In collaboration with Main Roads Western Australia

2010 WA ENGINEERING EXCELLENCE AWARDS

“MetroCount 5712 Timing Analysis Roadside Unit For Signalised Intersections and Railway Crossings”

(Categories: “Innovation & Development” and “Small Company Projects”)

“Measure the hazards; know the risks”
“Microcom (MetroCount) is an outstanding engineering company – not in the usual Western Australian areas of big civil projects, but in innovative and brilliant engineering software”.

Mr Bob Peters, Manager Road Asset Planning, Main Roads Western Australia

“This new system provides the traffic engineer with valuable intersection performance indicators which allows rapid assessment of any strategies or remedial work, before and after – without having to accumulate future accident statistics”.

Mr Doug Morgan MIEAust, Director Heavy Vehicle Operations, Main Roads Western Australia

“As far as I am aware we are the only Police Force in the UK currently able to gather factual evidence of red-light running, which although it is quite pleasing for us to be at the forefront of this type of survey work, it is also a position that I hope will change. As you are undoubtedly aware, although the number of risk-takers at traffic lights are thankfully few, it only takes one to cause a death. I believe Metrocount have provided the means to respond to anecdotal evidence of red-light running and substantiate, with factual evidence, the degree of non-compliance at our signal-controlled junctions.”

Mr Derek Young, Manager Traffic Data Unit, West Midlands Police, UK

The South Australian Centre for Automotive Safety Research conducted a recent study (2005) to evaluate the costs associated with road crashes in that state. They reported that all crashes cost the state of South Australia A$1,175,924,453 every year, with a single road fatality at A$1,747,522 (see Appendix).
At MetroCount, we:

- Work in a professional manner and conduct our business with integrity, honesty and fairness, with respect for the interests of those with whom we are doing business.
- Ensure our products and services are of the highest quality and meet our clients’ needs.
- Provide a harmonious and flexible work environment in which all individuals are treated with respect and dignity.
- Create a professional atmosphere that promotes business-like relationships and equal employment opportunities and which prohibits discriminatory practices, including harassment.
- Establish workplace relationships that value communication, consultation, cooperation and a willingness to work together at all levels.
- Demonstrate a commitment to research and development and promote technology in all aspects of our business.
- Focus on being profitable, without compromising our commitment to our people, our clients and the environment.
- Exercise leadership by empowering people to reach their full potential.
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Main Roads Western Australia, Mr Bob Peters, Manager Road Asset Planning
Road Infrastructure Traffic Management, Mr Geoffrey Miller and Mr Peter Pennisi

Technical Documents
MetroCount 5712 Timing Analysis Roadside Unit flyer
MC5712 Timing Analysis RSU
MC571X Installation for Traffic Signal Analysis

External Reports
The economic cost and impact of the road toll on South Australia, Centre for Automotive Safety Research
Executive Summary

As a community we are acutely aware of the social cost of vehicle crashes at signalised traffic intersections and railway crossings. This unique and world-first project from MetroCount provides traffic engineers and police authorities with a new way to analyse, predict and perhaps reduce intersection crashes. As the product establishes globally, it is hoped that this new data source and analysis will become a standard for traffic engineering.

The MetroCount® 5712 Timing Analysis Roadside Unit was developed in response to a query from Main Roads WA, seeking to combine vehicle movement recording and analysis with the phases of a traffic control signal. To achieve this, MetroCount engineers researched ways of incorporating both traffic signal timing information and traffic flow data as recorded by an especially designed microprocessor-based data logger.

The MC5712 is quickly and easily installed at traffic intersections and level crossings. It records vehicle movement information on one channel and signal timings on the other, 24 hours a day, for as long as required. Using purpose-built software incorporating MetroCount’s unique “Phase Map”, the traffic data can then be portrayed as statistical summaries, graphs and charts, each containing thousands of vehicle records. Traffic engineers can modify intersections and crossings to make them safer, more efficient and measure treatment effectiveness.

Microcom Pty Ltd trades as MetroCount and is a WA company. For the past 20 years it has focussed on developing and manufacturing equipment and software for monitoring and characterising vehicle flow and driver behaviour. The company has received three “Western Australian Exporter of the Year Awards” (2004, 2005 and 2007) and a Special Commendation in 2008.

This project demonstrates excellence in engineering in almost all criteria of this Award. The following attributes are its highlights:

- The MC5712 is unique and has global application. Accordingly, it has considerable economic and social potential for the community and as an export earner.
- This world-first product facilitates better traffic flow and has the potential to reduce intersection and crossing collisions.
- MetroCount has a long and proven history of traffic measurement engineering, and utilised these specialised skills for this project.
- The product provides a solution to an international problem for which there exists no other similar solution. Accordingly it could be expected to be a benchmark of Australian Engineering for hardware, firmware and software.
- It was designed for a purpose and precisely serves that purpose.

