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CNM3

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Economical Narrow Band Radio Modem

The CNM3 is an economical easy to use low power narrow band GFSK radio modem module that offers up to 40mW RF power 4800 baud rate data link with 3.3V TTL UART interface.

Figure 1: CNM3-921-4

Features

- Standard 865-867MHz (India), 868-870MHz (EU) or 915-928MHz (NA)
- Available from 142MHz to 1050MHz
- Frequency Programmable
- 25kHz channel spacing Narrow Band Multichannel Frequencies
- TCXO referenced Fractional-N PLL Frequency Synthesiser
- FCC Part 15.249, FCC Part 90 Emission Mask D compliant
- <3ms Transmit Switching Time
- 4800 baud rate Transparent (streaming) or direct control over packet operation (command mode)

Technical Summary

- Supply range: 3.5-15V DC
- Current consumption: 19mA TX (1mW) or 28mA TX (10mW) or 52mA TX (50mW)
- Current consumption: 17mA RX or 10µA (idle)
- RF baud rate: 6.6kbps GFSK (streaming mode) or 1.5kbps GFSK (command mode)
- User baud rate: 4800bps (streaming mode) or 9600bps (command mode)
- Transmit power: 0dBm (1mW) to +17dBm (50mW) Adjustable
- Receive Sensitivity: -112dBm for 0.1%BER @ 1.5kbps
- 26MHz TCXO Reference with ±1.0ppm frequency stability over -20˚C +70˚C
- Size: 32 x 21 x 5mm
- 0.1” pitch 0.65mm square pins or castellated SMD pads

Operational Description

The CNM2 radio modem can be used as either a packet orientated system or serial data streaming mode using programmable speed (1.5 or 6.6kbps GFSK) over-air link data rate. The relatively low data rates ensure optimum sensitivity and range for simple control applications.

Data packets are either short (1-8 bytes) or long (9-16 bytes) long, depending on the amount of user payload data uploaded (Packet length is selected automatically)

A straightforward “inverted RS232”, or UART type asynchronous baud (1 start, 8 data bits, no parity, 1 stop bit) serial port communicates with the user, employing a simple command protocol to both send and receive data, and to control critical RF parameters (such as channel frequency and RF power level)

The default operating state for the module is always receive. The CNM “listens” for a valid data packet (correct framing sequence, packet length and checksum) and in the event of finding one: decodes it, loads the payload data into an internal FIFO buffer and begins streaming it out via the serial port.

A CNM can receive and decode a new packet while still outputting a previous one.

Recommended PCB hole size 1mm after plating

Figure 2: CNM2/CNM3 Pinout and Dimensions

PIN	DESCIPTION
GND	Supply Ground
VCC	3.5V-15V DC Supply Voltage
GND	Supply Ground
3.3VOUT	3.3V 50mA max output; can also be used as regulated 3.3V input
TXD	3.3V TTL level UART Transmit Data Input Series 100kΩ “stopper” but NO pullup (tie to 3.3VOUT if unused)
RXD	3.3V TTL level UART Received Data Output Idles high. 330Ωseries resistor
STATUS	Active High when unit is transmitting. 330R series resistor
RFGND	RF ground
RF	50Ω RF Input / Output Antenna Port

General	min.	typ.	max.	unit	notes
DC supply					
Supply voltage (or 3.3V Regulated)	3.4		15	V	1
TX Supply current @ 10mW/50mW		28	60	mA	2
RX Supply Current		17		mA	
Idle State Current			10	µA	
RF					
Operating Frequency Band f_c		Programmable 902-928MHz			
Centre Frequency Accuracy			1	ppm	3
Channel width (frequency step)		25		kHz	
RF Output Power	0.75	10	50	mW	2
Harmonic Emissions		-50		dBm	4
Receive Sensitivity (@ 1.5kbps)		-115		dBm	5
(@ 6.6kbps)		-110		dBm	5
Adjacent Channel Rejection	-55			dB	4
Occupied Band Width (OBW)		15		kHz	
RF link data rate			1.5	kbps	
			6.6	kbps	
Preprogrammable Frequency Channels			32+1		6
RF pin / Antenna Port Impedance		50		Ω	
Dynamic timing					
Transmit ON Latency			3	ms	

Notes:

1. 3.3V regulated supply into 3.3VOUT instead of VCC
2. Transmit current consumption depends on RF Power setting for the country specific band
3. Frequency Stability over temperature range of -20˚C to +70˚C and supply voltage variations.
4. Meets EN300-220-2
5. 0.1% Packet Error Rate (PER) Receive Sensitivity for Packet vs Streaming mode
6. Channel frequencies are factory pre-programmed according country specific band

