ROSEMAN ENGINEERING LTD.

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Transceiver module description

General description

A low power FHSS transceiver module operates at the ISM frequency band 902-928 MHz. The module can operate in two different modes, master or slave. The mode is defined by external input. This feature allows the user to build a point-to-multipoint wireless network based on this module.

The module has 12 pins for assembling to other devices. The description of the pins is added in table 2.3.1. Data is transferred into or out of the module by serial communication with baud rate of 28800.

The module has an integral antenna without RF connector.

We intend to use the module as a slave in a vehicle device and as a master in a station controller. The environment is a fuel station.

Technical description

The device is a complete RF transmitter, it has its own reference oscillator and permanently attached antenna. The only connectors are power supply and data inputs. The device has its own RF shielding. The data inputs are buffered.

The device operates with DC voltage of 9 to 30 V DC. Current consumption is maximum 50 mA.

The module includes power supply regulator that supplies 3 V DC to the circuit.

The STANDBY input of the module defines if it is enabled. When it is zero the module does not operate. When it is positive the module is in full operation.

The MASTER\SLAVE input defines its operation mode. When it is zero, it operates as master, when it is positive it operates as slave.

When the module operates as master it transmits a frame with different frequency every 380 ms. The frequency is changed on a predetermined, pseudo random pattern according to the table 2. There are 51 different frequencies in the list. The occupancy time on any frequency is 101.4 ms. The cycle period is 51*380ms which is 19.38 s.

The transmission frame is divided into 19 time slots, 20 ms each. The second and the last slots are not used. The first time slot is used for one beacon transmission of 5.8 ms and a command of up to 7 ms. The other active time slots contain only the beacon and leave the slot open for the response. This means that the maximum Tx ON time is 17*5.8 + 7 = 105.6 ms.

The user may send data to the module only during the last time slot. The module signals this time slot by outputting low level at the TXFLAG output.

When the module operates as a slave it is most of time receiver. It transmits only when the user sends data. When the receiver is not synchronized on the master hopping frequencies, it hops every 90 ms from channel to channel according to the frequency list, until is receives the beacon from the master. Than it hops every 380 ms synchronized with the master.

In slave mode the TXFLAG is not used. The user may send the data to the module at any time. The user can define at which time slot the data will be transmitted to the air.

The data is transferred to or from the module by serial communication with baud rate of 28800.

The module includes a CPU. The CPU is a buffer for the data inputs. It receives the data from the user at any time and sends it at the correct time slot to the transceiver.

The module includes its own RF shield and cable dipole antenna without connector. The output power is constant and equals to 18 dBm.

The inputs\outputs are buffered through 3 V – 5 V converters. These converters need the 5 V DC for conversion of the signal levels.

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Table 1 Transceiver module ports and lines

Connector	Port NAME	Input/Output	Port detailed description
J1.1	GND	INPUT	GROUND
J1.2	+V	INPUT	9-30 VDC
J1.3	D-OUT	OUTPUT	SERIAL DATA OUT, BAUD RATE: 28800
J1.4	D-IN	INPUT	SERIAL DATA IN, BAUD RATE: 28800
J1.5	TXFLAG	OUTPUT	IN SLAVE MODE: NOT USED IN MASTER MODE: WHEN 0, USER IS ALLOWED TO SEND DATA
J1.6	+5V	INPUT	+5V FOR LEVEL ADAPTAIONS
J1.7	STANDBY	INPUT	0 – NO OPERATION, 1 – FULL OPERATION
J1.8	MASTER\SLAVE	INPUT	0 – MASTER, 1 – SLAVE

*** J1.9,J1.10,J1.11,J1.12 – NOT CONNECTED**

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Transmitter description

Type of equipment							
X	Stand-alone (Equipment with or without its own control provisions)						
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)						
	Plug-in card (Equipment intended for a variety of host systems)						
	Other:						
Operating frequency range	914.8 – 927.6 MHz						
Spread spectrum technique used							
X	Frequency hopping (FHSS)						
	Digitally modulated						
	Combined						
Spread spectrum parameters							
Dig. Mod.	chip sequence length (bits)						
	spectrum width (MHz)						
FHSS	total number of hops (units)	51					
	dwell time (milliseconds)	202					
	bandwidth per hop (MHz)	0.185					
	max. separation of hops (MHz)	0.26					
Transmitter aggregate data rate (bits per second)				32 kbps			
Normal test signal				PRBS			
Maximum rated output power							
At transmitter permanent external 50 Ω rf output connector (dBm)							
Effective radiated power (for equipment with integral antenna) (dBm)				18			
Is transmitter output power variable?	**X**	No					
		Yes		continuous variable			
				stepped variable			
				stepsize (dB):.....			
				minimum RF power (dBm):.....			
				maximum RF power (dBm):.....			
Transmitter power source							
	Battery	**Nominal rated voltage (VDC)**					
	Nickel Cadmium						
	Lithium						
	Other						
X	**DC**	**Nominal rated voltage (VDC)**		9 to 30			
	AC mains	**Nominal rated voltage (VAC)**					
Is there common power source for transmitter and receiver				**X**	yes		no

Antenna technical characteristics						
			Type	**Manufacturer**	**Model number**	**Gain**
Integral		with temporary RF connector	½ wave centre fed dipole	Galtronics	021006061-2583	0 dBi
	X	without temporary RF connector				
External						

External antenna connection - NA			
	standard connector		unique coupling

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Frequency Hopping Parameters

The station constantly transmits a transmission frame constructed from a synchronization beacon and commands. Each transmission frame is transmitted at different frequency (1 out of 51). The maximum occupancy time on any frequency is 212 ms within a 20 s period. This is under the limit of section 15.247(a)1. The FH carrier hops on a predetermined, pseudo random pattern (see table below).

All channels are used equally.

Frequency Hopping Sequence Table

Frequency [MHz]	Frequency Assignment	Frequency [MHz]	Frequency Assignment
919.456	18	916.896	8
918.944	16	922.272	29
922.016	28	914.848	0
916.64	7	926.88	47
918.432	14	920.224	21
920.992	24	915.872	4
917.408	10	922.784	31
919.712	19	921.76	27
926.368	45	924.832	39
917.664	11	924.32	37
925.856	43	927.648	50
922.528	30	921.504	26
919.164	17	923.808	35
920.48	22	924.576	38
915.36	2	925.344	41
916.128	5	915.104	1
919.968	20	915.616	3
918.176	13	925.6	42
925.088	40	917.152	9
923.040	32	916.384	6
923.552	34	917.92	12
926.112	44	923.296	33
924.064	36	918.688	15
926.624	46	920.736	23
921.248	25	916.896	48
927.392	49		

Receiver compliance with 15.247 (a)(1) / 2.1033(a)(10)

The system receiver has input bandwidth that matches the hopping bandwidth of the corresponding transmitters. The receiver shifts its frequency in accordance with the same frequency hopping table and pattern as the transmitters.

Transmitter compliance with 15.247(h)

The equipment fully complies with the requirements of this section. There is no coordination between the systems to avoid simultaneous occupancy of the hopping frequencies by multiple transmitters. Each transmitter operates independently and there is no synchronization with other transmitters.