# 17

# M2M I/O Modules

Vertrieb durch AMC

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To view all of Advantech's M2M I/O Modules, please visit www.advantech.com/products.

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# M2M I/O Modules Overview

## Introduction

The Internet of Things (IoT) is a new design paradigm, rapidly gaining wide global attention from academia, industry, and government. The fundamental concept is to emphasize ubiquitous computing among global networked machines and physical objects, denoted as things, such as sensors, actuators, machine-to-machine (M2M) devices, wireless sensor network (WSN) devices etc..

### Machine To Machine (M2M) Technology

Machine To Machine (M2M) technology is now sufficiently mature that large numbers of companies are confident enough in its potential to launch their own projects that include innovation in services and products. The use of M2M technology is particularly well-suited to interaction with a large number of remote, and possibly mobile, devices, usually acting as the interface with an end-user.

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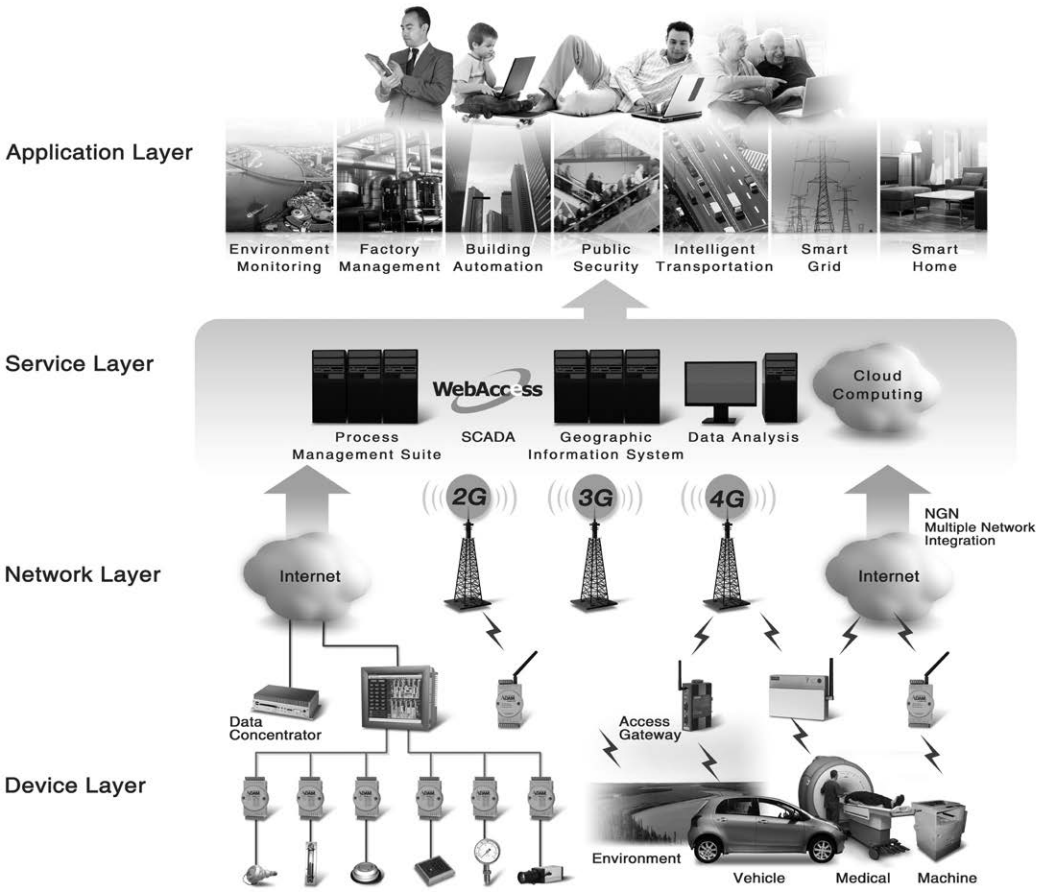
## Wireless Sensor Networks

The IoT is composed of four layers, an application layer, service layer, network layer and device layer. The application layer is the real application system, the service layer is now defined as cloud computing and the network layer is the wired/wireless network infrastructure. The device layer connects everything to the internet and is the key infrastructure of the IoT. One of the most important technologies is the Wireless Sensor Network, which is the wireless I/O and sensor solution/interface to collect and transmit analog/digital signals to the internet. The WSN is composed of two major parts; the wireless technology is based on IEEE 802.15.4 with many protocols, such as ZigBee, 6LoWPAN, WirelessHART. With different types of I/Os and sensors, signals can be measured in every situation. For instance, bridges can be measured through strain gauges, and buildings can be measured for energy usage. WSN is the next generation of wireless data acquisition solution.