Moreover, the testimonials herein clearly demonstrate the efficacy of the solution, and endorse MetroCount’s technical prowess (refer Appendix).
Categorisation Statements

Innovation & Development

The MetroCount 5712 Timing Analysis Roadside Unit is the culmination of ideas and concepts developed by MetroCount’s small engineering team in collaboration with Main Roads WA, who identified the need for this project and new technology, as existing technology was not available.

Resulting from this collaboration, this unique, advanced technology was developed after extensive review of the company’s existing engineering knowledge and then the formulation of a new and novel approach. At every stage, from conception to prototyping then final production, MetroCount’s engineers have applied their skill to test, analyse and develop the system.

Small Company Projects

MetroCount employs three engineers; therefore this project is eligible for the “Small Company Projects” category. The project was developed by MetroCount’s Chief Engineer, Mr Graham Foden.

The Engineers involved, in order of contribution, were:

<table>
<thead>
<tr>
<th>Mr Graham Foden</th>
<th>Mr Glenn Crafton</th>
<th>Mr Mike Kenny</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE MIEEE MITE</td>
<td>BE MIEEE</td>
<td>BE MIEAust CPEng MIEEE MITE</td>
</tr>
<tr>
<td>Chief Engineer</td>
<td>Engineer</td>
<td>Managing Director / CEO</td>
</tr>
</tbody>
</table>

Although a small company, MetroCount now exports to over 85 countries around the globe, and in recognition of this has been awarded Four Western Australian Exporter of the Year awards.
Detailed Submission
1. Attention to occupational health and safety

The installation of the MC5712 by authorised contractors has health and safety implications. The pneumatic hoses need to be secured on the road however the risk is mitigated because they can be installed while the traffic is stationary during a phase of the stop signal.

The MC5712 contributes to improved OH&S for installers as follows:

- The Optical Interface electrically isolates the MC5712 from the signals.
- The pneumatic tubes are simple to install, requiring only basic equipment.
- The pneumatic tubes are installed during the Red phase or pedestrian phase, and greatly reduces the need for traffic control.

2. Use of sound engineering practices and principles

Design principles and standards

Background

This MetroCount 5712 Timing Analysis Roadside Unit (the “MC5712”) project called for a convenient, cost-effective method of monitoring driver behaviour at signalised intersections and railway crossings. Although permanent monitoring may be preferable, practical considerations dictate the re-use of equipment across many intersections, with statistical sampling of typically one to three weeks.

MetroCount specialises in solutions combining electronic hardware and software. To fulfil the project’s requirements, and to create a viable and flexible product, the solution required:

- **Electronic hardware** to simultaneously gather vehicle and traffic signal timing data; and
- **Software** to perform the subsequent data analysis on a Windows-based PC.

The basic principle is to collect traffic with a single instrument using two rubber pneumatic tube axle sensors. The sensors are installed on the intersection side of the stop line, and signal timing is derived from one of the traffic signals facing the entering traffic.
The same instrument simultaneously collects signal timing information through a fibre optic cable via a dedicated interface. An outer stainless steel road case provides mechanical protection, while the microprocessor-based electronics and axle sensors are sealed, totally weatherproof, in the Main System Unit’s PVC enclosure.

With 2MB of onboard static RAM, the MC5712 stores the axle timings for every vehicle during the survey. It also stores the signal changes. After the survey, the MC5712’s data is retrieved via a PC (either in the field or back at base), to be post-processed using dedicated Windows-based software.

The resulting data can be used to examine:

- Driver behaviour, especially surrounding phase changes.
- Volume, Classification and Speed statistics for each phase.
- Individual vehicle transgressions.
- Performance statistics, such as average cycle times.
- Queuing and Capacity.
**Hardware – MetroCount 5712 Timing Analysis Roadside Unit**

- **Block diagram**

The basic layout of the MC5712 hardware system is as follows:

![Block diagram of MC5712 hardware system](image)

Note: this depicts the typical configuration for signalised intersections only. At rail crossings, the Optical Interface connects to the flashing Red signal.

The MC5712 has two channels, Channel 0 and Channel 1:

- **Channel 0** records traffic information, resulting in the “Traffic Dataset”.
- **Channel 1** (which is connected to the traffic lights), results in the creation of the “Timing Dataset”.

Once the MC5712 is downloaded, MetroCount Traffic Executive will combine these files to perform the analysis.

