**Technology Group International, Inc.**

4407 N. Beltwood Parkway, Suite 108
Dallas, Texas 75244-3246

# Model 851 Product Description

## 1. Overview

The **Minion 851 Rev A** main board with transciever **H100 Rev D** is design as a power outage notification device. The hardware requirements of this device are a close approximation of the requirements set forth for a TM702V00 gateway device, FCC ID P22TM702V00. Hardware features specific to this application include:

- Battery-powered operation
- User interface test push button
- Status light indicators
- Physical form-factor.

### 1.1 Product Package Contents

The 851 product package consists of:

- **851** circuit board which includes a built-in microcontroller, modem, circuit protection and external power supply, battery, and telco RJ-11 connectors.
- **H100 Rev D** transceiver operating at 918 MHz.
- User interface consists of a ½ inch square push button switch and two light indicators (red and green).
- The enclosure is a 65mm X 133mm X 29mm black ABS plastic enclosure with a door for the 9V battery. A flat insert in one end provides openings for the telephone and power connectors. A square hole in the center of the top surface is used by the push button. A recessed area on the top surrounding the button opening provides for application of an identifying label.

## 2. Power Source and Requirements

### 2.1 External Power Supply

The external power will be provided by an unregulated 9VDC wall transformer. This power supply will provide the operational power for the device and will also be used to detect line voltage fluctuations (brownouts and blackouts). The rated current from the transformer will be 200 mA. It is necessary to load the transformer to a significant percentage of its rating in order to ensure that the output voltage is proportional to the line voltage. The device will normally represent an insignificant load. The voltage measurement circuit will include a 100 ohm, 1 watt resistive divider. This will load the transformer to 50% of its rating and minimize the effect of load changes as the modem is turned on or off. The external power supply connects to the device with a 2.1 mm barrel connector with (+) on the center pin.

## 2.2 Battery

The battery will be a 9V alkaline primary cell. Typical ratings for an industrial alkaline battery show a life of 6 hours with a constant load of 100 ohms and an end-of-life voltage of 5.4 volts. Therefore, the average voltage is about 7.5 volts, average current is about 75 mA and capacity would be about 450 mA-Hours. Since this is a 3.3 volt design and we use a low-dropout regulator the actual life may more than double this figure.

The table shows estimated device longevity while operating on battery power. The last three columns show a life expectancy for the battery after using the modem for three different amounts of time. All of these numbers should be viewed as worst-case estimates; performance in real-world situations should be significantly better

| | **Maximum Sleep** | **Normal Sleep (1: 120)** | **Light Sleep (1: 60)** | **Continuous Calling** | **Modem Use During Normal Sleep** | | |
|---|---|---|---|---|---|---|---|
| | | | | | **10 minutes** | **2 hours** | **6 hours** |
| Battery | 450 mA-H | 450 mA-H | 450 mA-H | 450 mA-H | 445 mA-H | 394 mA-H | 282 mA-H |
| Main Board | 30 uA | 88 uA | 147 uA | 7 mA | 88 uA | 88 uA | 88 uA |
| Modem | 55 uA | 55 uA | 55 uA | 21 mA | 55 uA | 55 uA | 55 uA |
| Lifetime | 5294 hours (220 days) | 3147 hours (131 days) | 2239 hours (93 days) | 16 hours | 3112 hours (130 days) | 2775 hours (115 days) | 1972 hours (82 days) |

To summarize:

- The battery is only used while the main power is disconnected.
- If the external power is on continuously the battery will last for its rated shelf life.
- The battery life expectancy without external power is four (4) months.
- Each hour of modem use during a power failure will reduce that expectancy by eleven (11) days.

## 2.3 Device Component Requirements

### 2.3.1 Transceiver

Transceiver peak current is specified as 26 mA which is well within the drive capability of the output pin. Empirical results show that the operating voltage is typically 7.0V Vdd This represents a slight penalty, typically in reduced receiver sensitivity that can be eliminated by powering the transceiver directly from the Vdd rail in applications that do not require maximum power conservation.

### 2.3.2 Modem

The modem current is listed as 21 mA max at 3.3 volts during operation and 55 uA max during power-down. The duration of an outage notification call will be approximately 30 seconds which will be the only time that the full-power load will be presented to the battery.

