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A5191HRT Design for Low-power Environments

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APPLICATION NOTE

Introduction

The typical HART application can draw power from the current loop. However, for some applications, this power budget can be extremely restrictive.

For other applications, particularly handheld and/or movable HART devices, it may be undesirable to rely on the current loop for power, and the design could be powered by batteries. If this is the case, the design specifications often put a restriction on the minimum battery life and even the size – and thus capacity – of the batteries.

In both these cases, it is desirable to limit the power consumption of each section of the device to the bare minimum. In this design note, we will cover some actions that can be undertaken to reduce power consumption of the A5191HRT.

Master Power Control During Dead Times

For a master device, the modem should only be turned on when a frame needs to be transmitted, or when listening for a reply from a slave device. Since slave devices cannot send data without being asked for it, the master interface should be turned off when this is not the case. However, this entails that when the modem is activated again, it must again become synchronized with data flow from a possible secondary master. This may cause a delay in the data flow.

Clock Generation

The best way to reduce current consumption during the operation of the device, is to disable the internal oscillator circuit and provide an external clock signal, generated for example by a microcontroller. This will reduce current consumption of the A5191HRT by approximately 100 μA. The easiest way to do this is by generating this signal in a microcontroller operating at a clock frequency that is a multiple of 460.8 kHz, and setting a timer to toggle the XOUT pin of the A5191HRT. Table 1 lists possible frequencies that are multiples of 460.8 kHz. If this approach is chosen, care must be taken that the accuracy of the generated clock signal is less than 1%.

A slave device must always listen to the data transmitted over the network, as the minimal start of new frames is reference to the end of the previous frame. Care should be taken to release nRTS as soon as transmission is finished, as the transmitter consumes around 20 μA more than the receiver.

Supply Voltage

When designing for low power restrictions, it is advised to set the supply voltage as low as possible. The A5191HRT can operate down to 2.5 V. However it is advised to use a minimum of 2.7 V to prevent voltage dips from resetting the device. This may provide a current use reduction of up to 300 μA opposed to 5 V operation.

Reference Voltages

To achieve the lowest possible power consumption, care must be taken in the generation of reference voltages. As the required accuracy of the references is low, a low quiescent current series regulator will be a better choice than a shunt reference. The reference voltage should be able to provide at least 20 μA.

Conclusion

When designing with these guidelines in mind, the power consumption of the A5191HRT and the external components required for its operation can be reduced to a maximum of around 250 μA, with a typical consumption of 220 μA.

Table 1.

Operating Condition	Operating Voltage	Current Consumption
Idle, External oscillator	2.8 V	220 μA (Typ)
Idle, External oscillator	3 V	240 μA (Typ)
Normal Operation	3 V	350 μA (Typ)
Absolute maximum current consumption	3 V	450 μA (Max)

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