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Radio 136377
User Guide
Version 0.1

Legal Use Statement

REVISION HISTORY

Revision	Date	Description
0.1	October 19, 2017	Initial Release

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Radio 135377 Transceiver
The compact Radio 136377 900MHz transceiver replaces miles of cable in harsh industrial environments. Using field-proven FHSS technology, which needs no additional FCC licensing in the Americas, OEMs can easily make existing systems wireless with little or no RF expertise.

Overview
The Radio 136377 is a cost effective, high performance, frequency hopping spread spectrum (FHSS) transceiver designed for integration into OEM systems operating under FCC part 15.247 regulations for the 900 MHz ISM band.

Radio 136377 transceivers operate in a Masterless architecture. The Radio 136377 instead uses a Timekeeper to synchronize the network. The Timekeeper can be selected manually or the network can use built in a.i. to pick a timekeeper. Timekeeper can act as a pseudo gateway in order to synchronize signals or devices can communicate directly to one another when synchronization is not necessary.
All Timekeeper devices broadcast an RF sync pulse on periodic intervals along with timing information for secondary io beacons that are pulsed on a digital output line.
Serial data will be routed according to the destination serial number.
Digital input signals will be broadcast and then synchronized on the timekeeper pulses.

To boost data integrity and security, the Radio 136377 uses FHSS technology with data whitening and 16bit CRC data integrity checks. Configuration data is stored in an on-board EEPROM.
All frequency hopping, synchronization, and RF system data transmission/reception is programmed in the factory and is performed by the transceiver, transparent to the OEM host.

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The manufacturer is responsible for ensuring the final product meets all appropriate regulatory agency requirements listed herein before shipping any product.

Note: Unless mentioned specifically by name, the Radio 136377 modules are referred to as the radio or transceiver. Individual naming is used to differentiate product-specific features.
The host (any device to which the Radio 136377 is connected, such as a PC) are referred to as OEM host.

Features
- Standard IO - One digital input, 2 digital output lines, host serial lines for OTA serial.
- Options - 10 additional IO/serial communication lines are available for customization via custom factory firmware modification.
- Standard RF data rate options for 1Watt mode
  - *120kBaud
- Optional RF Data rates – contact the factory for details.
  - 1Watt
    - 15kBaud
    - 234kBaud
  - 1/4Watt mode.
    - 420kBaud
    - 620kBaud
- Serial data rate is 19,200Baud.
- Green LED signaling RF Transmission and Timekeeper Beacons.
- RED LED signaling RF packet Reception.

Ratings
Operating Temperature -40 to 80C
Operating Voltage 5VDC at Vin relative to ground
Operating Voltage on all io/serial lines is 0V to 3.3V DC.
Operating Humidity < 90%
When operating outdoors use an appropriately rated enclosure to prevent moisture from contacting the module.

RF Output Maximum 1Watt
RF Frequency range >= 902.4MHz and <= 927.6MHz

Available Antennas

1)   6dBi Omni - Fiberglass
2)   3dBi Omni Whip antenna - RPSMA
3)   3dBi Omni Low Profile 'Puck' shaped Antenna
4)   10.64dBi Yagi

FCC Information

FCC-Approved Antennas
WARNING: This equipment is approved only for mobile and base station transmitting devices.
Antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20
cm from all persons and must not be co-located or operating in conjunction with any other antenna
or transmitter.
Radio 136377 Module may be used only with Approved Antennas that have been tested with this
module.

Warnings
Radio 136377 is intended to be installed in a fixed location.
A minimum separation distance ≥ 20 cm is required between the antenna and radiating structures
of the device and nearby persons.

Radio 136377 will be sold with fixed power levels respective of the antenna that is provided and
network data rate that is programmed into the radio by the manufacturer.

The user shall not make changes or modifications to Radio 136377 unless expressly approved by
Tapco or the consequences could void the user's authority to operate the equipment.

FCC ID: 2ANWN-02ANWN
**This device complies with part 15 of the FCC Rules. Operation is subject to the
following two conditions: (1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that
may cause undesired operation.**

**The host device in which the module is installed shall have on its label the
statement "Contains FCC ID: 2ANWN-02ANWN".**

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Hookup and Layout
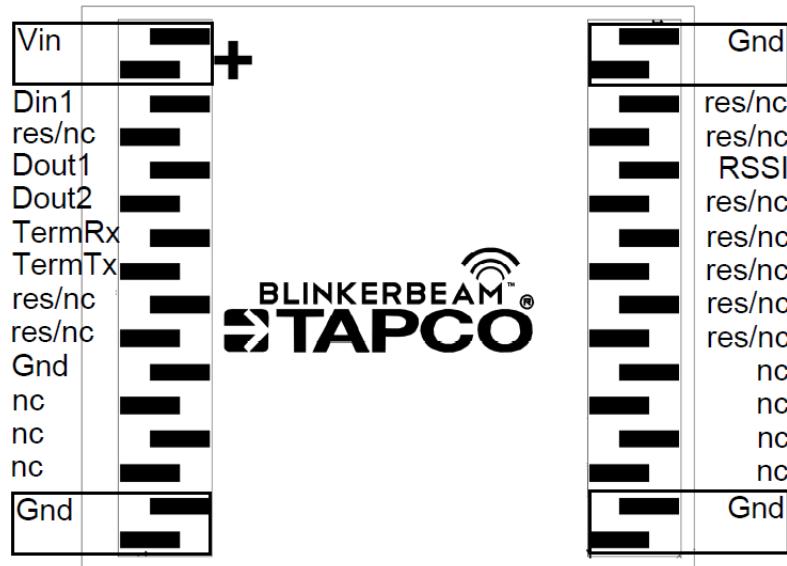
Figure 1 Signals