- **Channel 0 - Axle detection**

The MC5712 unit’s **Channel 0** detects axles via rubber pneumatic tube. Detecting axles with tube is very cost-effective, especially for short-term surveys. Rubber tubes are cheap, accurate, and operate reliably in many environments. The MC5712’s adaptive, auto-ranging axle sensors can detect a huge variety of vehicles, from bicycles to heavy vehicles, without any user-adjustment.

More importantly, pneumatic tubes are “non-intrusive” into the road pavement and don’t interfere with existing signal detectors.

Axle sensors also have an advantage over other traffic sensing modes, by providing a very high resolution. Another common traffic sensing method is via “inductive loops”. But, inductive loops only record the entire vehicle, for example, and therefore have less resolution rendering them unsatisfactory for this application.

Throughout the world, all detailed vehicle classifications are based on axles. Many systems have tried inductive, optical or magnetic methods, but only axle detectors give precise speeds and wheel
positions over the entire vehicle spectrum, from motorcycles through to heavy vehicles. Consequently data can be compared across international class scheme standards.

The MC5712 logs every axle event at 833µs resolution. The firmware corrects for potential sensor errors such as tube bounce, vehicle speed and trajectory problems.

- **Channel 1 - Detection of signal phase timings**

The MC5712’s Channel 1 records signal phase transitions at intersections and railway crossings. A dedicated “Optical Interface” electrically isolates the MC5712 recording instrument from the traffic lights. Easily mounted in or near the signal head, in parallel with the signals, the Optical Interface emits a signal which is recorded by the MC5712 during transitions.

Signal transitions have a firmware debounce to eliminate relay chatter, and there is also an impulse response filter to eliminate cross-debounce. The MC5712’s optical timing input has several advantages:

- Complete electrical isolation from the signal controller.
- No backward channel or possibility of damage to the signal controller.
- Immunity from electrical interference.
- Rugged and easily terminated.

The MC5712 purpose-built optical interface provides easy connection to the signals whilst maintaining electrical isolation.
MetroCount Traffic Executive (or “MTE”) is the MC5712 project’s software component and is the most complex and comprehensive part of the entire project. MTE comprises over 500,000 lines of Visual C++ code and contains very sophisticated traffic analysis algorithms, statistical calculations and graphical outputs.

- **“Phase Maps”**

A unique innovation in MTE is the “Phase Map”. The phase map is entirely user-controlled after the survey. With a Phase Map configured for the study location, MTE calculates relative statistics. The timing channel triggers are defined for additional fixed timing phases. For example, given a fixed Yellow time with four seconds, the complete Yellow-Red-Green cycle can be deduced.

Phase Maps can be created and saved as needed, then applied to other locations. Hypothetical Phase Maps can be used to examine different effects and treatments against the same data after the survey.
• Reporting and analysis

MTE includes so many statistical and graphical reports, that only a small sample is included herein.

An example of a text-based statistical report is shown below, summarising overall vehicle flow through the intersection during various phases of the traffic lights.

<table>
<thead>
<tr>
<th>Vehicle Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase</strong></td>
</tr>
<tr>
<td><strong>Vehicles</strong></td>
</tr>
<tr>
<td><strong>Posted speed limit</strong></td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
</tr>
<tr>
<td><strong>95% Speed</strong></td>
</tr>
<tr>
<td><strong>20 km/h Pace</strong></td>
</tr>
<tr>
<td><strong>Variance</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase = Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicles</strong></td>
</tr>
<tr>
<td><strong>Posted speed limit</strong></td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
</tr>
<tr>
<td><strong>95% Speed</strong></td>
</tr>
<tr>
<td><strong>20 km/h Pace</strong></td>
</tr>
<tr>
<td><strong>Variance</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase = All-Red</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicles</strong></td>
</tr>
<tr>
<td><strong>Posted speed limit</strong></td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
</tr>
<tr>
<td><strong>95% Speed</strong></td>
</tr>
<tr>
<td><strong>20 km/h Pace</strong></td>
</tr>
<tr>
<td><strong>Variance</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase = Red</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicles</strong></td>
</tr>
<tr>
<td><strong>Posted speed limit</strong></td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
</tr>
<tr>
<td><strong>95% Speed</strong></td>
</tr>
<tr>
<td><strong>20 km/h Pace</strong></td>
</tr>
<tr>
<td><strong>Variance</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase = Green</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicles</strong></td>
</tr>
<tr>
<td><strong>Posted speed limit</strong></td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
</tr>
<tr>
<td><strong>95% Speed</strong></td>
</tr>
<tr>
<td><strong>20 km/h Pace</strong></td>
</tr>
<tr>
<td><strong>Variance</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Timing Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A Trigger</strong></td>
</tr>
<tr>
<td><strong>Yellow</strong></td>
</tr>
<tr>
<td><strong>All-Red</strong></td>
</tr>
<tr>
<td><strong>Red</strong></td>
</tr>
<tr>
<td><strong>B Trigger</strong></td>
</tr>
<tr>
<td><strong>Green</strong></td>
</tr>
</tbody>
</table>

| A-A (Yellow-Yellow) Maximum | 34573.999, Minimum = 0.998, Mean = 71.575 |
| A-B (Yellow-Green) Maximum | 34546.328, Minimum = 0.539, Mean = 28.077 |
| B-B (Green-Green) Maximum | 64825.021, Minimum = 0.999, Mean = 71.98 |
| B-A (Green-Yellow) Maximum | 3306.421, Minimum = 0.457, Mean = 46.496 |

