The rise and rise of ELV traffic systems

Keith Manston of Traffic Solutions, Siemens Mobility, says that for the first time traffic managers are able to consider implementing a total ELV policy for all new sites, both intersection and pedestrian, and predicts that soon the numbers of new ELV installations will outstrip the more traditional LV ones

The launch of the ST900 ELV intersection controller at Traffex 2007 has been viewed by many as a pivotal moment in the development of traffic control infrastructure within the UK. For the first time a controller and its associated street furniture offered the potential for traffic engineers to realistically enhance the electrical safety of installations, by employing only Extra Low Voltages 'on the street', whilst also offering reduced installation costs and significant carbon footprint reductions.

For Siemens, the introduction was the result of an extensive research and development program that started over two years earlier, involving engineers from both the UK and Germany. Initially the aim was simply to undertake a relatively minor update to the very successful ST800 controller; 'just' changing the lamp supply voltage to 48V, but retaining much of the same hardware. The hope was that this would be sufficient to deliver the improved safety inherent in ELV systems, as well as enabling much lower power LED signals to be employed.

But detailed analysis soon demonstrated that continuing to use conventional designs for switching and monitoring of the signals was far from ideal. Although the new controller was to be specifically designed to interface to new, very low power LED heads, the reduction of the lamp supply voltage to 48V would mean that switching currents in the street cables would remain largely the same as that experienced with traditional HI signals, hence cable volt drops would be a real concern. Any unnecessary further volt drops within the controller switching elements would just exacerbate the problem, leading to severe restrictions on the length of cable runs that could be reliably accommodated by the system.

Another concern soon materialised. The new ELV system was to be used with low power LED signals consuming only about four watts in the dim state, but it was forecast that during the life of the controller, LED signal powers would continue to fall. Four watts could easily become two or even one watt in the next few years and at this power level the traditional electronic switches used in most existing controllers would cease to function properly.

So a completely new concept was needed, resulting in a revolutionary design, employing a fully rectified 'DC' lamp supply.

This allowed the design of the lamp switches to be implemented using highly efficient FET devices, rather than traditional triacs. These 'DC' only switches are able to reliably control much lower currents than is possible with triacs, hence ensuring that future 'ultra low power' LED signals will be able to be supported by the controller.

Critically the use of FET switches also reduces the volt drops within the controller by a factor of up to 10 times compared with the old fashioned triac switch, which in effect extends, by over 80m, the cable lengths that can be supported by the controller. A further benefit is that power wastage and unnecessary heating in the controller is also significantly reduced.

But concerns remained that potential cable length limitations could still prevent many larger sites from being reliably served by the new ELV design. The problem lies in the nature of modern LED traffic signals. The light output of traditional incandescent signals varies with the applied voltage, so as the voltage drops they get dimmer, but gradually, with no defined steps. On the other hand, LED signals are designed to maintain their light output at a constant level, whatever the input voltage, but then to switch instantaneously to a lower light output level if the voltage is reduced significantly, as is the case when night time dimming occurs.

As is demonstrated in the Figure 2, if the voltage to the signals falls too much, as might happen at times of low mains supply and there are significant losses in the controller or cable, some or all of the signals

