal.

For optimal modem performance it is recommended to set the *rxosr* to at least 8. A higher *rxosr* can be obtained by choosing a lower value for *ndec_exp* or enable *dwn3_bypass*. A correction in *filset* might be needed to correct the channel select bandwidth to the desired value. Note that when *ndec_exp* or *dwn3_bypass* are changed the related parameters (*rxosr*, *ncoff* and *crgain*) need to be updated.

Register 21h. Clock Recovery Offset 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	rxosr[10:8]			skip2phth	ncoff[19:16]			
Type	R/W			R/W	R/W			

Reset value = 00000001

Bit	Name	Function
7:5	rxosr[10:8]	**Oversampling Rate.** Upper bits.
4	skip2phth	**Skip 2nd Phase Ant Div Threshold.** Threshold for skipping the 2nd phase of RSSI detection during antenna diversity algorithm. 0=16 dB (default), 1=11 dB. NOT RECOMMENDED FOR USER CONFIGURATION.
3:0	ncoff[19:16]	**NCO Offset.** See formula above.

The offset can be calculated as follows:

$$ncoff = \frac{Rb \times (1 + enmanch) \times 2^{20+ndec\_\exp}}{500 \times (1 + 2 \times dwn3\_bypass)}$$

The default values for register 20h to 23h gives 40 kbps RX_DR with Manchester coding is disabled.

Register 22h. Clock Recovery Offset 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	ncoff[15:8]							
Type	R/W							

Reset value = 01000111

Bit	Name	Function
7:0	ncoff[15:8]	**NCO Offset.** See formula above.

Register 23h. Clock Recovery Offset 0

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	ncoff[7:0]							
Type	R/W							

Reset value = 10101110

Bit	Name	Function
7:0	ncoff[7:0]	**NCO Offset.** See formula above

Register 24h. Clock Recovery Timing Loop Gain 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved			rxncocomp	cgainx2	crgain[10:8]		
Type	R/W			R/W	R/W	R/W		

Reset value = 00000010

Bit	Name	Function
7:5	Reserved	**Reserved.**
4	rxncocomp	**Receive Compensation Enable for High Data Rate Offset.**
3	cgainx2	**Multiplying the CR Gain by 2.**
2:0	crgain[10:8]	**Clock Recovery Timing Loop Gain.**

The loop gain can be calculated as follows:

$$crgain = 2 + \frac{2^{15} \times (1 + enmanch) \times Rb}{rxosr \times Fd}$$

Register 25h. Clock Recovery Timing Loop Gain 0

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	crgain[7:0]							
Type	R/W							

Reset value = 10001111

Bit	Name	Function
7:0	crgain[7:0]	**Clock Recovery Timing Loop Gain.**

Register 26h. Received Signal Strength Indicator

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	rssi[7:0]							
Type	R							

Reset value = xxxxxxxx

Bit	Name	Function
7:0	rssi[7:0]	**Received Signal Strength Indicator Value.**

Register 27h. RSSI Threshold for Clear Channel Indicator

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	rssith[7:0]							
Type	R/W							

Reset value = 00011110

Bit	Name	Function
7:0	rssith[7:0]	**RSSI Threshold.** Interrupt is set if the RSSI value is above this threshold.

Register 28h. Antenna Diversity 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	adrssi[7:0]							
Type	R							

Reset value = xxxxxxxx

Bit	Name	Function
7:0	adrssi[7:0]	**Measured RSSI Value on Antenna 1.**

Register 29h. Antenna Diversity 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	adrssi2[7:0]							
Type	R							

Reset value = xxxxxxxx

Bit	Name	Function
7:0	adrssi2[7:0]	**Measured RSSI Value on Antenna 2.**

Register 2Ah. AFC Limiter

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Afclim[7:0]							
Type	R/W							

Reset value = 00000000

Bit	Name	Function
7:0	Afclim[7:0]	**AFC Limiter.** AFC limiter value.

For the following registers (addresses 2Bh and 2Ch), use the following equation:

$$\text{ook\_cnt\_val} = \frac{3 \times 500\ \text{kHz}}{R_b \times (\text{enmanch} + 1)}$$

where Rb's unit is in kHz and "enmanch" is the Manchester Enable bit (found at address 71h bit [1]). Therefore, the minimal data rate that this register can support without Manchester is 0.366 kbps.

Register 2Bh. AFC Correction (MSBs)

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	afc_corr[9:2]							
Type	R							

Reset value = xxxxxxxx

Bit	Name	Function
7:0	afc_corr[9:2]	**AFC Correction Values.** AFC loop correction values [9:2] (MSBs only). Values are updated once, after sync word is found during receiving. See also address 2Ch.