**Advantech's IoT-ready Product Development Framework**



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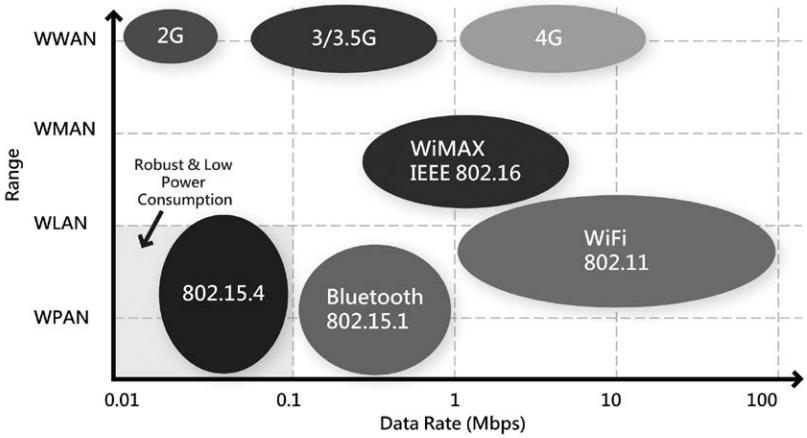
# IEEE 802.15.4

IEEE 802.15.4 is defined and maintain by the IEEE organization. The standard intends to offer fundamental lower network layers of low-rate wireless personal area networks (WPANs) which focuses on low-data rate, low-power consumption ubiquitous wireless communication between devices. IEEE 802.15.4 conforming devices may use one of three possible unlicensed frequency bands for operation:

- 868.0-868.6 MHz: Europe, allows one communication channel.
- 902-928 MHz: North America, up to ten channels, extended to thirty.
- 2400-2483.5 MHz: worldwide use, up to sixteen channels.

IEEE 802.15.4 defines the Wireless Medium Access Control (MAC) and Physical Layer (PHY) for WPANs only, upper layer stacks can be implemented by users for variety of applications. One example of the known protocols is ZigBee.




# Network Topologies

Wireless Sensor Networks (WSN) can be built using a few or a lot of "nodes". Each node can be connected to one or several sensors; the network topology is composed of three typical components, PAN Coordinator/Gateway, Router and End Device (or called End Node), which can be built to Star, Tree and Mesh network topologies.

### Three components of a wireless sensor network

- **PAN Coordinator/Gateway**

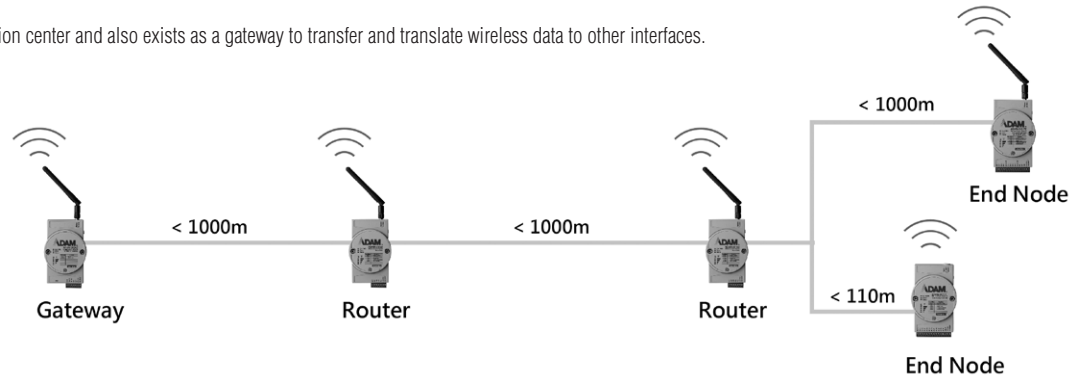
  A coordinator is the data collection center and also exists as a gateway to transfer and translate wireless data to other interfaces.

- **Router**

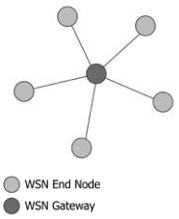
  A router enhances the wireless signal and a wireless router is used to select the optimal path for wireless communication between the coordinator and the end nodes.

- **End Node/Device**

  An end node is a wireless remote I/O for data acquisition. Data is acquired from sensors or devices which are then transmitted through it.
  The end node communicates with the coordinator directly or via a router to a coordinator.

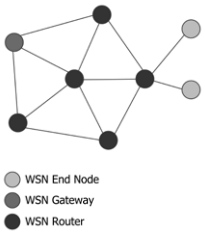



### Three Network Topologies




- **Star Topology**

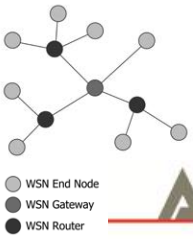
  It's the simplest way to construct a network with a gateway and end nodes. The benefit of the topology is that it operates as a low-latency communication network. But has the limitation of low wireless signal coverage.