This report is based on a statistically meaningful number of vehicles (116,000 in this instance). At this intersection there is a large statistical increase in the speeding only during the Yellow and Red phases. This trend can be mathematically analysed for the first time.
The following report depicts individual vehicles and demonstrates the true power of the MC5712 system. Each line shows individual vehicles entering this intersection with respect to the signal phases.

<table>
<thead>
<tr>
<th>Time</th>
<th>DateTime</th>
<th>Phase</th>
<th>VXX</th>
<th>HHMMSS</th>
<th>Speed</th>
<th>Angle</th>
<th>Sky</th>
<th>Clr</th>
<th>Ton</th>
<th>Vehicle Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>05-07-06</td>
<td>16:14:08.317</td>
<td>BT</td>
<td>52.5</td>
<td>0.0</td>
<td>#</td>
<td></td>
<td></td>
<td></td>
<td>PhJ Green</td>
</tr>
<tr>
<td>0.2</td>
<td>05-07-06</td>
<td>16:15:41.137</td>
<td>AB</td>
<td>82.6</td>
<td>2.4</td>
<td>2.1</td>
<td>80.0</td>
<td>2</td>
<td>2</td>
<td>10000000</td>
</tr>
<tr>
<td>0.3</td>
<td>05-07-06</td>
<td>16:15:42.089</td>
<td>AB</td>
<td>70.1</td>
<td>2.7</td>
<td>1.0</td>
<td>51.7</td>
<td>2</td>
<td>2</td>
<td>10000000</td>
</tr>
<tr>
<td>0.4</td>
<td>05-07-06</td>
<td>16:15:44.201</td>
<td>AB</td>
<td>79.3</td>
<td>2.5</td>
<td>2.1</td>
<td>45.8</td>
<td>2</td>
<td>2</td>
<td>10000000</td>
</tr>
<tr>
<td>0.5</td>
<td>05-07-06</td>
<td>16:15:44.844</td>
<td>AB</td>
<td>83.6</td>
<td>2.7</td>
<td>2.7</td>
<td>57.0</td>
<td>2</td>
<td>2</td>
<td>10000000</td>
</tr>
<tr>
<td>0.6</td>
<td>05-07-06</td>
<td>16:15:50.455</td>
<td>AB</td>
<td>75.4</td>
<td>2.4</td>
<td>3.1</td>
<td>60.1</td>
<td>2</td>
<td>2</td>
<td>10000000</td>
</tr>
<tr>
<td>0.7</td>
<td>05-07-06</td>
<td>16:15:53.792</td>
<td>AB</td>
<td>71.5</td>
<td>5.5</td>
<td>3.3</td>
<td>68.4</td>
<td>3</td>
<td>1</td>
<td>10000000</td>
</tr>
<tr>
<td>0.8</td>
<td>05-07-06</td>
<td>16:15:55.163</td>
<td>AB</td>
<td>72.2</td>
<td>2.6</td>
<td>1.0</td>
<td>64.8</td>
<td>2</td>
<td>2</td>
<td>10000000</td>
</tr>
<tr>
<td>0.9</td>
<td>05-07-06</td>
<td>16:15:55.074</td>
<td>AB</td>
<td>75.2</td>
<td>3.2</td>
<td>0.9</td>
<td>65.7</td>
<td>2</td>
<td>2</td>
<td>10000000</td>
</tr>
</tbody>
</table>

Following is a sample graphical report. This intersection has a Yellow phase of four seconds. Note the alarming general speed increase after the Yellow and into the Red. The predominant speed increase is around 15 km/hr, which is seen commonly in MC5712 data. Traffic engineers report that this phenomenon is now graphically represented for the first time.

