SERVICEMAN'S LOG

Un-bricking a Samsung smartphone

Remember the cartoon of the frog about to be swallowed by a stork? The frog is valiantly choking the bird with its front legs so it can't swallow and the accompanying caption was "never ever give up!". Well that's what it was like when it came to un-bricking the Samsung smartphone I fouled up on recently.

Items Covered This Month

- Un-bricking a Samsung Galaxy smartphone
- The iPhone that swam in Coca-Cola
- False-alarming security system
- Resurrecting an ancient Fender Champ guitar amplifier

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Regular readers will know that I've spent the last few months doing battle (off and on) with a "bricked" Samsung Galaxy smartphone (ie, a phone that had been rendered useless by a software update that went horribly wrong). And when I say "doing battle", that's exactly what I mean because numerous attempts at un-bricking what had become an expensive paperweight had left me with egg all over my face.

Of course, I really only had myself to blame. After all, I was the smart-alec who had bricked the phone in the first place!

Those with total recall will remember that my main challenge in resurrecting this unit was how to connect a programming box of tricks I'd purchased for the very purpose. Once I'd achieved that, I would then be able to flash enough data into the phone's ROM to get it to boot into a state I could do something with; or at least, that was the theory. In the vernacular of phone-geeks, I would be able to "un-brick" it.

The good news was that Samsung made provision for just such a connection. The bad news was that this-so-called "JTAG" point consisted of a series of DIL pads designed for a tiny 12-pin header connector, which was not included. With a pin pitch of just 0.4mm, each row of six pads covered just 2mm on the board, making it smaller than anything I'd ever worked on before.

In fact, I could barely even see the pads let alone connect wires to them. This is where my illuminated magnifying headset really came into its own; without something like this, working on such small components would be impossible.

In order to make the necessary connections, a friend and I had brainstormed the design of some programming adaptor jigs. He was going to turn them out on his laser-engraving machine. The problem was getting the laser fine-tuned enough to drill two rows of holes just 0.15mm in diameter but it turned out that the laser could do that standing on its head.

Our idea was to make a jig from some clear acetate sheet, shaped like a butterfly. Rows of holes in the centre of the jig would match the DIL pad pattern in the phone and I could then thread 0.13mm wires through these holes and run them off to larger pads spaced far enough apart in the "wings". I would then be able to easily solder heavier wires to these thin wires and run them to my JTAG programmer.

After that, it would simply be a matter of clamping the jig onto the pads and the wires would make the necessary contacts.

Well, it all sounded fine in theory but when the jigs arrived and I saw how tiny everything was, I began to have serious doubts. I had to try though so I stripped the insulation from some

…WITH THE AID OF MY MAGNIFYING HEADSET & A PAIR OF NEEDLEPOINT TWEEZERS

multi-core hobby wire and used the individual 0.13mm strands from that to thread my jig. It was all a bit fiddly but with the aid of my magnifying headset and a pair of needle-point tweezers, I soon had each row of six holes wired up.

However, I had to be careful not to pull the strands too tight for a couple of reasons. First, the wire was very fragile and easily broken and second, too much tension pulled the tiny jig out of shape.

When I finally had the jig wired, I tried to fit it onto the pads. But while I could position it correctly, it would immediately twist off to one side or the other each time I tried to clamp it.

After several abortive attempts, it quickly became obvious that this was just not going to work. The theory was good but in practice it just didn't work out.

At this point, I was so disappointed and frustrated that I was ready to chuck it in and put it down to experience. But the fact that others were doing this successfully to the same phone drove me to look once again at sourcing the headers the circuit board was designed for. If you recall, I had gone down this road before only to find that they were not available in New Zealand. And all the companies that sold them online wanted a minimum of $US30-50 to ship one to me.

You could fit 30 of these headers in a matchbox, so charging that much for shipping was just a rip-off. Most of these companies also had a minimum spend of $30 and given that the parts I wanted were just 89 cents apiece, I'd need to buy quite a few of them plus a lot of stuff I didn't really need just to reach that dollar value.

As a result, I emailed every vendor I could find advertising either these Molex or Panasonic headers and asked them to make an exception to their minimum order and/or minimum shipping costs. Not one of them would budge so I got nowhere and on principle, I will now never buy anything from any of them in my lifetime.

However, one company did at least apologise and advised me to contact an Auckland-based company that may be able help. I contacted them and to my delight discovered that they could supply the Panasonic male and female headers I needed and would only charge a few dollars for shipping. I would still need to spend at least NZ$30.00 but I considered this to be a reasonable compromise.