- **Mesh Topology**

  When routers connect to each other in a mesh topology they have the following benefits.
  1. Wide network coverage.
  2. Robust routing mechanism with self-healing.
  3. Multi-hopping mechanism.

  But also the following limitations:
  1. More power consumption than the other topologies.
  2. Routing path and hop counts affect the latency and performance.




- **Tree Topology**

  Using a tree topology, the network can be extended through routers making it flexible enough to locate the end nodes in specified locations. Latency is increased with the number of routers hopping.

# Comparison of Topologies

| Topology | Star | Tree | Mesh |
|---|---|---|---|
| Power Consumption | Low | Medium | High |
| Installation Fee | Low | Medium | High |
| Network Coverage | Small | Large | Large |
| Network Capability | Small | Large | Large |
| Reliability | Low | Low | High |

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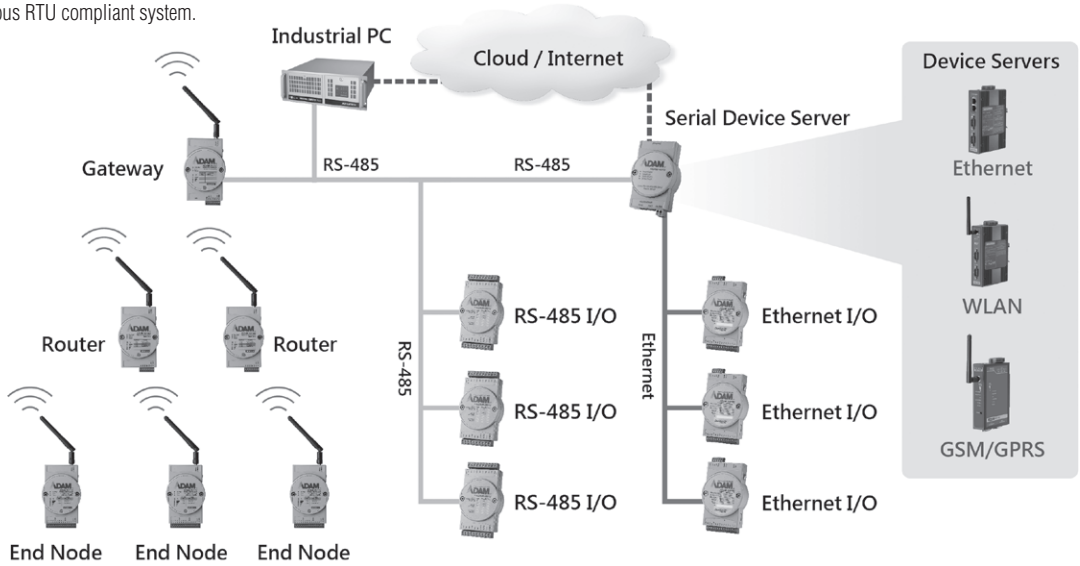
# M2M I/O Modules Overview

## ADAM-2000 Series

Advantech provides ADAM-2000 series industrial grade Wireless Sensor Network I/O solutions for low-power consumption, cost-efficient and reliable networking for remote monitoring applications. It utilizes IEEE 802.15.4 wireless technology and supports star, tree and mesh topologies. Once the modules are configured, the ADAM-2000 series will automatically construct the most suitable network topology for your control system without further configuration.

The ADAM-2000 series contains several models, including coordinator (gateway), router, analog input, digital input, relay output and sensor modules. To perform as a Wireless Sensor Network, a gateway ADAM-2520Z is essential for collecting data from end nodes. With the Modbus RTU protocol, the ADAM-2000 series can be easily integrated into any SCADA or Modbus RTU compliant system.

- **ADAM-2520Z:** Wireless Modbus RTU Gateway
- **ADAM-2510Z:** Wireless Router
- **ADAM-2017PZ:** Wireless 6-ch Analog Input Node with Power Amplifier
- **ADAM-2031Z:** Wireless Temperature & Humidity Sensor Node
- **ADAM-2051Z:** Wireless Sensor Network 8-ch Digital Input Node
- **ADAM-2051PZ:** Wireless Sensor Network 8-ch Digital Input Node with Power Amplifier




## Features

Advantech's ADAM-2000 Series are wireless I/O devices designed for industrial systems and applications.

2.4GHz IEEE 802.15.4

### Global Deployable ISM 2.4GHz IEEE 802.15.4 Standard

The standard has the following benefits.