### Phase Speed

<table>
<thead>
<tr>
<th>Time (Second)</th>
<th>Speed (km/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>52.5</td>
</tr>
<tr>
<td>0.2</td>
<td>82.6</td>
</tr>
<tr>
<td>0.3</td>
<td>70.1</td>
</tr>
<tr>
<td>0.4</td>
<td>79.3</td>
</tr>
<tr>
<td>0.5</td>
<td>83.6</td>
</tr>
<tr>
<td>0.6</td>
<td>75.4</td>
</tr>
<tr>
<td>0.7</td>
<td>71.5</td>
</tr>
<tr>
<td>0.8</td>
<td>72.2</td>
</tr>
<tr>
<td>0.9</td>
<td>75.2</td>
</tr>
</tbody>
</table>

Note the six-axle truck travelling at 74 km/hr entered the intersection 1.3 seconds into the Red phase.
Another graphical report reveals the intersection’s efficiency, wherein the initial vehicle platoons can be seen slowly dissipating several seconds into the Green phase. This particular intersection requires up to 30 seconds before flow establishes consistent through-put, which is as little as 5% of the peak flow.

**Phase Flow**

**Phase Flow**

*Phase Flow 1224 (Nth)* Site: Kensington Leach Nth Kensington Leach Nth

Description: Multiple entry - See legend inside the fan

Filter Time: 15:00 Wednesday, 8 April 2009 to 11:00 Friday, 22 April 2009

Filter Conf: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Scenario: Vehicle classification (ANPR)

The traffic volume reduction several seconds into the Green phase. Note the initial platoons and the time to establish steady through-put.
Manufacturing standards and controls

The MC5712 is a unique new product and there are no standards which are directly applicable to it.

- **Electrical standards**

  MetroCount ensures that its products exceed the general standards for electrical interference and susceptibility applicable in Australia, Europe and USA. Maximum power dissipation of any individual component in normal use is 20mW. Noise immunity exceeds CE standards.

  The MetroCount MC5712 and its supplied cable meet FCC requirements, and exceeds CE standards for electromagnetic susceptibility, including repeated 8kV static discharge directly to the exposed connector pins. Formal approvals are listed in the Appendix MC2.

- **Reporting standards for vehicle classes**

  The MTE software reports vehicle classes to the latest Australian standard which is denoted “AustRoads 94”. This defines 12 vehicle classifications from cars to road trains.

### AustRoads94 Classification Scheme

AustRoads94 replaced NAASRA in Australia in 1994. It is an improved system using information from the spacing of the first three axles, the total number of axles and the number of axle groups. There are 13 classes.

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>AustRoads Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length Characteristics</td>
<td>Axes and Groups</td>
<td>Vehicle Type</td>
<td>Parameters</td>
</tr>
<tr>
<td>Short</td>
<td>1 or 2</td>
<td>Short</td>
<td>SV 1</td>
</tr>
<tr>
<td>Medium 3 to 5 m</td>
<td>2 or 3</td>
<td>Two Axle Truck or Bus</td>
<td>TB2 3</td>
</tr>
<tr>
<td>3</td>
<td>Three Axle Truck or Bus</td>
<td>TB3 4</td>
<td>axle 1 and groups 2</td>
</tr>
<tr>
<td>&gt; 3</td>
<td>Four Axle Truck</td>
<td>TB 5</td>
<td>axle 1 and groups 2</td>
</tr>
<tr>
<td>Long</td>
<td>3 to 5 m</td>
<td>Three Axle Articulated</td>
<td>ART3 6</td>
</tr>
<tr>
<td>4</td>
<td>Four Axle Articulated</td>
<td>ART4 7</td>
<td>451 &gt; 3.2m, axle 4</td>
</tr>
<tr>
<td>5</td>
<td>Five Axle Articulated</td>
<td>ART5 8</td>
<td>451 &gt; 3.2m, axle 5</td>
</tr>
<tr>
<td>&gt; 6</td>
<td>Six Axle Articulated</td>
<td>ART6 9</td>
<td>axle 6, groups 2 or axle 6 and groups 1</td>
</tr>
<tr>
<td>Medium Combination</td>
<td>4 to 6 m</td>
<td>R Double</td>
<td>RD 10</td>
</tr>
<tr>
<td>&gt; 6</td>
<td>Double Road Train</td>
<td>DRT 11</td>
<td>groups 1 and axle 6</td>
</tr>
<tr>
<td>&gt; 6</td>
<td>Triples Road Train</td>
<td>TRT 12</td>
<td>groups 1 and axle 6</td>
</tr>
</tbody>
</table>

### Unclassifiable Classes

- **Unclassifiable Axle Event**: N/A
- **Unclassifiable Vehicle**: ???

**Definitions**

- **Group**: Axle group, where adjacent axles are less than 2.1 m apart
- **Groups**: Number of axle groups
- **Axles**: Number of axles (maximum axle spacing of 10.6m)
- **d(1)**: Distance between first and second axle
- **d(2)**: Distance between second and third axle
Construction processes

The MC5712 is a specialised event recorder. Construction processes involve electronics and enclosure design. Therefore, this section will differ from large civil engineering projects.