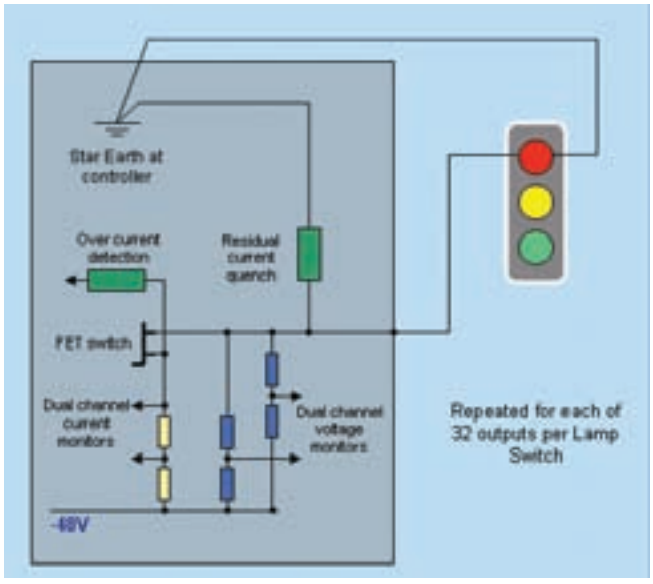


Figure 1: ELV drive and monitor schematic

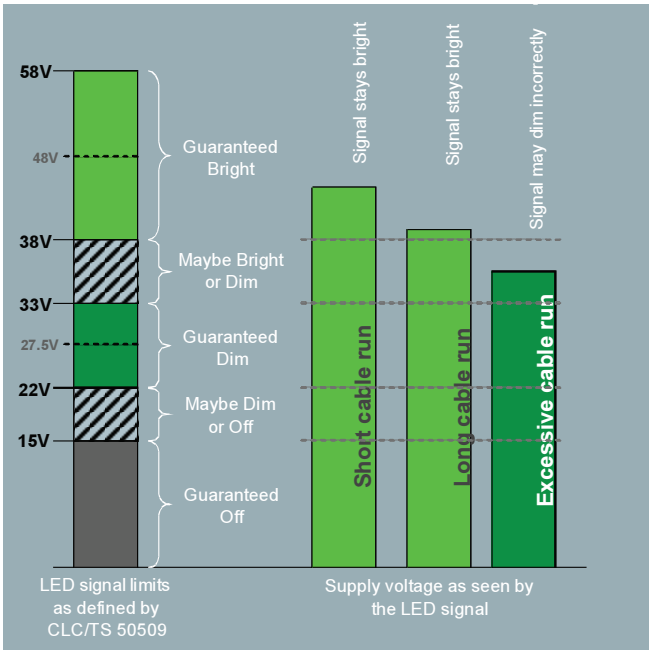


Figure 2: Effects of excessive volt drop

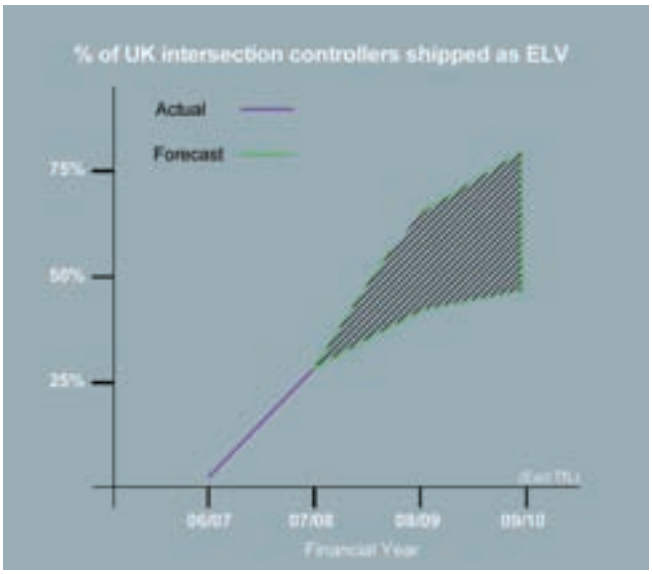
might go to dim when they should still be bright!

Fortunately the authors of a new LED Signal Technical Specification CLC/TS 50509 had already foreseen this problem and proposed a lowering of the standard dimming voltage for ELV systems to just 57% of the bright supply, compared to 66% for normal LV systems.

This simple solution allows more voltage to be lost before the signals begin to experience false dimming. By implementing this specification the ST900 ELV controller is able to support signal heads as far as 250m away from the controller without the risk of false dimming occurring.

The result of all this careful research and innovative design has been that the ST900 ELV system has now found favour with many local authorities and is the leading ELV solution available today. Indeed, in its first full year, the growth of ELV installations on street has exceeded expectations, with the ST900 ELV making up about 25% of intersection controllers supplied by Siemens within the UK.

Figure 3: Growth of ELV systems



It seems certain that this growth will continue, but right from the outset questions were being raised by potential users who were not just looking for ELV intersection controllers, but were also requesting solutions for pedestrian applications. Although the ST900 ELV can be configured to provide stand alone pedestrian facilities, its basic design, focused as it is on delivering a fully flexible solution for intersections, may be considered by some as rather expensive when compared to more traditional 'pedestrian only' controllers.

Obviously a new ELV pedestrian controller was needed, but the challenges in achieving this within a reasonable timeframe were considerable:

- **Price pressure in the stand-alone pedestrian market**. As already mention the price level of pedestrian controllers is lower than that of intersection controllers, so any new design would need to recognise this fact. This recognition had to extend beyond just the actual cost of the controller itself and embrace the overall cost of development as well. A high development cost puts an additional burden on the final price, as the development expenditure has to be recovered. If a way could be found to develop a brand new controller, with lower R&D expenditure, the overall price to the end customer could also be contained.

- **Continue to offer all the benefits** of the ST900 ELV. The success of the ST900 ELV has been in no small part due to the features and benefits it offers, including:
  - Total ELV implementation offering enhanced safety over traditional LV pedestrian solutions.
  - Reduced power consumption and support for even lower low power LED signals in the future.
  - Fully integrated lamp monitoring of both ELV LED traffic signals as well as associated Nearside signals.
  - Sort circuit protection of all phase outputs to minimise downtime in the event of street cabling faults.

Maintaining these was seen as an essential ingredient of a winning formula for a new pedestrian controller.

- **Continued support for LV solutions**. Although the focus here is on ELV solutions, it was recognised at an early stage that ongoing support for LV pedestrian solutions must be maintained. Not all customers are yet willing to switch to ELV and even those who are may be constrained by budgets, so that it is only possible to change out controllers in some cases, retaining existing street furniture where it is still serviceable.

To solve these key challenges has meant the introduction of a family of controllers, adapted specifically for both LV and ELV pedestrian control. In common with the now well established ST900 family, which embraces both LV and ELV traffic controller solutions, the ST750 family also offers both LV and ELV solutions, but optimised for pedestrian control. And the naming of the controllers also follows the familiar ST900 theme.

The ST750 is basically an LV controller, designed to switch incandescent and standard CLS LED-based signal heads. Being heavily derived from the successful ST700 it also retains its ability to directly drive ELV nearside equipment, making it a particularly efficient solution for standard pedestrian crossings.

The ST750 ELV on the other hand, owes much of its design to the ST900 ELV but in a way that has been optimised for pedestrian control. This has allowed all the identified challenges to be met in an elegant way.

The development costs have been minimised by the re-use of many ST900 components ensuring that all the key features of the ST900 to be retained as well as helping to reduce spares holdings within service organisations.

With both controllers now in full production, traffic managers are, for the first time able to fully consider implementing a total ELV policy for all new sites, both intersection and pedestrian. It seems certain that the rise and rise of ELV traffic systems will continue apace, with the numbers of new ELV installations soon outstripping the more traditional LV ones.