Ratings

	Min	Nom	Max
Vin	4.5V	4.8V	5.2V
Din1	0V		3.3V
Dout1/2	0V		3.3V
TermTx/Rx	0V		3.3V
RSSI	0V		3.3V

Din1 is a Schmitt Trigger Input with min active Low voltage 0.7V and Active High voltage 2.5V.

Dout1/2 are push pull outputs.

RSSI uses 8bit 1 start 1 stop bit active low 460,800baud to transmit RSSI information in ascii format.

TermTxRx uses 8bit 1 start 1 stop bit active low 19,200baud to transmit and receive serial data over the air.
TermTx is in reference to the Host TX and TermRx is in reference to Host Rx.

Host Layout
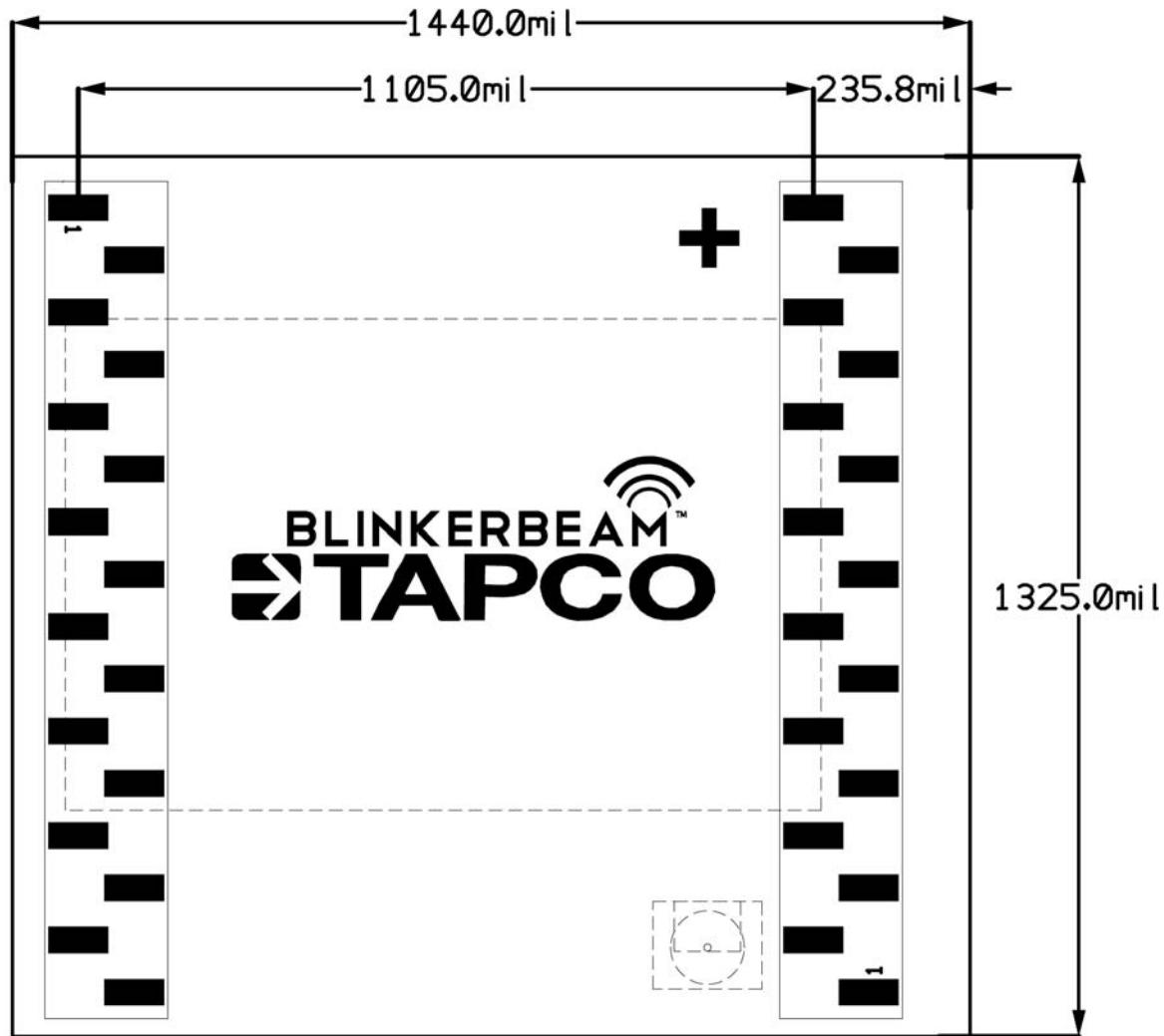
Tapco suggested Host layout using Samtec SMM-116-02-S-S
*Host layout may use any 2mm pitch connector suitable for mating with Samtec TMM-116-01-S-S-SM

THEORY OF OPERATION

Frequency Hopping Spread Spectrum
A FHSS radio does just what its name implies – that is, it 'hops' from frequency to frequency over a wide band. The specific order in which frequencies are occupied is fixed but in a pseudo random order.