I purchased several of these male and female connectors in case I made a mess of things and while there, ordered some surface-mount solder compound. I have almost zero surface-mount soldering experience, other than tackling the odd suspect dry-joint, so the thought of soldering these connectors in place was giving me sleepless nights. I searched the web and read up all I could about the subject and figured that with the right soldering tools and this recommended soldering compound, I should be OK.

Cold feet

The package arrived a few days later and when I saw the headers in the flesh, I got cold feet again. They were even smaller than I had imagined. However, the flux compound had excellent instructions on how to use it so I told myself I could do it and set about getting everything prepared.

First, I cleaned the circuit board and pads with isopropyl alcohol and applied a microscopic amount of the flux, which comes in a syringe, onto each pad (or as close as I could get to them). I then orientated and placed the header connector using a pair of tweezers, pressing it as tightly as I could onto the pads. After then nudging it into place with the tweezers, I took a deep breath, cleaned and tinned my smallest soldering-tip and touched the corner pin. Solder instantly flowed into and welded nearby pins to their pads underneath. I could scarcely believe it.

A few touches of the soldering iron tip to the remaining pins had the header soldered beautifully. I checked out my work with my high-magnification jeweller's loupe and it looked perfect, with no bridges or dodgy-looking joints. I readily admit that it had nothing to do with any great skill on my part; it was all due to that solder flux.

It certainly cured my previous reluctance to work with surface mount technology on future projects.

But having the header connected to the board was only a third of the battle won. I still had the problem of connecting my JTAG programmer to it. I would have to use the matching female header for that and that would have to be soldered to a board of some kind which would then connect to the programmer.

During my internet travels I remembered a guy who had built his own expansion boards and I figured I'd have to make something similar. The board I'd need would look like a spider, with the pads for the header being the body of the spider and "legs" leading from each pad to larger solder pads for heavier-gauge expansion wires.

I've made hundreds of boards before but nothing on this minute scale. I doubted that my laser printer could even print a 0.125mm line and even if it could, there was the question of whether my basic photo-etching set-up would be capable of producing the board. There was only one way to find out and that was to try.

I use DipTrace to draw schematics and design circuit boards. I fired it up, found the pads to suit in the software's pattern library and set about designing the board. It all looked easy as I zoomed the pattern size up on my 24-inch widescreen monitor.

Once I had the DIL pattern in place, I created 12 normally-sized pads to solder the programmer's wires to and ran the various traces between. However, when I shrank it down to normal size, it just looked like a blob in the middle of my screen with no discernible features. However, I went ahead and printed it out actual size and it actually looked great, with clearly-defined traces, pads and holes. At least the printer was up to the job!

I then printed it out on the clear acetate sheet I usually use for making PCBs and it too looked good. I use Kinsten-brand materials for making all my circuit boards so I found a tiny off-cut, lined up the acetate and exposed it in my lightbox. I then developed it carefully using a weaker-than-usual solution of developer and etched it in my tank.

The resulting board measured just 9 x 10mm and it looked perfect. Nevertheless, I used a multimeter to check that each header pad connected to its corresponding expansion pad and that there were no bridges between the pads.

That done, I carefully soldered the female header onto my expansion board, using the same technique described above, and this too was successful. I then soldered the programmer's leads to the relevant expansion pads.

Re-flashing the phone

It took a little prodding with a needle file to get the adaptor board to fit the new JTAG header but it soon clicked home. And with that, I was finally ready to try my first dead-phone resurrection.

I connected the programmer to my computer, plugged in the expansion board connector and connected that to the phone. After loading the software and ensuring the correct files were loaded, I held my breath and hit the button. The information window gave me a running commentary of what was going on but before I had even finished reading the entries, the process was completed.

It had all been unbelievably quick but each separate process was followed by "success" and at the end it said everything had been done so who was I to argue!

I wasn't out of the woods yet though; I still had the last phase of the process to go. What I had done so far was to flash the basic boot ROM to the phone, allowing it to be placed in the "download" mode. This would now enable me to re-load the original operating system and applications.

Basically, a "soft-bricked" phone will not boot but will it still go into download mode. My phone had previously been "hard-bricked" because it would neither boot nor go into download mode. So now came the acid test.

I went through the download mode procedure and lo and behold, the little yellow Android man appeared on the screen, indicating that the phone was ready for flashing. However, my sense of accomplishment was tempered by the fact that I still had to install the operating system and various applications and the phone had been bricked during a legitimate software update in the first place.

