Notes from the microsKanner Design Team

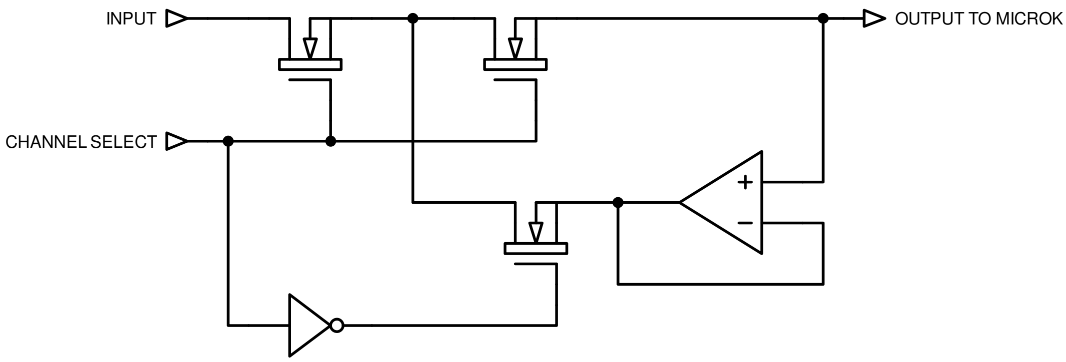
When the design team was first approached with a view to producing a multiplexer for the microK Thermometry Bridge, the brief was fairly ‘open’… “we just want it to be the best bridge multiplexer on the market” was the message we heard. As with all our projects, the design team went looking for ways to make the microsKanner different from its peers, not for the sake of being different but in order to give it a competitive edge. With this in mind and the request from the sales team to make this product “the best multiplexer around” we set our main design objectives to be:

- Performance – <u>zero</u> uncertainty contribution
- Flexibility – supports all sensor types (PRTs, thermocouples & thermistors)
- Features – individually programmable keep-warm currents for PRTs
- Ease of use – plug-and-play… new channels added by the microsKanner just appear in the existing operator interface on the microsKanner
- Input channels – up to 90 expansion channels
- Reliability – completely solid-state (no relays!)

Performance

A zero uncertainty contribution sounds a little ambitious, but that was our target. In order to achieve this we could not make the microsKanner simply a ‘switch’ box’ that connects a number of inputs into one channel of the microK Bridge. Instead we had to replicate the front end input system used on the microK bridge for every channel. Each microsKanner input therefore has its own signal routing switches, active guarding system and programmable keep-warm current source. Effectively when you connect to an input on the microsKanner, you are connecting to exactly the same electronics as you would be on the main microK Bridge.

Another challenge was the switching system. Whether you use mechanical switching devices (relays) or semiconductor devices (as we do), they all have a finite on-resistance and off-resistance/leakage. The semiconductors switches used on the main microK bridge contribute very little to the overall measurement uncertainty. However, if we were to connect a further 90 input channels, in parallel, to the input system then these leakage effects would become significant. We therefore decided to use a buffered switching arrangement in which each switched channel is connected through two switches in series. When that ‘channel’ if off, the mid-point is connected via a third switch to a buffered version of the output voltage so that the voltage across the switch connected to the microK has no voltage across it and there is therefore no effect from its high (but finite) off-resistance:



The approach to the switching of thermocouples was equally robust. The inputs on the microsKanner are reversed immediately behind the input terminals during the measurement sequence in order to eliminate the effect of thermal EMFs. This is exactly the same approach as is used in the main microK Bridge to eliminate thermal EMFs. When the microK detects that a microsKanner is connected, it automatically changes from making the channel reversal at its own input terminals and changes to making these reversal at the microsKanner input. This means that thermal EMFs in the analogue connections between the microK and microsKanner are eliminated from the measurement uncertainty.

The measurement uncertainty, whether for PRTs, thermocouples or thermistors is the same whether connected directly to the microK Bridge or via the microsKanner. This means you can achieve the full performance specification of your microK bridge even when you expand the input channels using a microsKanner.

The only ‘down-side’ to this approach is that fact that it requires more switching devices. In a simple ‘switch box, you would only need four switching devices per channel. In the microsKanner we use 14 switching devices for each channel. Thankfully they are surface-mount devices and so are very small!

When we tested the microsKanner, we were pleased to discover that we could not detect any change in readings when we inserted it between the thermometer (for a 25 ohm SPRT at 1mA) and the bridge even when we took long enough averages to achieve a measurement uncertainty (2σ) below 0.04ppm. Good enough for the task, we thought.

Ease of Use

Normally when you attach a multiplexer to an instrument, you then have the problem of how to control it. We wanted the microsKanner to be the easiest multiplexer available. In fact, all you need to do is to connect the microsKanner to your microK, which then automatically detects the microsKanner(s) (up to 9 may be connected to one microK) and the additional channels simply appear on the microK.

The expanded system is equally easy to use if you choose to control it from your PC. You simply connect your PC to the measurement system and request a measurement from the required channel, it then responds with a reading in exactly the same way as requests for readings from the microK’s three internal channels.

When you connect a number of microsKanners to a microK Bridge, the system automatically assigns channel numbers to the new inputs. An LED by each channel indicates which channel is being selected at any time to help you keep track of what it going on.

Final Thoughts

Like the original microK project, this has been an enjoyable project to work on, giving the design team the opportunity to develop some fun (and we hope useful) technology that sets the microsKanner apart from other multiplexers. We are, of course, very happy to hear what our customer think of our work so if you want to contact us with questions, comments or feedback, then please email us at microkteam@isotech.co.uk.

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