CNM3-921-4 Channel Frequency Table

CH0	915.185	CH1	915.225
CH2	915.975	CH3	916.015
CH4	916.765	CH5	916.805
CH6	917.555	CH7	917.595
CH8	918.345	CH9	918.385
CH10	919.135	CH11	919.175
CH12	919.925	CH13	919.965
CH14	920.715	CH15	920.755
CH16	921.505	CH17	921.545
CH18	922.295	CH19	922.335
CH20	923.085	CH21	923.125
CH22	923.875	CH23	923.915
CH24	924.665	CH25	924.705
CH26	925.455	CH27	925.495
CH28	926.245	CH29	926.285
CH30	927.035	CH31	927.075

Configuration Mode

The method used to transmit data depends on which operating mode the unit has been set to.
In "**transparent**" mode the CNM will buffer and transmit bytes arriving over the serial port without any further input from the user.
In "**command**" mode it is necessary to use an `@PKT` command to transmit a packet (see later)

There are other versions in the pipeline (but all CNM family members will keep the same command format)

Commands and transmitted data are sent to the CNM over the same serial input.

This interface runs at **4800 baud if the unit is in the default "transparent" mode** (although in transparent the commands are sent at 2400 baud)
It operates at **9600 baud if the unit has been set to "command" operation** (MODE bit 1 set)

In either of the modes, the same format command strings are used (but in transparent mode the unit automatically differentiates between 4800 baud user data and 2400 baud command strings on the fly)

The radio link can also operate at one of two different speeds (set by MODE bit 0).
The faster (default) 6.6kbps rate is intended for use with "transparent" mode, while the slower 1.5kbps speed optimises range at the price of longer data packet timings, and is usually used for industrial control applications in "command" mode (it is possible to use the slower link in transparent mode, but the 64 byte Transmit buffer will fill up faster than it can empty and data overrun errors may occur, so the user needs to carefully watch the data throughput)

Following the `@` character at the start of a command string, the unit will stop receiving, and any data left in the buffer will be lost.

All command strings start with an '`@`' character (0x40), and terminate with an '`]`' (0x5D)
Note that < > delimiters are used to indicate a value. The actual < > characters are NOT needed.

Send a packet: The module will format a packet, enter transmit mode and send it.

```
@PKT <LEN> <1-16 payload bytes>]
```

This process will take approximately 20/86ms (1-8 bytes) or 36/133ms (9-16 bytes)
While in transmit mode (STATUS pin HIGH) it will ignore any other commands.
At the end, it will send a single '>' character (0x3E) over the serial port before returning to receive operation.

The LEN byte is a value (1-16) representing the number of payload bytes
It can EITHER be raw binary (0x01-0x10) OR an ASCII A through P

Programming a CNM: BE CAREFUL: you ***can*** render the unit non-functional!

The CNM has one 'default' frequency store (selected if the channel pointer is set to a number >31) and thirty two 'channel frequency' stores, selected by channel pointer values from 0 through 31.

Both default frequency and channel number stores can be 'set' as non volatile EEPROM values OR as temporary RAM values. (Although the 32 channel frequencies are EEPROM only).

`@SETf<4 bytes raw binary, msb sent first><checksum>]`

sets the default frequency

If the three most significant bytes of frequency set are zero then a "transfer current default to channel map" is executed, using the LSB as the channel number (valid channels: 0 to 31)

Non-volatile Commands	**Description**
`@SETp<power byte> <checksum>]`	sets power variable (permitted values 0-191)
`@SETt<trim byte> <checksum>]`	sets frequency trim variable
`@SETm<mode byte> <checksum>]`	programs mode byte into EEPROM location 0x17
`@SETc<chan byte> <checksum>]`	programs channel pointer EEPROM location 0x18 and writes them to the EEPROM!
Volatile Commands	**Description**
`@RAMf<4 bytes raw binary, msb sent first><checksum>]`	sets the immediate frequency
`@RAMp<power byte> <checksum>]`	sets power variable
`@RAMt<trim byte> <checksum>]`	sets frequency trim variable
`@RAMc<chan byte>  <checksum>]`	sets the channel (volatile)

The frequency set up is a 32 bit (raw binary) word
You calculate it as:

$$Programmed\ Number = f_c(MHz) \times \frac{2^{19}}{6.5MHz}$$ UHF Version

checksum is the **8 bit truncated binary sum** of all payload bytes and the function code (f, p or t (or m))

Critical timing

No more than 20ms is permitted BETWEEN characters after the initial `@` character, or the CNM will empty its buffers and return to default (receive) mode

Between command strings (following the '`]`' character (0x5D) a pause of at least 10ms is required (and, more following an EEPROM write, which needs a longer idle period, of 25ms at least)