My next problem was getting my computer to recognise the phone. This had been an issue when I had originally tried connecting it to my computer, which is why it probably ended up bricked in the first place.

At that time, I eventually found some drivers that worked but now no matter what I did, I still ended up with the dreaded "Unknown Device" entry in the Windows Device Manager. So until I could get the computer to correctly recognise the phone, I couldn't complete the ROM flashing process.

I tried every possible driver and even different computers with other versions of Windows but all to no avail. The gurus on the online technical forums had no ideas either and I was quickly becoming more than a little frustrated. It seemed as if I'd wasted all this time and money only to fall at the last fence.

The general online consensus was that because the phone was bricked, the original driver couldn't recognise it. Some experts suggested that I try the Android developer drivers which are generic and should get most devices to be at least "seen" by Windows so I downloaded and tried them. However, it was still "no go".

Eventually, out of desperation and with no other ideas, I thought I'd try another USB cable. The one I had been using was the one that came with the phone and I'd discovered from working with other phones that even though cables may look the same, they are not always interchangeable.

Changing the cable really was clutching at straws and I would have bet my next pay cheque that it wouldn't make any difference, so you can imagine my surprise when the computer informed me that the driver had been successfully installed! I quickly started my flashing software and received confirmation that COM5 – the port used to communicate with the phone – was now open and waiting.

With one mouse click, the new system software began uploading to the phone, with the phone then rebooting in less than 60 seconds. And up came the familiar boot screen and sounds. Success!

So my persistence paid off in the end but what a battle. The cable swap made absolutely no sense but no matter; stranger things have happened when it comes to servicing. In fact, I have now gone back to using the original cable and everything works as it should.

It just goes to show that when you've exhausted all other possible options, it's often worth trying something outside the square, no matter how unlikely the chances of success.

In the end, the experience proved invaluable and I gained some necessary skills to tackle this sort of problem. What's more, as word got out that I'd successfully resurrected my phone, various servicing jobs involving phones and tablet computers began to trickle in.

It's all a result of my original plan to diversify my business, so un-bricking my phone was well worth the effort!

Fixing an iPhone 4

How many mobile phones have come to a premature end because they took a bath? A. P. of Toowoomba, Qld recently resurrected an iPhone 4 that went swimming in Coca-Cola. Here's what happened . . .

This story began when my friend Sally called to tell me that her iPhone 4 had met with an accident. Apparently, she had put an almost-full bottle of Coke Zero into her bag, along with her iPhone. Unfortunately, the lid of the Coke bottle wasn't properly screwed on and the contents leaked out.

But that wasn't the end of her misfortune. The bag was watertight, so the iPhone took a real dunking. Sally didn't notice the problem for several minutes and when she finally fished the phone out, it had shut down and wouldn't come back on.

Sally couldn't bring me the phone for a few days. So was there anything she should do in the meantime, to prevent further damage?

The advice in several online forums to recover a mobile phone that has been immersed in water is pretty straightforward. This involves removing the battery and placing the phone in a jar of uncooked rice for an extended period of time, so that the rice absorbs the moisture evaporating slowly out of the unit. That's probably good advice for a phone that's been immersed in clean, fresh water but soft drink is going to leave a sticky residue that will lead to corrosion.

I toyed briefly with the idea of asking Sally to immerse her phone in fresh water, to wash out the Coke, but quickly rejected it on the grounds that the battery was still connected. I also had no idea how much Coke had made its way into the phone and immersing it in water could do more damage. So the phone went into some rice for three days before coming into my hands.

I resisted the temptation to turn the phone on because that could have caused further problems. Instead, I paid a visit to the **iFixit.com** website where I knew I could find comprehensive guides to replacing any part of an iPhone 4. My plan was to dismantle the phone and clean out any liquid or residue that I found.

I had previously purchased a replacement iPhone 4 part on eBay and this came with a set of tools necessary for working on the phone. These tools were a pentalobe screwdriver for removing the two pentalobe screws that hold the back on, a size 00 Phillips screwdriver for the remaining multitude of tiny screws in the device, a small flat screwdriver for removing a single stand-off that didn't have a Phillips head, and a plastic "spudger" for prying off the thin steel covers over various parts, as well as prying off the many flat ribbon connectors.

I supplemented these tools with some tweezers, a magnifier, two empty egg cartons which served as screw trays, a steady hand and infinite patience.