- With the global deployable ISM 2.4 GHz RF band, the ADAM-2000 series can be installed worldwide.
- Compared to a wired solution, wireless technology makes the network easily extendible and can be installed in almost any location, especially in distributed construction applications.
- Enhances transmission power and high gain antennas can expand network coverage.
- Enlarges highly effective network structure to reduce development costs and maintainable complexity in harsh applications.
- Provides self-forming and self-healing ability to cope with communication failures or node failures conditions.
- Low data rates and low duty cycles make it possible to act as standalone devices with batteries for a long term operation without maintenance.

Modbus RTU Protocol

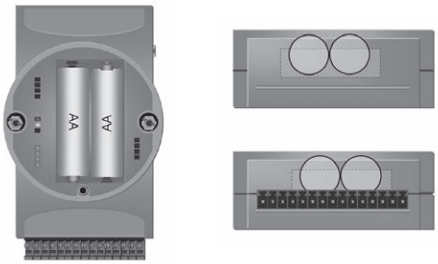
### Industrial Communication and I/O Interfaces

The popular industrial communication protocol Modbus makes the ADAM-2000 series easy to integrate with industrial systems and is also compliant with ADAM-4000 and ADAM-6000 wired solutions. Multiple I/O interface selection provides users plentiful sensor options.

Low-power Consumption

### Low Power Consumption Design

The ADAM-2000 series is designed for applications that require long-time operation without maintenance. Therefore power consumption is taken into consideration during its design. The ADAM-2000 series not only follows the IEEE 802.15.4 standard for low-power consumption wireless communication, but also optimizes the peripheral hardware and firmware design to achieve uA-level power consumption. This allows ADAM-2000 input/output and sensor modules to be powered by 2 AA Alkaline batteries*.




* For the choice of battery, we suggest Energizer L91 Ultimate Lithium AA battery.

* Only ADAM-2031Z and ADAM-2051Z support low power consumptions. For other modules battery can still be used as back-up power.



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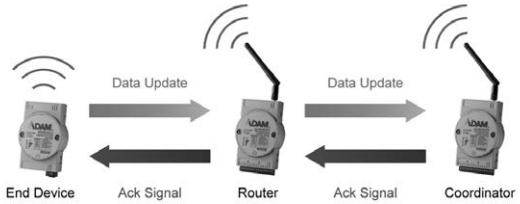
WebAccess
SCADA Software Support

## Advantech and Industrial SCADA Software Support

The ADAM-2000 series can be configured through the Adam/Apax .NET Utility. Only a few steps are required, and wireless networks can be built up quickly. Due to the Modbus protocol design, the ADAM-2000 series can support any third-party SCADA software and HMI, including Advantech SCADA software, WebAccess.

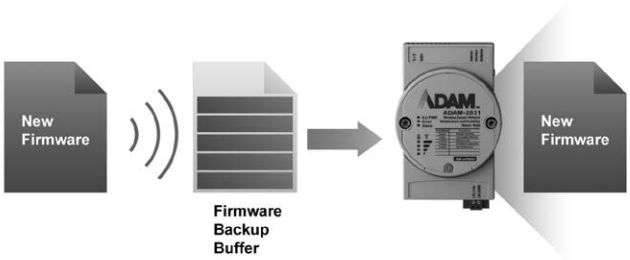
## Ensured Data Design

The ADAM-2000 family has an acking mechanism feature to ensure data communicating processes can be successfully transferred between the coordinator and end device before device entering sleep mode.



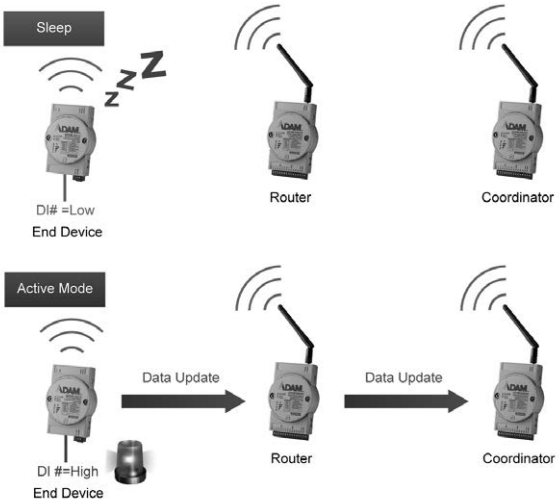

## Over The Air (OTA) Firmware Update

The ADAM-2000 modules with strengthened firmware maintenance technique, which integrates a stable backup buffer and secure mechanism allowing wireless module firmware updates during operation.