### 2.3.3 Power Regulator

The power supply section of the device provides for both external (wall) and internal (battery) operation. These nominal 9V supplies are regulated down to 3.3V by a Low Dropout analog regulator. Diode protection ensures that reverse connections will not

damage the device. The protection diodes also ensure that power is supplied only by the wall transformer during normal operation. The transformer voltage being slightly higher than the battery voltage reverse-biases the battery protection diode and ensures that no current flows from the battery.

- Resistive dividers are used to establish measurement points for A/D converters used to measure the voltages of each supply. The measurement points must be between 0 and 3.3V, the range of the A/D converter using the regulated Vdd as a reference.
- A 100 ohm, 1 watt divider chain scales the external supply to 1/4 of its value and provides a load for the transformer. A series diode protects the analog input against reverse connection or inadvertent use of an AC transformer.
- A 1 Mohm divider scales the battery to 1/4 of its value and presents an insignificant continuous drain on the battery. A 0.1 uF capacitor is used to provide charge storage at the measurement point to ensure accurate measurements by the A/D converter. A series diode protects against accidental battery reversal.

### 2.3.4 Microcontroller

Low-power consumption:

- - < 0.6 mA typical @ 3V, 4 MHz
- -20 ∝A typical @ 3V, 32 kHz
- -< 1 ∝A typical standby current

# 3. Device Component Details

## 3.1 Transceiver

The radio transceiver is a single-chip design utilizing an FSK receiver manufactured by Honeywell. It provides operation on a single frequency in the 900 MHz ISM band with a power output of less than 1mW.

- The transciever is controlled by a processor via an SPI interface. Data is encoded using Manchester encoding/decoding.
- 851 current requirements are 26mA at 3.3 volts. Normal device operations turn the radio transceiver on for one second every two minutes when operating on battery power.

## 3.2 Microcontroller

The microcontroller is a PIC 18 series microcontroller from Microchip Technologies. The single-chip controller combines processor, flash program store, EEPROM non-volatile data storage, RAM memory, clock oscillator, real-time clock, parallel I/O ports, serial I/O and A/D converters.

### 3.2.1 Input/Output Details

The device I/O configuration is as follows:

- The asynchronous serial I/O port provides communication with the modem module. Asynchronous data and commands are transferred at 2400 baud.
- I/O port controls the reset line to the modem.

- I/O port connects to the LED indicator through a 330 ohm current limiting resistor.
- I/O port connects to the push button which switches a 10K ohm pull-up resistor to ground when pressed.
- I/O port connects to the switched contact of the external power supply barrel connector. Since this contact switches to ground and is closed when the external power supply is NOT connected, care must be exercised with power consumption. A long-time-constant RC network is connected to the contact. The firmware will periodically drive the pin high for a period of time, then switch to input to detect the charge, if present. The capacitor will be grounded if the external supply is not connected. This eliminates the continuous drain that would be associated with a simple pull-up resistor. A 10K resistor and 0.1 uF capacitor yield a 1 mSec time constant. The firmware will control the interval between tests and thus the effective current consumption which will run as high as 300 uA during the test.
- Six I/O ports are used to control the radio transceiver via an SPI bus interface.

### 3.2.2 Other Components

Other components are as follows:

- Two A/D converter channels are used to measure the voltage level of the external power supply and the battery. The 3.3V Vdd is used as the reference.
- The processor clock operates at 5.0688 MHz using a crystal oscillator. The processor clock oscillator stops during sleep mode to conserve power.
- The real-time clock oscillator uses a 32 KHz crystal and provides very low current drain during sleep mode while ensuring accurate interval measurement for wake-up.
- The SPI interface is connected to an optional single-chip non-volatile serial memory with a capacity of up to 512KB.

# 4. Contact Information

## 4.1 Applicant

AFX Technology Group International Inc.
4407 N. Beltwood Parkway, Suite 108
Dallas, Texas 75244

## 4.2 Manufacturer

Bottoms Technology Incorporated (BTI)
710 Business Way P.O. Box 1805
Wylie, TX 75098-1805