AN337

CS5463: Determining No-load Condition Without Violating Starting Condition Standards

1. INTRODUCTION

When the CS5463 is used in power meter applications, some customers use the I_{RMS} residual value as the threshold for the external microprocessor to decide if the meter is under the no-load condition, and then find the meter can not pass the starting test. This applications note gives the reason and the correct solution.

2. NO-LOAD AND STARTING CONDITIONS

According to the standard IEC 62053-22, the definition of a no-load condition is defined as: *"When the voltage is applied with no current flowing in the current circuit, the test output of the meter shall not produce more than one pulse."*. The test of starting condition is defined as: *"The meter shall start and continue to register at 0.001In and unity power factor."*.

To meet these requirements, a power meter has to use the correct no-load threshold in order to restrain the pulse output and energy accumulation when there is no load current but resume pulse output and energy accumulation when the load is above the starting current (I_{st}).

3. DETERMINING A NO-LOAD CONDITION CORRECTLY

The CS5463 has three energy pulse outputs (E1, E2, and E3). The pulse outputs under no-load or starting condition has been well manipulated by the CS5463. In addition, the CS5463 has a no-load threshold register ($LOAD_{Min}$) to help disable the active energy pulse output under some specified condition. When the magnitude of the P_{Active} register is less than $LOAD_{Min}$, the active energy pulse output is disabled.

Different from the energy pulses, the energy register, either mechanical or electronic, is normally manipulated by a microcontroller. The microcontroller needs to use a variable and a threshold value to decide if the meter is under a no-load condition, in which case the values in the power registers should be discarded.

There are two options to select the variable and the threshold.

Variable Used	Threshold Value	Compare Result
I_{RMS}	Residual value (AC offset) with inputs of U_n and no current	BAD
P_{Active}	Less than the value with inputs of U_n and starting current	GOOD

Table 1: Variable & Threshold Values Comparison

Because I_{RMS} exhibits much more system noise than P_{Active}, I_{RMS} should not be used as a variable to determine the no-load condition.

For example, assume a 10(60)A Class 0.5 watt-hour meter using a 200 uΩ shunt as the current sensor. The voltage on the CS5463 I-channel input (IIN±) with the starting current (I_{st} = 0.1% I_b) will be 2 uV which is well below the I-channel noise level. Therefore, if I_{RMS} was used to decide the no-load condition, the meter will not pass the no-load and starting tests. Even though the meter has lower than 2 uV noise level and passes the no-load test, this application can not be used as a 5(60)A meter because the noise level is fixed within the application, however the starting current would be 50% lower.

In the next example, P_{Active} is used as the variable.

Assume the following:

- A 5(60)A Class 0.5 watt-hour meter, AC gain calibrated, with inputs of U_n and I_{max}
- P_{Active}_Imax = 0.36 (decimal register value, same below) with inputs of U_n and I_{max}
- P_{Active}_Ib = 0.03 with inputs of U_n and I_b
- P_{Active}_Starting = 0.00003 with inputs of U_n and starting current (Ist = 0.1% I_b)

Typically, the residual value in the P_{Active} register P_{Active}_Residual is less than 0.000002 (with 150 mVrms on VIN± and no signal on IIN±, HPFs enabled, N = 4000).

Because P_{Active}_Starting >> P_{Active}_Residual, the threshold can easily be selected between P_{Active}_Residual and P_{Active}_Starting (a threshold of 0.00001, for example) to allow the meter pass the no-load and starting tests.

Furthermore, if the meter is well designed and has very low system noise, the threshold can be set even lower (e.g. 0.000005) to allow much smaller starting current which is more welcomed by electric utilities. The meter current dynamic range (I_{max} / I_b) can also be extended.

Contacting Cirrus Logic Support

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