Masterless TimeKeeper Architecture
Masterless TimeKeeper architecture is a peer-to-peer architecture, where any module that has data to transmit will transmit to the desired location in the network. TapNet is available in both Masterless and sync'd Masterless where one device is used as timing device to keep the network synchronized.

Modes of Operation
The Radio 136377 has 4 operating functions:
• Transmit serial data
• Receive serial data
• Hardware IO control
• Hardware Beacon outputs

Hardware IO mode acts like a one to many remote controls so when Digital input one on any device is activated, the radio broadcasts this information to all other radios on a synchronized beacon. When a remote device receives information that one of the other radios Digital Input 1 has been activated, it activates its Digital Output 1.

Hardware Beacon outputs are configurable at the factory to output a beacon pulse on Digital Output 2 in any 1 second period increment. The Fundamental System Timekeeper generates the timing for this pulse and keeps Listener radios updated as to the status of this Hardware Beacon Pulse.
Serial Data Received on any radio will be directed to the remote radio device that is getting addressed by the host application.
Local Serial Data received for device configuration will not be transmitted on the RF network.

Transmit Mode
All packets sent over the air are either Addressed or Broadcast packets. Broadcast and Addressed delivery can be controlled dynamically with the API Control byte. Contact the factory for details. When a radio has data to transmit, it sends it out on its reserved timeslot. The number of devices on a network is configurable at the factory.

To increase the odds of successful delivery the host application is required to Transmit Retries.

RF Serial Communication is not transparent to the OEM host and the Manufacturer will need to advise the Host on how to apply data packaging for transmission OTA (over the air). Contact the factory for details.

Receive Mode
Serial data can be asynchronously received by Radio 136377 OTA then directed to the Host serial port.

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RSSI - Received Signal Strength
RSSI is in units of dBm and is available through serial communication. Contact the factory for details on reading this information from the transceiver.

System Timing and Latency
Latency is the amount of time that it takes for an action to take place. There are different actions available in TapNet including remote digital control and serial data transmission/reception.
IO latency is dependent on the size of the RF network.
7 Device networks require a maximum of 62.5ms for one transceiver to transmit information to the system and in as little as 9ms to transmit information directly.
13 Device networks require a maximum of 116ms for one transceiver to transmit information to the system and in as little as 9ms to transmit information directly.

System Throughput
 Maximum System Throughput
Timekeeper to Listener = 1280 baud continuous max host throughput rate
Listener to Listener in direct mode = 1280 baud continuous max rate
Listener to Listener in sync mode = 640 bytes baud continuous
Maximum host serial payload size is 64 bytes.
RF Data Rate default is 120kBaud.
Other data rates and payload sizes are available. Contact Tapco for details on custom serial data configurations.

System Operation
The Radio 136377 network is preconfigured at the factory so all the user needs to do is power up the devices and they will automatically sync and begin working. IO and OTA serial functionality is only available once a device is sync'd.

A flashing green LED indicates the TimeKeeper device. The Green LED specifically indicates that data has been transmitted OTA.
A red flashing LED indicates that a Listener Device is in sync with the TimeKeeper. The Red LED specifically indicates that RF data has been received OTA.

ORDERING INFORMATION

Product Part Number
Radio 136377 – Radio Transceiver Module

Available Antennas

Antennas:
•   Tapco Part No.: 100441, 3dBi Puck Antenna with permanently fixed reverse polarity SMA pigtail
•   Tapco Part No.: 1343-00009, 6dBi Omni Base Station Antenna
•   Tapco Part No.: 1343-00006, 10.6dBi Yagi Antenna

Antenna Accessories:
•   Lightning Arrestor, L-com Model AL-NFNFB
•   L-Com Cable Model CA-RSPNMA002

Radio 136377 must be purchased with the antenna that is intended to be used in the host application.
Antennas with connectors that do not meet the requirement of a non-standard antenna connector will have an adapter permanently connected with industrial epoxy, "Loctite" or solder to make the connection permanent prior to shipping.

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☐ Traffic Signals & Intelligent Transportation Systems
☐ Cloud-based Traffic Device Management
☐ Parking & Security Systems
☐ Custom Traffic Signs and Accessories
☐ Streetscape Decoratives
☐ Signmaking & Inventory
☐ Sign Post Anchoring
☐ Federal Applications

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