TW-049-S Sensor Operational Description

The TWS-049 unit is a 902-298MHz frequency hopping transceiver consisting of the main micro board PCB and a low power radio module PCB.

Features/Specs

- The TWS-049 functions as a Remote Wireless Sensor, recording sensor data and wirelessly forwarding the data to the companion TWB-049 Base/Repeater units.
- The system supports over 500 sensors with 15 minute transmission intervals.
- An internal thermistor type sensor or external sensors are supported.
- Powered by 2 AA batteries.
- Battery life approximately 2 years with 15 minute measurement interval.
- Jumper P2 acts as power switch (off w/o jumper)
- The TWS-049 utilizes a Chipcon CC1020 RFIC (radio frequency integrated circuit) with maximum power output of +5dBm
- Baud Rate = 4800 bps, Modulation is FSK with a 4.9kHz deviation
- 60 channel frequency hopping system, minimum 400KHz channel separation
- Dwell time per channel is 120mS maximum, 72mS typical
- The TWS-049 is controlled via an 8 bit Atmel AVR micro (ATMega168V), clocked by its internal 8MHz LC oscillator.
- The ATMega168V contains Flash ROM for program code, EEPROM for configuration/serial number, and SRAM for CPU operation, all internal to the IC
- Real time clock maintained by 32.768KHz crystal

Operation

- The TWS-049 is configured by the user to measure attached sensors periodically with an interval time between 60 seconds and 18 hours.
- At measurement intervals, sensor readings are taken by the micro and a data packet generated and queued up for transmission. The transmission time (and thereby channel selection) is chosen by a randomize function (seeded by the unit's unique Serial ID) and a timer set to schedule the radio transmission.
- At transmission time, receiver is first enabled to check for carrier detect (in case of interfering system or anther sensor). If carrier detect is clear, transmission proceeds. If another carrier is detected, transmission is delayed by approximately 100mS and the process repeated. If a carrier is detected the 2nd time, the data is stored and the transmission rescheduled.
- Upon transmission of data packet, the unit switches to receive mode to await the Acknowledge (ACK) packet from the Base/Repeater. If no ACK is seen, the data is stored in non-volatile memory for later transmission.
- The TWS-049 can generate only one transmission per channel.
- Typical configuration generates one transmission every 15 minutes
- All transmitted packets incorporate a header that contains unique serial number ID of the transmitting unit.
- The real time clock is synchronized via the acknowledge packet (ACK) from Base/Repeater.

Clocks and Crystals:

- 32.768KHz Crystal on Main PCB
- 14.7456MHz Crystal on Radio PCB
- SPI Clock line at 2MHz, active only when unit is transmitting

Frequency Map

Channel #	Frequency MHz	Separation KHz	Channel #	Frequency MHz	Separation KHz
0	902.4		30	915.2	400
1	902.8	400	31	915.6	400
2	903.2	400	32	916	400
3	903.6	400	33	916.4	400
4	904	400	34	916.8	400
5	904.4	400	35	917.4	600
6	904.8	400	36	917.8	400
7	905.4	600	37	918.2	400
8	905.8	400	38	918.6	400
9	906.2	400	39	919	400
10	906.6	400	40	919.4	400
11	907	400	41	919.8	400
12	907.4	400	42	920.4	600
13	907.8	400	43	920.8	400
14	908.4	600	44	921.2	400
15	908.8	400	45	921.6	400
16	909.2	400	46	922	400
17	909.6	400	47	922.4	400
18	910	400	48	922.8	400
19	910.4	400	49	923.4	600
20	910.8	400	50	923.8	400
21	911.4	600	51	924.2	400
22	911.8	400	52	924.6	400
23	912.2	400	53	925	400
24	912.6	400	54	925.4	400
25	913	400	55	925.8	400
26	913.4	400	56	926.4	600
27	913.8	400	57	926.8	400
28	914.4	600	58	927.2	400
29	914.8	400	59	927.6	400

Typical Hopping Plan

The hopping plan is generated from a randomize function by each unit upon reset, therefore is unique to each unit. This is a typical hopping plan:

```
47 -> 21 -> 50 -> 49 -> 58 -> 28 -> 57 -> 24 -> 43 -> 5 -> 33 -> 44 ->
19 -> 32 -> 45 -> 10 -> 2  -> 34 -> 31 -> 22 -> 37 -> 8 -> 16 -> 23 ->
1  -> 14 -> 27 -> 12 -> 6  -> 39 -> 0  -> 55 -> 52 -> 48 -> 30 -> 7 ->
51 -> 54 -> 56 -> 13 -> 18 -> 40 -> 41 -> 29 -> 36 -> 42 -> 59 -> 3 ->
9  -> 11 -> 20 -> 46 -> 35 -> 38 -> 4
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