Before commencing the disassembly, I peered into the headphone socket of the phone with the help of a LED torch and saw that the semicircular liquid contact indicator at the end of the headphone socket had turned pink. This meant, at the very least, that liquid had made its way into the headphone socket.

I followed the instructions on iFixit for replacing the display, because this results in the phone being almost completely stripped down. I began by removing the pentalobe screws from either side of the dock connector. The back could then be slid up by a few millimetres and lifted free.

The first thing I noticed inside the phone was that the two internal liquid contact indicators had also turned from white to pink. I could also see that there was still some moisture adhering to the inside of the back, the battery and the steel shields on the logic board. Later, when I had the front panel off, I could see that there was moisture between the back of the display and the chassis.

In this model, the display is glued to the front panel and cannot be removed without being damaged, so that was as far as I was able to go.

My next step was to carefully examine the logic board but it seemed to have been untouched by the liquid. This was good news as it is quite expensive to replace. Sure, most of it is covered by metal shields but I couldn't see any evidence of moisture near the edges of these shields. I was afraid that removing the lids from the shields might damage them, so I left them alone.

Having dried up the remaining

moisture during the disassembly and not having seen any signs of corrosion or staining near any conductors, I now carefully reassembled the phone. The instructions on iFixit make it clear that grease from one's fingers on any of the mating shiny metal surfaces can compromise either the shielding or the operation of the WiFi antenna (which doubles as a retainer for the flat cable connectors on the logic board). As a result, I diligently swabbed all shiny metal mating surfaces with alcohol to eliminate the possibility of contamination with finger grease.

With the phone back in one piece, the moment of truth had arrived. I pressed the power button and . . . nothing happened! Maybe the battery was flat? I connected a charger to the phone and waited but still nothing happened.

Sally particularly wanted me to rescue the photos and videos from the phone, so as a last-ditch effort I connected the phone to the USB port of a computer to see if it would at least let me access the phone's file system.

And this time it worked – the display came on showing the warning icon for a very flat battery. And then, several minutes later, the phone started up normally and appeared to be fully functioning, in the process receiving a backlog of texts and notifications.

I tested the cameras, the vibrator, the WiFi, the volume buttons, the home button, the speakers and the microphones, and they all worked fine. I even managed to copy all the photos and videos off the phone through the USB connection to the computer. The only aspect of the phone that wasn't 100% was the display, which had some brown staining near the bottom.

Next, I tested the Sleep On/Off switch by briefly pressing it. The display immediately went dark and nothing I could do would bring it back. I then tried connecting the phone to the charger again for a few hours but nothing happened. I connected the phone to the computer again and again it came good. And then, a few hours after that, it died again and nothing would bring it back.

Disappointed at this turn of events, I then began to consider some possible causes for these symptoms. Apart from the possibility of a logic board problem, it seemed logical to assume that the Sleep On/Off switch might have become intermittent, due to its contacts having been contaminated by the liquid. I was also concerned about the dock connector, as I couldn't see into it well enough to confirm that its gold contact fingers were clean.

As a result, I decided to replace both these parts and so I bought a "Power/Sleep On/Off Switch Button/Proximity Light Sensor Flex Cable Part" and a "Dock/Home Connector Charging Flex Cable with Microphone". These parts cost about $19 from an eBay seller.

Replacement of the dock connector went smoothly but not so for Sleep On/Off switch. Its replacement required removal of the headphone socket and some flat cables and I somehow tore the cable running to the headphone socket. I therefore had to order and replace the "Headphone Audio Jack Volume Mute/Silent Switch Button Flex Cable", which cost $14.

While waiting for the replacement headphone jack assembly to arrive, I took a closer look at the logic board and found something that I had missed earlier – a small spot of residue and corrosion on a couple of pads near the entrance to the SIM card socket. I speculated that because these pads were fully exposed, not soldered and close to the opening for the SIM card drawer, they might be part of an electronic arrangement designed to shut the phone down when exposed to liquid.

I swabbed the residue and corrosion away with a cotton bud dipped in alcohol. One of the pads and its connecting trace were still somewhat discoloured after this procedure and I crossed my fingers that there was no permanent damage.

Almost all the rest of the logic board was enclosed by four shiny steel shields. Now that I had found evidence of this board getting wet near the SIM card socket, it was obvious that I would have to remove the lids from these shields, to see if any liquid might have found its way inside them. Unfortunately, the lid on one shield seemed to be welded around half its edge, preventing its removal, but the lids on the other three were held in place entirely by spring tension.