Register 2Ch. OOK Counter Value 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	afc_corr[1:0]		ookfrzen	peakdeten	madeten	ookcnt[10]	ookcnt[9]	ookcnt[8]
Type	R		R/W	R/W	R/W	R/W	R/W	R/W

Reset value = 00011000

Bit	Name	Function
7:6	afc_corr[1:0]	**AFC Correction Values.** AFC loop correction values [1:0] (LSBs). Values are updated once, after sync word is found during receiving. See also address 2Bh.
5	ookfrzen	**OOK Freeze.** ookfrzen= when 0 (default), AGC and OOK Moving Average Detector threshold operate continuously. When 1, AGC and OOK MA Detector threshold operate until PREAMBLE_VALID signal is detected; values are frozen thereafter. Recommended for use with non-Manchestered payload data.
4	peakdeten	**Peak Detector Enable.** peakdeten= when 1 (default), Peak Detector for OOK Modem is enabled. Provides improved performance in presence of co-channel interferers, at slight reduction of sensitivity. Peak Detector output is logically AND'ed with Moving Average Detector output.
3	madeten	**MA_Enable.** madeten= when 1 (default), Moving Average Detector for OOK Modem is enabled. Provides best sensitivity, but requires DC-balanced data (e.g., Manchester data) and is more sensitive to co-channel interference. Peak Detector output is logically AND'ed with Moving Average Detector output.
2:0	ookcnt[10:8]	**OOK Counter [10:8].** OOK counter [10:8] =OOK counter Value MSBs. This counter value will affect the OOK AGC's decay time.

Register 2Dh. OOK Counter Value 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	ookcnt[7:0]							
Type	R/W							

Reset value = 10111100

Bit	Name	Function
7:0	ookcnt[7:0]	**OOK Counter [7:0].** OOK counter value LSBs. This counter value will affect the OOK AGC's decay time.

Register 2Eh. Slicer Peak Holder

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved	attack[2:0]			decay[3:0]			
Type	R/W	R/W			R/W			

Reset value = 00101100

Bit	Name	Function
7	Reserved	**Reserved.**
6:4	attack[2:0]	**Attack.** attack [2:0}=OOK Peak Detector attack time. Peak detector value charges up at rate proportional to 2^(-attack[2:0]). OOK slicing threshold is set 6 dB below peak detector value. Effective only when OOK Peak Detector is enabled.
3:0	decay[3:0]	**Decay.** decay[3:0]=OOK Peak Detector decay time. Peak detector value discharges at rate proportional to 2^(-decay[3:0]). OOK slicing threshold is set 6 dB below peak detector value. Effective only when OOK Peak Detector is enabled.

Register 30h. FIFO Configuration

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	FIFO_RX	Reserved						
Type	R/W	R/W						

Reset value = 10000010

Bit	Name	Function
7	FIFO_RX	**FIFO Receive.** Must set to 0 to allow correct operation of the FIFO. Default is 1.
6:0	Reserved	**Reserved.**

Register 35h. Preamble Detection Control 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	preath[4:0]					rssi_offset[2:0]		
Type	R/W					R/W		

Reset value = 00101010

Bit	Name	Function
7:3	preath[4:0]	**Preamble Detection Threshold.** The value in the preath[4:0] register corresponds to the number of nibbles (4 bits) of preamble pattern (i.e., 01010...) that must be received correctly, before a PREAMBLE_VALID signal is issued. This threshold helps guard against false preamble detection upon noise.
2:0	rssi_offset[2:0]	**rssi_offset[2:0]** Value added as offset to RSSI calculation. Every increment in this register results in an increment of +4 dB in the RSSI.

Register 36h. Synchronization Word 3

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	sync[31:24]							
Type	R/W							

Reset value = 00101101

Bit	Name	Function
7:0	sync[31:24]	**Synchronization Word 3.** 4th byte of the synchronization word.

Register 37h. Synchronization Word 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	sync[23:16]							
Type	R/W							

Reset value = 11010100

Bit	Name	Function
7:0	sync[23:16]	**Synchronization Word 2.** 3rd byte of the synchronization word.

Register 38h. Synchronization Word 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	sync[15:8]							
Type	R/W							

Reset value = 00000000

Bit	Name	Function
7:0	sync[15:8]	**Synchronization Word 1.** 2nd byte of the synchronization word.

Register 39h. Synchronization Word 0

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	sync[7:0]							
Type	R/W							

Reset value = 00000000

Bit	Name	Function
7:0	sync[7:0]	**Synchronization Word 0.** 1st byte of the synchronization word.