- **Construction**

All MetroCount products are designed for maximum hardware reliability. The MC5712 uses surface mount technology (SMT) and is completely solid state.

With the exception of the battery pack, there are no wear components (eg. liquid-crystal displays or aluminium electrolytic capacitors are not used). All internal connectors are gold-on-gold and of dual-wiping construction. The external connector is waterproof, self-wiping, long-pin design and has a sealed protective cap. Printed circuit board construction exposes the circuitry to temperatures of approximately 300°C.

The MetroCount MC5712 is powered by a four D-size alkaline battery pack. Efficient design gives a life of at least 290 days of continuous use. (See Appendix MC3).

- **Printed Circuit Board**

The PCB is conformally coated with silicone meeting MIL-I-46058C (Type SR). All internal assemblies are rigidly attached with brass or stainless steel fasteners. All electrical connectors are latching or immobilised with adhesive. All electronics are rated for continuous use in the specified temperature range (-10ºC to 60ºC).

- **Protective external case**

An external powder-coated stainless steel case is provided for security. It is constructed without fasteners or moving parts such as latches or hinges. To eliminate electrochemical corrosion there are no dissimilar metals in contact. The case provides two independent locking points and chain attachments at either end.

- **Calibration and maintenance**

The MC5712 requires no routine service, calibration or maintenance. The sensors are adaptive and self-adjust for speed or threshold. The MTE software detects and removes any spurious sensor hits. The software reliably detects, separates and classifies vehicles, even at very low speeds. The sensors
can detect vehicles travelling less than 5 kph to over 160 kph. Separate settings are available for each sensor.

**Project/Contract management**

As a small project involving three engineers, the MC5712 did not require detailed project or contract management.

The installation at signalised traffic intersections or railway crossings, requires coordination between different disciplines and jurisdictions within either the Departments of Transport, Railway Authorities or Police.

Coordinating and integrating these authorities during installation required more project management than the actual construction of the device.

To facilitate installation and approvals, the Optical Interface alleviated almost all electrical approval issues. With the Optical Interface being voltage-free from the signals, installers don’t need to be on-site with electrician: they simply connect an optical fibre between the MC5712 and the pre-installed Optical Interface.

As a result of this innovation, the project management requirements of the MC5712 have been dramatically reduced in all evaluation jurisdictions in Australia and overseas.

**Quality Systems**

While not currently holding formal quality assurance accreditation, MetroCount always adheres to internal quality procedures and protocol, covering:

- Identification and traceability of all major components used for traffic monitoring equipment and field stations.
- Maintenance of records, approvals and documentation.
- Details of special processes and testing procedures.
- Details of non conformance to specification.

As part of the Quality process and if required for any contract, MetroCount can provide:

- Specifications and drawings (see attached Installation Guidelines).
- Details of all communication systems and protocols.
- Electrical circuit, wiring and cabling schematics.

Before starting any actual site works, MetroCount can provide:

- All compliance details as specified or implied.
- All reports of tests performed for the client to verify specification compliance.
3. Originality and ingenuity of the solution

Innovativeness of design, process or application

To the best of MetroCount’s knowledge, the MC5712 is globally unique. MetroCount engineers regularly attend international traffic-related conferences and exhibitions. They also constantly examine relevant technical literature, and are across developments in this field. Despite this, no product similar in nature has been deployed elsewhere or seen in documentation.

MetroCount has had a long history of product innovation. With reference to the attached letter from Mr Bob Peters, Manager Road Asset Planning from Main Roads Western Australia, our level of innovation is described in his final paragraph:

“I've had a close relationship with Microcom [MetroCount] for many years. I believe they may be the best in the world when it comes to the development, design and construction of hardware and software to support traffic data collection and analysis. Microcom is an outstanding engineering company – not in the usual west Australian areas of big civil projects, but in innovative electronics and brilliant engineering software”

Achievement of outcomes

With reference to the attached memo from the West Midlands Police, the Achievement of Outcomes is clearly exemplified in the final comment from the Officer managing their Traffic Data Unit, Mr Derek Young:

“I believe Metrocount have provided the means to respond to anecdotal evidence of red-light running and substantiate, with factual evidence, the degree of non-compliance at our signal-controlled junctions.”

Potential for future applications

It is envisaged that the MC5712 will be adopted globally. Every signalised intersection throughout the world exhibits it’s own unique driver behaviour, and is therefore a candidate for routine monitoring by the relevant authorities.