I gently prised these lids off and found some powdery-looking residue between a resistor and an inductor under one of them. This was also swabbed away with alcohol.

When the replacement headphone jack assembly arrived, I installed it and reassembled the rest of the phone. Holding my breath and crossing my fingers, I pressed the power button at the top of the phone. This time, the phone came on normally, without the help of a charger or computer USB port, and the battery showed a 68% charge. I then re-tested the various facilities and all seemed to be working.

My elation was to be short-lived. At the end of these tests, I put the phone on charge to completely recharge the battery. And once it reached 100%, the phone shut down and wouldn't turn on again.

I vowed that I wasn't going to let this thing beat me – at least, not yet. I removed the back, disconnected the battery and put the phone to one side while I figured out my next step.

In the end, I decided to do something that I should have done at the very beginning – fully immerse the logic board in clean water to wash away any hidden Coke residue. I followed the 19 iFixit steps to remove the logic board, then prised off the three removable shields. That done, I thoroughly swished the board in filtered rainwater and wiped every exposed square millimetre with a cotton bud, with the aim of encouraging any Coke residue to dissolve.

I then shook the board until no more drops would come out and dried it superficially with a tissue. It was then put aside overnight and the next day, I sat it on a sunny window-sill for a few hours to let it dry thoroughly.

Finally, I reinstalled the logic board in the phone and this time everything really was back to normal. It now worked without shutting down but what a saga.

So what would I do differently next time? Rushing to replace the power switch and the dock connector now seems wrong in hindsight. Having read stories about iPhones that have survived after being dropped into swimming pools or salt water, or been washed with laundry detergent in a washing machine, I would now be less squeamish about washing the whole thing with fresh water and then just letting it dry out.

I suspect that Apple has incorporated circuitry to reduce battery current to almost zero if liquid is detected, so these scenarios are not as dire as they may seem. My preferred action would be to remove the battery, speaker, vibrator and cameras and wash the remaining parts in fresh water. I would then use gentle heat to speed the drying process, remembering that there could also be water trapped in the tiny spaces under those large chips which would have to evaporate out.

False-alarming security system

Security systems that routinely false-alarm can be a real pain in the neck. Here's how G. C. of Tawa, NZ solved one particularly persistent false-alarm problem . . .

I look after an elderly but still serviceable security system protecting a museum site's workshop and vehicle storage areas. Over the years (and even prior to my involvement), this system generated so many false alarms that an alarm activation call in the middle of the night would usually be ignored until the next day – that is, until I took over.

This was not good. If there had been a genuine break-in (and there was at least one attempt to my knowledge), then the alarm may have gone unanswered.

When I took over the system, I became the unfortunate person who was first on the call-out list. As a result, the security monitoring staff would telephone me at all hours of the night, advising that the alarm had gone off. This was a real problem in the early hours of the morning because my wife was woken as well. So my scarce "brownie points" were being used up fast!

This particular security system uses a number of motion detectors to protect areas inside "rough" buildings with unlined walls. All the zone detection circuits on the control unit are used, with multiple motion detectors wired to each one. As a result, it was difficult to determine which individual detector had activated to cause a false alarm, although it was possible to determine which zone had activated.

I tried all sorts of things to eliminate the false alarms, including a battery-backed regulated power supply to supply the motion detectors, as it was noticed that some false alarms occurred during mains power supply outages. However, that didn't stop the false alarms.

Next, I fitted wooden shades to keep the light from the roof skylights away from the detectors. This certainly helped reduce the false alarms as the light changed but they weren't eliminated altogether.

Two of the detectors connected to zones which were subject to false alarms were combined microwave/PIR types and I suspected that these were the main culprits. The microwave detection part was very sensitive to movement but the PIR detector was difficult to trigger except when a human was standing in direct view of the unit. So what could be causing these units to false trigger at night?

Eventually, I decided that the only way to solve the problem was to determine which individual detector of a multiple set had triggered. The wiring to these motion detectors was run using standard 6-core security cable, providing the power supply (two wires), the "end-of-line" resistor detection circuit back to the control panel (two wires) and a common "end-of-line" resistor "tamper" circuit (1-2 wires).

In the end, I determined that a

Resurrecting An Ancient Fender Champ Amplifier

R. D. of Lara, Victoria, recently resurrected an ancient Fender guitar amplifier with valves. Here's how he tells it . . .