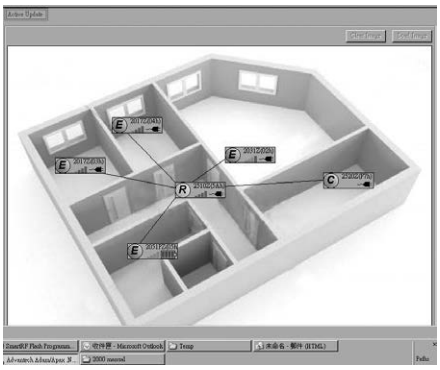

## Event Triggering

ADAM-2000 digital input modules are empowered with an Event Triggering function. When receiving DI status change, ADAM-2000 digital input modules will wake up immediately from sleep mode and send I/O data to a coordinator. This avoids the missing of events during operation.




## Site Survey Monitoring

The ADAM-2000 modules provide an useful site survey tool in Adam/Apax .Net utility to help users to achieve network setup and major remote maintenance tasks to avoid try and error network processes. The topology monitoring of an ADAM-2000 network adopts an easy place and drag action allowing users to choose the working field image for monitoring backgrounds, and lists the relations among ADAM-2000 modules then illustrated in a single page. Through site survey monitoring, users can comprehensively know each device location, current status, and information in customized background.





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# M2M I/O Modules Selection Guide

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| Model | | ADAM-2510Z | ADAM-2520Z | ADAM-2031Z |
|---|---|---|---|---|
| Description | | Wireless Router | Wireless Modbus RTU Gateway | Wireless Temperature & Humidity Sensor Node |
| Wireless Network | IEEE Standard | IEEE 802.15.4 | | |
| | Modulation Type | DSSS (OQPSK) | | |
| | Frequency Band | ISM 2.4 GHz (2.4 GHz ~ 2.4835 GHz) | | |
| | Channels | 11 - 26 | | |
| | Topology | Star / Tree / Mesh | | |
| | Transmit Power | 19 ± 1 dBm | 19 ± 1 dBm | 3 ± 1 dBm |
| | Receiver Sensitivity | -97 dBm | | |
| | Outdoor Range * | 1000 m (with 2 dBi Antenna) | | 110 m |
| | RF Data Rate | 250 Kbps | | |
| | Function | Router | Coordinator | End Device |
| Network | Interface | - | RS-485/USB | - |
| | Communication Protocol | - | Modbus RTU | - |
| Analog Input | Resolution | - | - | - |
| | Channels | - | - | - |
| | Sampling Rate | - | - | - |
| | Voltage Input | - | - | - |
| | Current Input | - | - | - |
| Thermocouple Type | | - | - | - |
| Digital Input and Digital Output | Input Channels | - | - | - |
| | Output Channels | - | - | - |
| Sensor Input | Temperature | - | - | -20°C ~ 70°C (-4°F ~ 157.9°F) |
| | Humidity | - | - | 0 ~ 100% RH |
| | CO2 | - | - | - |
| LED Indicator | | External PWR/Error/Status/Level Index | | |
| Power Requirement | | Power Input: Unregulated 10 ~ 30 $V_{DC}$<br>Battery Input: 2 x AA Alkaline 3 $V_{DC}$ | | |
| Operating Temperature | External Power | -20°C ~ 70°C (-4°F ~ 157.9°F) | | |
| | Battery Power | 0°C ~ 50°C (32°F ~ 122°F) | | |
| Power Consumption | Power Supply | 0.8 W @ 24 $V_{DC}$ | | 0.3 W @ 24 $V_{DC}$ |
| | USB | - | 0.5 W @ 5 $V_{DC}$ | - |
| | Battery AA * 2 | 0.3 W @ 3 $V_{DC}$ | | 420 uW @ 3 $V_{DC}$<br>(1 minute Tx Interval)<br>240 uW @ 3 $V_{DC}$<br>(2 minute Tx Interval)<br>150 uW @ 3 $V_{DC}$<br>(5 minute Tx Interval) |
| Storage Temperature | | -40°C~ 85°C (-40°F ~ 184°F) | | |
| Operation Humidity | | 20~95% RH | | |
| Storage Humidity | | 0~95% RH | | |
| Page | | 17-8 | 17-8 | 17-9 |

