From:	Ralf Emberger (acam messelectronic GmbH)
To:	JShen
Cc:	"Jim Kunz"; "John Monteith"; Norbert Breyer
Subject:	Re: Spire Metering Action Item left over
Date:	Monday, September 30, 2013 10:56:53 PM

Hi John,

Well, basically you are asking two questions: 1.) do changes in transit time difference have any effects and if so, how to compensate for them and 2.) if a cycle jump can occur and what to do in this case.

My answers:
1.) Of course the transit time will vary with each direction, the difference should be about the same. The triggering of the zero-crossing is indeed of importance (because of the changing amplitude over temperature), this is why we have a close monitoring here (<1 mV offset) with GP22.

2.) The second phenomenon you are describing you indeed potentially had with GP21, because "windows" had to be managed manually (in the external uC). Again, in GP22 this is automatically handled by the so called "first hit detection". It takes care of tracking the correct window over these changes.

An additional note: you didn't ask this directly, but there may be changes on the spool-piece itself according to temperature changes, i.e. a mechanical change in length. This can also alter your "effective travel path" of the US wave and therefore potentially introduce a change. This is usually taken care off in the calibration process.

Hope this helps,
Best wishes,
Ralf

Am 25.09.2013 15:02, schrieb JShen:

> Hi Ralf,
> Thank you for the help.
> Other than sound speed compensation, what other temperature compensation we should do?
> In GP21, when temperature changes, the triggering point will change. As such, the measured transit time will change. Will this cause transit-time difference change as well? I l knew it will not in theory. However, when we are looking at a few percent error, this may cause the transit-time difference vary a few percent.
> More seriously, due to temperature change, sometimes GP21 will trigger to the next cycle. This will cause the result a big jump. Is this true?
>
> In GP22, will the cycle jump happen?
>
> Regards

John

From: Ralf Emberger (acam messelectronic GmbH) [mailto:r.emberger@acam.de]
Sent: Wednesday, September 25, 2013 3:27 AM
To: JShen
Cc: 'Jim Kunz'; 'John Monteith'
Subject: Re: Spire Metering Action Item left over

Hi John,

Good to hear from you. Yes, your assumption is correct. The temperature can be sensed by GP22, but the temperature compensation needs to be done in your (MCU's) firmware then.

Best wishes,
Ralf

Am 24.09.2013 23:52, schrieb JShen:

> Jim,
> Regarding the temperature compensation, could you please clarify that an external temperature compensation is required? In other words, we have to implement temperature compensation in our firmware, correct?
> Thanks
> John
>
> ---
>
> **From:** JShen [mailto:john.shen@spiremt.com]
> **Sent:** Thursday, September 05, 2013 12:04 PM
> **To:** 'Jim Kunz'
> **Cc:** 'John Monteith'; 'r.emberger@acam.de'
> **Subject:** RE: Spire Metering Action Item left over
>
> Jim,
> Very much appreciate the reply. We will consider your recommendations in our design
> Best regards
> John
>
> ---
>
> **From:** Jim Kunz [mailto:Jim_kunz@pmt-fl.com]
> **Sent:** Thursday, September 05, 2013 10:54 AM
> **To:** john.shen@spiremt.com
> **Cc:** 'John Monteith'; r.emberger@acam.de
> **Subject:** FW: Spire Metering Action Item left over
>
> Hello John,

I received back some comments from Ralf Emberger at ACAM that will hopefully answer some of the questions posed when we met you in July. Also we were wondering what the status is of Spire Metering designing with the ACAM device, and when you might be targeting a product for production?

Here the Q&A from my notes:

1. Quality of plastic spool-pieces?
Again, we are not the sensor experts, but from what we heard: the type of plastic is important, usually fiber-glass reinforced materials are used. Further, a crucial parameter is the thermal expansion coefficient for the material in question.

2. Aging effects -> reduction in amplitude -> error?
Spire asked for the consequences of amplitude reduction due to aging. The answer is, that the signal to noise ration (SNR) is getting worse by aging. The hit itself can be reliably be tracked thanks to the secure 1st hit detection. We don't have numbers how much worse the SNR gets, but we recommend to monitor "aging" by the pulse ratio and make own investigations.

3. Temperature compensation / changes in speed of sound
Spire asked how to do the compensation for the change of speed in sound in water over temperature. The answer is, that this is done externally to the GP22. The temperature is sensed with GP22 and then externally a correction is applied. For this, (publicly available) diagrams showing the dependency between the speed of sound in water over temperature can be used. I attach an Excel spreadsheet showing the dependency. The numbers were taken from the Internet (Wikipedia & Co.) and some Excel calculations were done, please use it as an indication.

4. Constant offset in Tup / Tdown
John explained a constant "offset" in the travel path of ToFUp and ToFDown and asked for its potential compensation. The simple answer is, that it doesn't matter with the time interval measurement, since we are doing ToFUp and ToFDown, calculating the difference levels it out (that was my answer on that day too). If he was referring to the fact, that via the sum of ToFUp and ToFDown some dependency to the temperature is given (and consequently it could be used to indirectly measure the temperature), the picture looks different: in calculating the sum of ToFUp and ToFDown this offset of course matters. Here the only

way that makes sense is to do some basic calibration (optimally in the linear part of the speed of sound curve), i.e. take the sum value at several temperature points.

Please feel free to comment back or ask further questions, we are here to support you and your staff!

Best Regards,

Jim

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Kind regards

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Available at http://keyserver.pgp.com and other public key servers

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Kind regards

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