The Fender Champ guitar amplifier (introduced in 1948) used just one valve in the output stage, arranged in a single-ended class-A configuration (about 5W). I had one come in recently, the owner complaining that "it smells", which makes a nice change from "it blows fuses".

This one was a Silver-Faced Champ with the AA764 circuit and I started to get a bit nostalgic. This amplifier was around when Jimi Hendrix was strutting his stuff.

After removing the amplifier from its case and setting it up on the bench, the problem was immediately obvious. The screen grid resistor was a charred mess, completely unrecognisable from its original state, and the smell was really quite bad.

My first thought was that maybe the output valve, a 6V6GT, was dead. But first I replaced the screen grid resistor which, according to the circuit schematic was a 1kΩ 1W unit. I replaced it with a 5W resistor and then powered the unit up to test it, as I would now have to order in a new valve if this was faulty. It still didn't work, with no output from the amplifier whatsoever.

As a result, I began checking the circuit voltages and found that the screen grid resistor I had just replaced had around 300V across it! In normal operation, this should be just a few volts. This meant that the output valve was definitely dead, the screen grid having developed a short.

I left it alone for a few days until the new valve arrived. This was then installed and I powered the amplifier up again but it still didn't work. The voltage across the screen grid resistor was still quite high, though not as high as before, which meant that there had to be another fault lurking somewhere.

Well, the answer became apparent only after I had disconnected all the leads from the tag strip that held the screen grid resistor and I checked the resistor itself. It measured close to 1MΩ instead of 1kΩ and I could only put this down to the fact that I had initially tested the amplifier with the dodgy valve still in place. As a result, the output stage drew so much current that the new 1kΩ screen grid resistor had gone high resistance, although it still looked perfectly OK and there was no discolouration.

Replacing this resistor yet again fixed the problem and the amplifier sprang back into life.

With modern day valve amplifiers, this situation would not have arisen because the high-voltage (HT) rail is fuse-protected. So, as a safeguard against further failure, I fitted a fuse between the HT rail and the anode of the 6V6 valve. That way, if the valve fails in the future, the amplifier will just die in a very uneventful way instead of also burning the screen grid resistor to death – although I'm sure the ghost of Jimi Hendrix would prefer the latter.

simple transistor latch circuit with a local indicating LED could easily be installed inside each motion detector's case and powered from the detector's 12V power supply circuit. When the NC (normally-closed) relay contact in the detector opened, this could trigger the LED indicator circuit and provided this circuit had a high enough impedance, the alarm system would function normally.

The real difficulty was figuring out how to stop these LED indicators from latching during the day when the building was occupied. I certainly didn't want to have to install any more cabling to do this, as the building runs were quite extensive.

The solution was to reset each latched LED circuit by using a connection to the tamper circuit. The idea was to detect the change in voltage when the tamper circuit was open-circuited at the control unit. Provided this reset connection was of high enough impedance, then all the installed LED indicators could be wired in parallel across the tamper circuit.

A wiring trial indicated that this arrangement would work well. All I had to do now was figure out how to disable this reset circuit late every afternoon, when the security control unit was armed for the night.

In the end, the solution was relatively simple. In this system, a security flap is used to hide the separately located keypad panel near the entrance from prying eyes. The site protocol was that this flap had to be locked "closed" after the control unit was disarmed at the start of each day. It was then opened at night to arm the unit.

As a result, I simply extended the tamper circuit to the keypad panel and used a microswitch to detect when the flap was closed. This scheme effectively prevented all the indicating LED circuits from latching on during normal building-occupied operation while allowing them to work at night when the flap was open. With that in place, I was set to determine which motion detector on a particular zone circuit had triggered a false alarm.

After a few late night-time trips to the site after false alarms, a pattern soon became evident in regard to the environmental conditions prevalent at these times. In particular, one PIR sensor that was prone to false triggering was located at the southern end of the building, which is exposed to very cold winds, especially during winter.

Finally, the reason for the false triggerings became clear – a PIR detector is sensitive to fast moving air with sharp temperature gradients in its area of surveillance. And when the cold wind blew strongly enough through the rather large cracks between the large entrance door and the door posts, the sudden temperature changes due to air movement were sufficient to trigger the detector.

The cure was simple – I blocked off the door cracks with timber and the false alarms ceased. It was much the same story for the other motion detectors that were causing false alarms.

So that solved the false alarm problems – at least during winter. Now all I have to do is figure out how to keep birds out of the building during the spring nesting period. If I can do that, there should be no more false alarms to disturb my sleep. **SC**