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NEW

| ADAM-2017PZ | ADAM-2051Z | ADAM-2051PZ |
|---|---|---|
| Wireless 6-ch Analog Input Node with Power Amplifier | Wireless 8-ch Digital Input Node | Wireless 8-ch Digital Input Node with Power Amplifier |
| IEEE 802.15.4 | | |
| DSSS (OQPSK) | | |
| ISM 2.4 GHz (2.4 GHz ~ 2.4835 GHz) | | |
| 11 - 26 | | |
| Star / Tree / Mesh | | |
| 19 ± 1 dBm | 3 ± 1 dBm | 19 ± 1 dBm |
| -97 dBm | | |
| 1000 m | 110 m | 1000 m |
| 250 Kbps | | |
| End Device | | |
| - | - | - |
| - | - | - |
| 16-bit | - | - |
| 6 Non-Isolation (Differential) | - | - |
| 12 samples/second (total) | - | - |
| ±150mV,±500mV<br>±1V,±5V,±10V | - | - |
| ±20mA,0~20mA,4~20 mA | - | - |
| - | - | - |
| - | 8 | 8 |
| - | - | - |
| - | - | - |
| - | - | - |
| - | - | - |
| External PWR/Error/Status/Level Index | | |
| Power Input:Unregulated 10 ~ 30 $V_{DC}$<br>Battery Input: 2 x AA Alkaline 3 $V_{DC}$ | | |
| -20°C ~ 70°C (-4°F ~ 157.9°F) | | |
| 0°C ~ 50°C (32°F ~ 122°F) | | |
| 0.3 W @ 24 $V_{DC}$ | | |
| - | - | - |
| 380 uW @ 3 $V_{DC}$ (1 minute Tx Interval)<br>220 uW @ 3 $V_{DC}$ (2 minute Tx Interval)<br>130 uW @ 3 $V_{DC}$ (5 minute Tx Interval) | | |
| -40°C~ 85°C (-40°F ~ 184°F) | | |
| 20~95% RH | | |
| 0~95% RH | | |
| 17-9 | 17-10 | 17-10 |

* Outdoor Range is estimated with line of sight, and please perform site survey to determine the set up range of wireless network.



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# ADAM-2510Z
# ADAM-2520Z

## Wireless Router

## Wireless Modbus RTU Gateway

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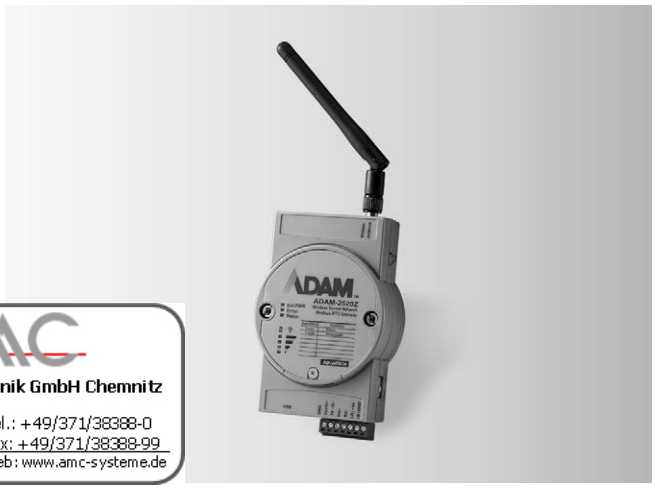

**ADAM-2510Z** R&TTE SRRC FCC CE RoHS

## Features

- Easy maintenance and field installation
- Low duty wireless communication
- Smart and simple indicator design
- Extends network range and coverage

## Specifications

### Wireless Communication

- **IEEE Standard** IEEE 802.15.4
- **Modulation Type** DSSS (OQPSK)
- **Frequency Band** ISM 2.4 GHz (2.4 GHz ~ 2.4835 GHz)
- **Channels** 11 - 26
- **RF Data Rate** 250 Kbps
- **Transmit Power** Typ. 19 ± 1 dBm
- **Receiver Sensitivity** -97 dBm
- **Topology** Star / Tree / Mesh
- **Outdoor Range** 1000 m with line of sight (with 2 dBi Antenna)
- **Function** Router

### General

- **Connectors** 1 x plug-in terminal block (#14 ~ 22 AWG)
- **Power Input** Unregulated 10 ~ 30 $V_{DC}$
- **Battery Input** 2 x AA Alkaline
- **Power Consumption** 0.8 W @ 24 $V_{DC}$
  0.3 W @ 3 $V_{DC}$ (Battery AA * 2)

## Common Specifications

### Environment

- **Operating Temperature**
  External Power -20°C ~ 70°C (-4°F ~ 157.9°F)
  Battery Power 0°C ~ 50°C (32°F ~ 122°F)
- **Storage Temperature** -40°C~ 85°C (-40°F ~ 184°F)
- **Operating Humidity** 20~95% RH
- **Storage Humidity** 0~95% RH

## Ordering Information

- **ADAM-2510Z** Wireless Router

**ADAM-2520Z** R&TTE SRRC FCC CE RoHS

## Features

- 2.4 GHz IEEE 802.15.4 compliant RF
- Provides RS-422/485 and USB interfaces
- Multiple power input design

## Specifications

### Wireless Communication

- **IEEE Standard** IEEE 802.15.4
- **Modulation Type** DSSS (OQPSK)
- **Frequency Band** ISM 2.4 GHz (2.4 GHz ~ 2.4835 GHz)
- **Channels** 11 - 26
- **RF Data Rate** 250 Kbps
- **Transmit Power** Typ. 19 ± 1 dBm
- **Receiver Sensitivity** -97 dBm
- **Topology** Star / Tree / Mesh
- **Outdoor Range** 1000 m with line of sight (with 2 dBi Antenna)
- **Network Capacity** 32 nodes (Routers & End Devices)*
  *Based on user's configuration
- **Range Extenders** Maximum 5 Hops
- **Function** Coordinator