Register 4Fh. ADC8 Control

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved		adc8[5:0]					
Type	R/W		R/W					

Reset value = 00010000

Bit	Name	Function
7:6	Reserved	**Reserved.**
5:0	adc8[5:0]	**ADC8 Control Bits.**

Register 60h. Channel Filter Coefficient Address

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	invalid_preamble_threshold[3:0]				Reserved			
Type	R/W				R/W			

Reset value = 00000000

Bit	Name	Function
7:4	invalid_pream-ble_threshold[3:0]	**Invalid Preamble Threshold.** invalid_preamble_threshold[3:0}=This configures (in nibbles) for how long we will search for preamble. If during this time the preamble is not detected, we will send a signal (which can be configured as interrupt) and restart looking for the preamble again. The interval between each interrupt is given by the formula below.
3:0	Reserved	**Reserved.**

Register 62h. Crystal Oscillator/Power-on-Reset Control

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	pwst[2:0]			clkhyst	enbias2x	enamp2x	bufovr	enbuf
Type	R			R/W	R/W	R/W	R/W	R/W

Reset value = xxx00100

Bit	Name	Function
7:5	pwst[2:0]	**Internal Power States of the Chip.** LP: 000 RDY: 001 Tune: 011 RX: 111
4	clkhyst	**Clock Hysteresis Setting.**
3	enbias2x	**2 Times Higher Bias Current Enable.**
2	enamp2x	**2 Times Higher Amplification Enable.**
1	bufovr	**Output Buffer Enable Override.** If set to 1 then the enbuf bit controls the output buffer. 0: output buffer is controlled by the state machine. 1: output buffer is controlled by the enbuf bit.
0	enbuf	**Output Buffer Enable.** This bit is active only if the bufovr bit is set to 1.

Register 69h. AGC Override 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved	sgin	agcen	lnagain	pga[3:0]			
Type	R	R/W	R/W	R/W	R/W			

Reset value = 00100000

Bit	Name	Function
7	Reserved	**Reserved.**
6	sgin	**sgin**=AGC stop increasing gain override bit (active low). When ‘0’ (default), AGC gain increases during signal reductions are prevented. When ‘1’, AGC gain increases during signal reductions are allowed. Only effective during Preamble, prior to detection of PREAMBLE_VALID signal.
5	agcen	**Automatic Gain Control Enable.** agcen=Automatic Gain Control enable. When this bit is set then the result of the control can be read out from bits [4:0], otherwise the gain can be controlled manually by writing into bits [4:0].
4	lnagain	**LNA Gain Select.** **lnagain=LNA Gain select.** 0 – min. gain = 5 dB 1 – max. gain = 25 dB
3:0	pga[3:0]	**PGA Gain Override Value.** 0000: 0 dB 0001: 3 dB 0010: 6 dB ... 1000: 24 dB max.

Register 70h. Modulation Mode Control 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved		Reserved		manppol	enmaninv	enmanch	enwhite
Type	R		R/W		R/W	R/W	R/W	R/W

Reset value = 00001100

Bit	Name	Function
7:4	Reserved	**Reserved.**
3	manppol	**Manchester Preamble Polarity (will transmit a series of 1 if set, or series of 0 if reset).** This bit affects only the transmitter side, not the receiver. This is valid only if Manchester Mode is enabled.
2	enmaninv	**Manchester Data Inversion is Enabled if this bit is set.** When this bit is low, a 10 pair is considered a Manchester 0, and a 01 pair as a Manchester 1. By setting this bit, do the opposite: every 10 will be considered as a 1, and every 01 will be considered as a 0. This function is relevant only if the Manchester mode is enabled.
1	enmanch	**Manchester Coding is Enabled if this bit is set.** What Manchester coding does is to replace a single high bit (1) with two bits starting with low followed by high (01) and a low bit (0) with a high bit followed by a low bit (10). When Manchester is enabled, please configure as well the enmaninv at 70h bit [2] since it influences the Manchester encoding/decoding process.
0	enwhite	**Data Whitening is Enabled if this bit is set.**

Register 71h. Modulation Mode Control 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	rxclk[1:0]		dtmod[1:0]		eninv	fd[8]	modtyp[1:0]	
Type	R/W		R/W		R/W	R/W	R/W	