Again, with reference to the attached memo from the West Midlands Police, the potential for expanded future applications is enunciated clearly as follows:

“As far as I am aware we are the only Police Force in the UK currently able to gather factual evidence of red-light running, which although it is quite pleasing for us to be at the forefront of this type of survey work, it is also a position that I hope will change. As you are undoubtedly aware, although the number of risk-takers at traffic lights are thankfully few, it only takes one to cause a death”

There is also significant potential for future application at controlled pedestrian crossings. In fact, any application where there is a detectible timing parameter can be investigated given a suitable interface/transducer combination. For instance, traffic behaviour during icing conditions can be investigated with a simple on-road temperature switch. Other environmental conditions such as rainfall or lighting can also be used to correlate behavioural patterns.
4. Actual or potential contribution of the work to the economy

Should it realise its potential, the MC5712 could well become a standard device for assessing controlled intersections and level crossing throughout the world, and if so, the Australian and international sales potential is considerable.

Efficiency in the application of engineering services

Installation of the MC5712 at traffic intersections and level crossing will provide a new business opportunity for authorised traffic signal service contractors.

Value adding, export potential

The MC5712 has been installed in early-adopter sites in the UK and Australia. The results from the UK site are most encouraging. Refer to the letter from Mr Derek Young, West Midland Police (see Appendix):

“The considerable help and guidance given by Metrocount and data collected from the junctions convinced me and the Local Authority Road Safety Engineers of two facts: West Midlands has a problem with red-light running, and we have the means to determine the degree of that problem. We now have twenty-three MC5712 units and the results we are obtaining are already having significant input into the decision-making process for targeting red-light offenders. The liaison we have with the Signal Engineers is improving and we currently have over fifty junctions ‘on the books’ waiting for surveys (I don’t doubt I shall be asking Finance for more units in the future!’”.

MetroCount has the international production, sales and distribution structure capable of supplying this product throughout the world, with branch offices in the UK and USA.

Impact on the quality of life

The two primary objectives from use of the data provided by the MC5712 are:
- Safer traffic intersections with fewer crashes, and
- Smoother traffic flow.

These factors contributes to an improved quality of life within the society.

Business improvements

Revenue growth will result from local and international sales of the MC5712.

Additionally, the commercial success of the Product will result in additional sales, engineering and technical support staff in the Western Australian office and an increased sales and support load in regional offices.
5. Benefits to the community

The MC5712 can provide direct and indirect benefits to the community

**Employment**

Increased employment opportunities in sales, technical support, administration and engineering within MetroCount would result from the adoption of the MC5712 within its world market.

**Contractor Business Opportunity**

The MC5712 can be installed at traffic intersections and level crossings by authorised contractors to the Government. These installations will provide an additional business opportunity for these contractors.

**Environment, conservation**

The MC5712 is a non-polluting device consuming virtually zero power (it operates continuously from its battery pack for more than 9 months). The design deliberately incorporates lead-free components, including the battery pack.

Moreover, the strong potential for the conservation of human life resulting from effective use of this project must be taken into consideration under this heading.

**Amenity**

The use of the MC5712 and the consequent changes that result in improved efficiency at traffic intersections and level crossing will contribute to the commuter amenity through smoother passage and less risk of crashes. According to Doug Morgan, Director Heavy Vehicle Operations, Main Roads WA:

"Thus, the [MC5712] system has the potential to, by providing the professional engineer with previously unavailable design and performance insights, contribute to improving roads safety and therefore the amenity of the general public."

**Quality of life**

Where the MC5712 contributes to changes which result in safer intersections and thus reducing the risk of crashes, has an effect on commuter quality of life.

The South Australian Centre for Automotive Safety Research conducted a recent study (2005) to evaluate the costs associated with road crashes in that state. They reported that all crashes cost the state of South Australia A$1,175,924,453 every year, with a single road fatality at A$1,747,522 (see Appendix).

Although relatively minor, an improved flow of traffic will help to minimise driver frustration.
6. Contribution to sustainable development

The MC5712 is a non-polluting device consuming virtually zero power (it operates continuously from its battery pack for more than 9 months). The design deliberately incorporates lead-free components, including the battery pack.

Moreover, the strong potential for the conservation of human life resulting from effective use of this project must be taken into consideration under this heading.

Furthermore, the MC5712 does in fact contribute to sustainable development, by strongly contributing to the body of knowledge available to traffic engineers and road authorities. Armed with a greater understanding of driver behaviour at intersections and level crossings, road authorities achieve:

- Improved intersection design.
- Appropriate remedial treatments.
- Rapid statistical assessment of existing hazards and remedies.
7. Significance of the work as a benchmark of Australian Engineering

Reputation as a quality project

With reference to the attached letter from Mr Bob Peters, Manager Road Asset Planning from Main Roads Western Australia, the reputation as a quality project is described in his final paragraph:

“I've had a close relationship with Microcom [MetroCount] for many years. I believe they may be the best in the world when it comes to the development, design and construction of hardware and software to support traffic data collection and analysis. Microcom is an outstanding engineering company – not in the usual west Australian areas of big civil projects, but in innovative electronics and brilliant engineering software.”