### General

- **Connectors** 1 x plug-in terminal block (#14 ~ 22 AWG)
  1x USB-type A connector (type A to B cable provided)
- **Protocol** Modbus RTU
- **Power Input** Unregulated 10 ~ 30 $V_{DC}$
- **Battery Input** 2 x AA Alkaline
- **Power Consumption** 0.8 W @ 24 $V_{DC}$
  0.5 W @ 5 $V_{DC}$ (USB)
  0.3 W @ 3 $V_{DC}$ (Battery AA * 2)

## Common Specifications

### Environment

- **Operating Temperature**
  External Power -20°C ~ 70°C (-4°F ~ 157.9°F)
  Battery Power 0°C ~ 50°C (32°F ~ 122°F)
- **Storage Temperature** -40°C~ 85°C (-40°F ~ 184°F)
- **Operating Humidity** 20~95% RH
- **Storage Humidity** 0~95% RH

## Ordering Information

- **ADAM-2520Z** Wireless Modbus RTU Gateway



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# ADAM-2031Z
# ADAM-2017PZ

## Wireless Temperature & Humidity Sensor Node

## Wireless 6-ch Analog Input Node with Power Amplifier

Vertrieb durch AMC
AMC – Analytik & Messtechnik GmbH Chemnitz
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ADAM-2031Z

R&TTE SRRC FCC CE RoHS

## Features

- IEEE 802.15.4 Wireless Standard
- Support Star/Tree/Mesh Network Topology
- Modbus Communication Protocol
- Low Power Consumption
- LED Indicators
- Sensor Embedded

## Specifications

### Temperature Sensor Input

| | |
|---|---|
| **Operating Range** | -20°C ~ 70°C (-4°F ~ 157.9°F) |
| **Resolution** | 0.02°C (0.04°F) |
| **Accuracy** | ±1.0°C (33.8°F)(±0.5°C @ 0 ~ +35°C) |
| **Repeatability** | ±0.1°C (0.4°F) |
| **Response Rate** | ±1°C/min. |
| **Long Term Drift** | < 0.04°C/Year (0.07°F/Year) |

### Humidity Sensor Input

| | |
|---|---|
| **Operating Range** | 0 ~ 100% RH |
| **Resolution** | 0.15% RH |
| **Accuracy** | ±3.0% RH |
| **Repeatability** | ±0.1% RH |
| **Response Time** | 8 seconds (Achieving 63% of a step function) |
| **Long Term Drift** | 0.5% RH/Year |

## Ordering Information

- **ADAM-2031Z** Wireless Temperature & Humidity Sensor Node

ADAMTECH Premier Partner

ADAM-2017PZ

CE RoHS

## Introduction

The ADAM-2017PZ is a wireless module with 6 analog input channels to measure the voltage and current. Its low power design allows it to be powered by 2 AA Alkaline batteries, making it an ideal module for remote data acquisition in a wide area.

## Features

- IEEE 802.15.4 Wireless Standard
- Support Star/Tree/Mesh Network Topology
- Modbus Communication Protocol
- Low Power Consumption
- LED Indicators

## Specifications

### Analog Input

| | |
|---|---|
| **Channels** | 6 Non-Isolation (Differential) |
| **Input Max Voltage** | +/-15V |
| **Common Mode Volts** | 10 $V_{DC}$ |
| **Input Impedance** | >10 MΩ (Voltage), 120Ω (Current) |
| **Input Type** | mV, V, mA |
| **Input Range** | ±150mV, ±500mV, ±1V, ±5V, ±10V, ±20mA, 0~20mA, 4~20 mA |
| **Accuracy** | Voltage: +/-0.1% or better (Current) at 25°C<br>Current: +/-0.2% or better (Current) at 25°C |
| **Span Drift** | ±25 ppm/°C |
| **Zero Drift** | ±6 μV/°C |
| **Resolution** | 16-bit |
| **Sampling Rate** | 12 samples/second (total) |
| **CMR @ 50/60 Hz** | 100 dB |
| **NMR @ 50/60 Hz** | 65 dB |