Reset value = 00000000

Bit	Name	Function
7:6	trclk[1:0]	**RX Data Clock Configuration.** 00: NA 01: NA 10: RX Data CLK is available via the SDO pin. 11: RX Data CLK is available via the nIRQ pin.
5:4	dtmod[1:0]	**Modulation Source.** 00: Direct Mode using Data function via the GPIO pin (one of the GPIO's should be programmed accordingly as well) 01: Direct Mode using Data function via the SDI pin (only when nSEL is high) 10: FIFO Mode 11: PN9 (internally generated)
3	eninv	**Invert RX Data.**
2	fd[8]	**MSB of Frequency Deviation Setting.**
1:0	modtyp[1:0]	**Modulation Type.** 00: Unmodulated carrier 01: OOK 10: FSK 11: GFSK

The frequency offset can be calculated: Offset = 156.25 Hz x (hbsel + 1) x fo[7:0] . fo[9:0] is a 2s complement value. In EZRadioPRO, reading from this register will give the AFC correction last results, not this register value.

Register 73h. Frequency Offset 1

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	fo[7:0]							
Type	R/W							

Reset value = 00000000

Bit	Name	Function
7:0	fo[7:0]	**Frequency Offset Setting.** The frequency offset can be calculated as Offset = 156.25 Hz x (hbsel + 1) x fo[7:0]. fo[9:0] is a twos complement value.

In EZRadioPRO, reading from this register will give the AFC correction last results, not this register value.

Register 74h. Frequency Offset 2

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved						fo[9:8]	
Type	R						R/W	

Reset value = 00000000

Bit	Name	Function
7:2	Reserved	**Reserved.**
1:0	fo[9:8]	**Upper Bits of the Frequency Offset Setting.** fo[9] is the sign bit. The frequency offset can be calculated as Offset = 156.25 Hz x (hbsel + 1) x fo[7:0]. fo[9:0] is a twos complement value.

Register 75h. Frequency Band Select

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved	sbsel	hbsel	fb[4:0]				
Type	R	R/W	R/W	R/W				

Reset value = 01110101

Bit	Name	Function
7	Reserved	**Reserved.**
6	sbsel	**Side Band Select.**
5	hbsel	**High Band Select.** Setting hbsel = 1 will choose the frequency range from 480–960 MHz (high bands). Setting hbsel = 0 will choose the frequency range from 240–479.9 MHz (low bands).
4:0	fb[4:0]	**Frequency Band Select.** Every increment corresponds to a 10 MHz Band for the Low Bands and a 20 MHz Band for the High Bands. Setting fb[4:0] = 00000 corresponds to the 240–250 MHz Band for hbsel = 0 and the 480–500 MHz Band for hbsel = 1. Setting fb[4:0] = 00001 corresponds to the 250–260 MHz Band for hbsel = 0 and the 500–520 MHz Band for hbsel = 1.

The RF carrier frequency can be calculated as follows:

$f_{carrier} = (f_b+24+(f_c+f_o)/64000) \times 10000 \times (hbsel+1) + (f_{hch} \times f_{hs} \times 10)$ [kHz],

where parameters f_c, f_o, f_b and hb_sel come from registers 73h–77h. Parameters f_{hch} and f_{hs} come from register 79h and 7Ah.

Register 76h. Nominal Carrier Frequency

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	fc[15:8]							
Type	R/W							

Reset value = 10111011

Bit	Name	Function
7:0	fc[15:8]	**Nominal Carrier Frequency Setting.** See formula above.

Register 77h. Nominal Carrier Frequency

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	fc[7:0]							
Type	R/W							

Reset value = 10000000

Bit	Name	Function
7:0	fc[7:0]	**Nominal Carrier Frequency Setting.** See formula above.

Register 79h. Frequency Hopping Channel Select

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	fhch[7:0]							
Type	R/W							

Reset value = 00000000

Bit	Name	Function
7:0	fhch[7:0]	**Frequency Hopping Channel Number.**

Register 7Ah. Frequency Hopping Step Size

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	fhs[7:0]							
Type	R/W							

Reset value = 00000000

Bit	Name	Function
7:0	fhs[7:0]	**Frequency Hopping Step Size in 10 kHz Increments.** See formula for the nominal carrier frequency at "Register 76h. Nominal Carrier Frequency".

Register 7Eh. RX FIFO Control

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	Reserved		rxafthr[5:0]					
Type	R/W		R/W					

Reset value = 00110111

Bit	Name	Function
7:6	Reserved	**Reserved.**
5:0	rxafthr[5:0]	**RX FIFO Almost Full Threshold.**

Register 7Fh. FIFO Access

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	fifod[7:0]							
Type	R/W							

Reset value = NA

Bit	Name	Function
7:0	fifod[7:0]	**FIFO Data.** A Read (R/W=0) to this address will begin a burst read of the RX FIFO.

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