Single Byte Commands

Command	Hex	Dec	Description
!	0x21	33	Puts unit into TEST transmission (CW by default)
$	0x24	36	Puts the CNM into SLEEP mode (low Iq, no RX)
&	0x26	38	RSSI read-out
%	0x25	37	Internal EEPROM read-out
@	0x40	64	Start of a long command
]	0x5D	93	End of a long command

The TEST and the SLEEP modes are terminated by any activity on the serial input (a DEL (0x7F) is recommended)
The RSSI command initiates an immediate RSSI read, and a single character (raw binary) reply
The read-out command triggers a human readable hex dump of EEPROM 0x11 - 0x18, separated by spaces

EEPROM Location	Description
0x10	cookie jar (if not 0x57, then program to defaults at start up)
0x11	power setting word
0x12	frequency trimming offsetbit7: 1 = adjust up 0 = adjust down
0x13	frequency word LSB
0x14	“
0x15	“
0x16	frequency word MSB
0x17	“mode” byte 0x00 = default mode (transparent, fast)
0x18	Channel pointer number

Two Byte Command

Byte	Hex	Command	
# # 0xFE	0x23	Channel Select	Channel select (2 byte command: second byte is the raw binary channel number) This is a volatile set-up. After a power cycle or reset the channel pointer value reverts to the last value written into the EEPROM **NOTE! Special case: Programming a value of 0xFE into the channel pointer results in a hard RESE**
	0x03	Mode	Normal (1500bps link, 9600 baud port, command mode) operation
Bit 7 set			Locked CW mode (no packet TX, no RX)
Bit 6 set			CW transmission is replaced with 1200 baud PN9 sequence 3kHz deviation
Bit 5		Reserved	
Bit 4 set			Long (pager type) preamble
Bit 3		Unused	

Bit 2		Unused	
Bit 1=0		Transparent mode	port speed 4800 baud, commands at 2400 baud
Bit 1=1		Command Mode Lock	Lock into ‘command’ mode with port speed of 9600 baud
Bit 0=0		Transparent RF baud rate	Radio link runs at 6600 bps (compatible with 4800 baud transparent mode)
Bit 0=1		Packet mode RF baud rate	Radio link runs at 1500bps (maximum range, but longer packets)

CNM Evaluation Kit

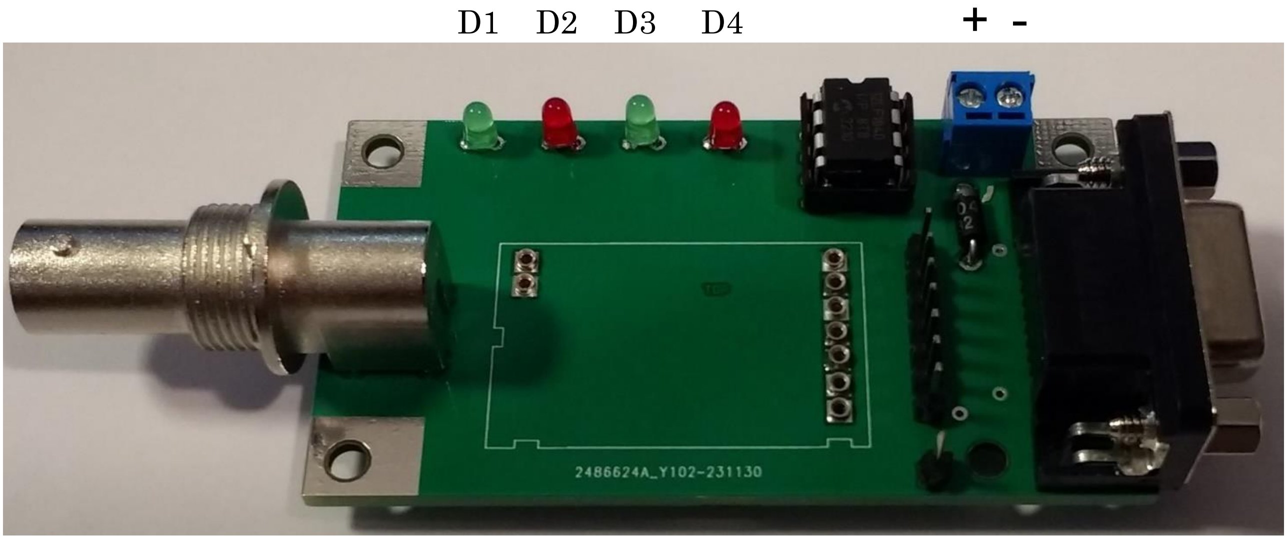

Figure 3: CNM2/CNM3 Evaluation Kit with RS232, RS485 and USB interface

Dimensions (excluding BNC and DE9F connector): 72 x 39 mm

LED	Function
D1 Green	STATUS / TX ON
D2 Red	TXD Activity
D3 Green	RXD Activity
D4 Red	Power Applied