## Ordering Information

- **ADAM-2017PZ** Wireless 6-ch Analog Input Node with Power Amplifier

## Common Specifications

### Wireless Communication

| | |
|---|---|
| **IEEE Standard** | IEEE 802.15.4 |
| **Modulation Type** | DSSS (OQPSK) |
| **Frequency Band** | ISM 2.4 GHz (2.4 GHz ~ 2.4835 GHz) |
| **Channels** | 11 - 26 |
| **RF Data Rate** | 250 Kbps |
| **Transmit Power** | 3 ± 1 dBm (ADAM-2031Z)<br>19 ± 1 dBm (ADAM-2017PZ) |
| **Receiver Sensitivity** | -97 dBm |
| **Topology** | Star / Tree / Mesh |
| **Outdoor Range** | 110 m with line of sight (ADAM-2031Z)<br>1000 m with line of sight (ADAM-2017PZ) |
| **Function** | End Device |

### General

| | |
|---|---|
| **Connectors** | 1 x plug-in terminal block (#14 ~ 22 AWG) |
| **Power Input** | Unregulated 10 ~ 30 $V_{DC}$ |
| **Battery Input** | 2 x AA Alkaline |
| **Power Consumption** | 0.3 W @ 24 $V_{DC}$<br>Battery AA * 2<br>420 uW @ 3 $V_{DC}$ (1 minute Tx Interval)<br>240 uW @ 3 $V_{DC}$ (2 minute Tx Interval)<br>150 uW @ 3 $V_{DC}$ (5 minute Tx Interval) |

### Environment

| | |
|---|---|
| **Operating Temperature** | |
| External Power | -20°C ~ 70°C (-4°F ~ 157.9°F) |
| Battery Power | 0°C ~ 50°C (32°F ~ 122°F) |
| **Storage Temperature** | -40°C~ 85°C (-40°F ~ 184°F ) |
| **Operating Humidity** | 20~95% RH |
| **Storage Humidity** | 0~95% RH |



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# ADAM-2051Z
# ADAM-2051PZ

## Wireless Sensor Network 8-ch Digital Input Node

## Wireless Sensor Network 8-ch Digital Input Node with Power Amplifier

Vertrieb durch AMC
AMC – Analytik & Messtechnik GmbH Chemnitz
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E-Mail: info@amc-systeme.de Web: www.amc-systeme.de

ADAM-2051Z

R&TTE SRRC FCC CE RoHS

## Specifications

### Digital Input

- **Channels** 8
- **Input Resistance** 10 KΩ
  Supports wet and dry contacts
- **Input Level** Logic Level 0 0~0.8 Vmax
  Logic Level 1 2.0 Vmin~5.0 Vmax

## Ordering Information

- **ADAM-2051Z*** Wireless 8-ch Digital Input Node

ADAM-2051PZ

R&TTE SRRC FCC CE RoHS

## Specifications

### Digital Input

- **Channels** 8
- **Input Resistance** 10 KΩ
- **Input Level** Logic Level 0 0~0.8 Vmax
  Logic Level 1 2.0 Vmin ~5.0Vmax

## Ordering Information

- **ADAM-2051PZ*** Wireless 8-ch Digital Input Node with Power Amplifier

AMC

ADVANTECH Premier Partner

## Common Specifications

### Wireless Communication

- **IEEE Standard** IEEE 802.15.4
- **Modulation Type** DSSS (OQPSK)
- **Frequency Band** ISM 2.4 GHz
  (2.4 GHz ~ 2.4835 GHz)
- **Channels** 11 - 26
- **RF Data Rate** 250 Kbps
- **Transmit Power Typ.** 3 ± 1 dBm (ADAM-2051Z)
  19 ± 1 dBm (ADAM-2051PZ)
- **Receiver Sensitivity** -97 dBm
- **Topology** Star / Tree / Mesh
- **Outdoor Range** 110 m with line of sight (ADAM-2051Z)
  1000 m with line of sight (ADAM-2051PZ)
- **Function** End Device

### General

- **Connectors** 1 x plug-in terminal block (#14 ~ 22 AWG)
- **Power Input** Unregulated 10 ~ 30 $V_{DC}$
- **Battery Input** 2 x AA Alkaline
- **Power Consumption** 0.3 W @ 24 $V_{DC}$
  (ADAM-2051Z/PZ) Battery AA * 2 380 uW @ 3 $V_{DC}$ (1 minute Tx Interval)
  220 uW @ 3 $V_{DC}$ (2 minute Tx Interval)
  130 uW @ 3 $V_{DC}$ (5 minute Tx Interval)

### Environment

- **Operating Temperature**
  External Power -20°C ~ 70°C (-4°F ~ 157.9°F)
  Battery Power 0°C ~ 50°C ( 32°F ~ 122°F)
- **Storage Temperature** -20°C ~ 70°C (-4°F ~ 157.9°F)
- **Operating Humidity** 20~95% RH
- **Storage Humidity** 0~95% RH

*If want to operate in a wider temperature (-40°C~ 85°C (-4°F ~ 157.9°F) ), contact our sales team.



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