D4 flashes at power up, or when a CNM has just been inserted into a powered board.
If there is TXD/RXD or CNM3 activity, the Eval Kit goes into sleep mode drawing <10µA

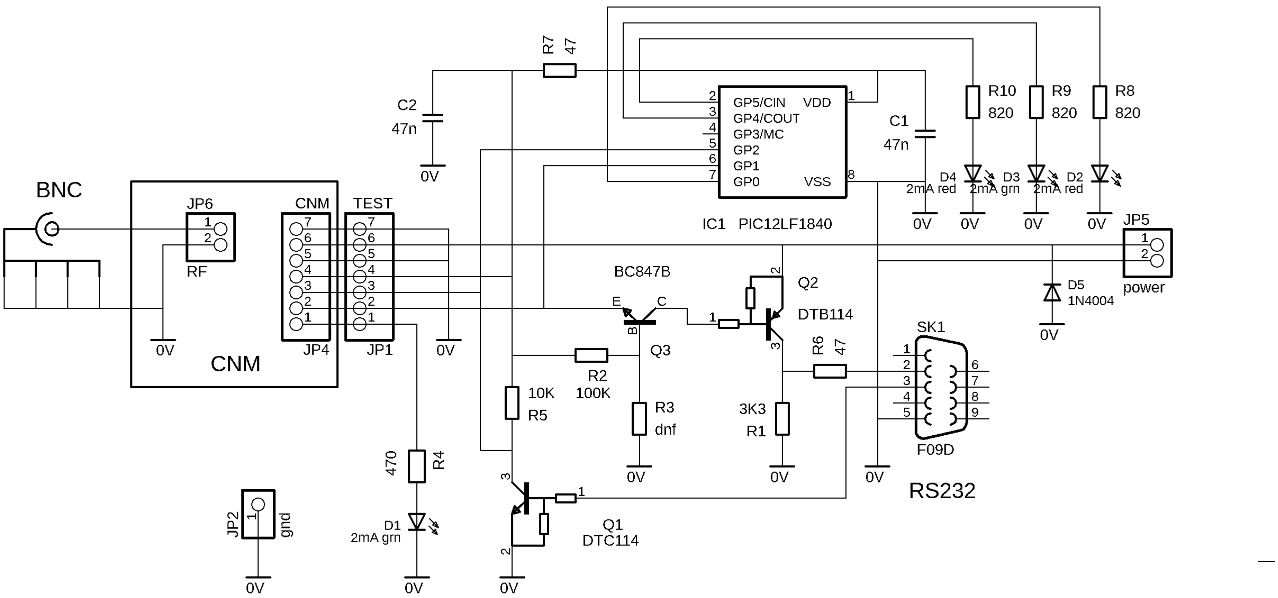

Figure 4: CNM Evaluation Kit Schematics

JP1 User Interface	Function
Pin 1	STATUS / Transmitter ON output
Pin 2	3.3V TTL level UART Received Data (RXD) Output
Pin 3	3.3V TTL level UART Transmit Data (TXD) Input
Pin 4	3.3V 50mA max output or regulated 3.3V input without VCC
Pin 5	GND
Pin 6	3.5V-15V DC Supply Voltage

Variants and ordering information

The CNM3 Modem is manufactured in several variants:

CNM3-869-4	50mW	Europe
CNM3-921-4	0.75mW	North & South America

Please note it is the responsibility of end user to limit RF Power and Transmit Duty cycle according to operating sub-band within 868-870MHz.

https://efis.cept.org/adhoc_grabber.jsp?annex=4

h1.5	868.0MHz - 868.6MHz	25 mW e.r.p.	≤ 1% duty cycle
h1.7	869.4MHz - 869.65MHz	500 mW e.r.p.	≤ 10% duty cycle
h1.8	869.7MHz - 870MHz	5 mW e.r.p.	No requirement

https://www.ecfr.gov/current/title-47/chapter-I/subchapter-A/part-15#15.249
902 - 928MHz 50mV/m at 3m [0.75mW ERP]

https://ised-isde.canada.ca/site/spectrum-management-telecommunications/en/rss-210-licence-exempt-radio-apparatus-category-i-equipment
902 - 928MHz 50mV/m at 3m [0.75mW ERP]

For other variants please contact the factory.

Other variants can be supplied to individual customer requirements at frequencies from 142MHz to 1050MHz

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R&TTE Directive

After 7 April 2001 the manufacturer can only place finished product on the market under the provisions of the R&TTE Directive. Equipment within the scope of the R&TTE Directive may demonstrate compliance to the essential requirements specified in Article 3 of the Directive, as appropriate to the particular equipment.
Further details are available on The Office of Communications (Ofcom) web site:
http://www.ofcom.org.uk/radiocomms/ifi/

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