Also, Dr Peter Cairney, Principal Research Scientist ARRB Group, adds:

“I therefore very much appreciate the possibilities for recording and analysing road user behaviour at railway level crossings which the 5712 units have opened up, as well as their ease of use and reliability in service.”

Furthermore, according to Mr Geoffrey Miller and Mr Peter Pennisi of Road Infrastructure Management:

“MetroCount have had a significant affect on the development of quality and reliable products for Traffic Engineers and Transport Economists and are in front line of continued development of their existing products.”

Recognition as an engineering achievement

Mr Doug Morgan, Director Heavy Vehicle Operations from Main Roads Western Australia, describes MetroCount’s level of engineering achievement is in his document:

“I consider the [MC5712] Timing Analysis Roadside Unit to be a world-first, unique product, that for the first time allows the traffic engineer to examine large statistical samples of driver behaviour at intersections and level crossings, with vehicle speed, class and timing relative to the traffic signals. I also consider that the conceptualisation and development of this unit demonstrated an original and ingenious approach by MetroCount to addressing a long standing problem of how to obtain detailed timing information over a long period at such locations.”

Patents or other protection

MetroCount’s Managing Director, Mr Mike Kenny (BE MIEAust CPEng MIEEE MITE) has been granted several Australian and United States patents, and is well versed in Australian, European and U.S. intellectual property law, with over 25 years experience.

MetroCount uses the most appropriate intellectual property protection without using patent applications. As a small company, MetroCount finds international protection via the Patent Cooperation Treaty (PCT) or National Phase applications to be prohibitively expensive and generally unenforceable. As a more effective alternative, MetroCount uses 160-bit encryption within its MTE software. Similarly, MetroCount rigorously applies for trademarks in its operating jurisdictions.

Following are registered Trademarks of MetroCount in Australia and/or MetroCount USA Inc. in the United States and/or MetroCount (UK) Ltd (registered EU company):

Additional Criteria

8. The simplicity of the engineering solution

The MC5712 is conceptually a very simple solution to the problem. Two independent data streams are recorded by a single instrument, which are seamlessly post-processed with the included software.

As discussed by Dr Peter Cairney, Principal Research Scientist ARRB Group:

“The alternative to using the 5712 units to measure behaviour... would have required a considerably larger budget and... required much longer to run”.

And

“...[Without] the non-contact connection to the railway level crossing signalling equipment... it would be very difficult to obtain permission... to use the equipment”.

9. Use and development of innovative design, construction, maintenance or management practices

The MC5712 system is an innovative design hitherto globally unavailable.

With reference to the attached letter from Mr Bob Peters, Manager Road Asset Planning from Main Roads Western Australia, MetroCount’s innovation is described as follows:

“I believe they [MetroCount] may be the best in the world when it comes to the development, design and construction of hardware and software to support traffic data collection and analysis. Microcom is an outstanding engineering company – not in the usual west Australian areas of big civil projects, but in innovative electronics and brilliant engineering software.”

10. Technical complexity

Although electronic hardware is an essential part of the MC5712 and in itself is technically complex, the major complexity the overall system is its MTE software. When combined with this hardware, MTE enables extremely sophisticated and powerful data analysis. This is exemplified by Dr Peter Cairney’s comments (see letter from ARRB Group in the Appendix):

“...The detailed recording and storing of the traffic data... required non-standard analysis which the MetroCount data system was able to accommodate”.

11. Cooperation with other disciplines and professions and/or effective use of community, government or industry consultation

Involves cooperation between different disciplines and jurisdictions within either the Departments of Transport, Railway Authorities or Police.

12. Substantial evidence of sales and export potential of the project and/or its intellectual property

Key achievements
MetroCount is now well established and respected as the global leader in portable traffic data monitoring systems. Key achievements include:
- Gradual and sustainable growth.
- Establishing purpose-built premises in Perth for all business activities.
- Continuous expansion into all world markets.
- Establishing and maintaining a strong “MetroCount” brand name.

Exporting success
- MetroCount has Regional Offices in UK and USA servicing major international markets in Europe and America. MetroCount exports directly from Australia to those countries not serviced by its Regional Offices. MetroCount has resellers in countries difficult to service from Regional Offices.
- MetroCount’s leads the portable vehicle counting market, with a substantial user base in over 80 countries. MetroCount will continue to enhance the MC5712 system, extending it to new applications.

Strategies for sustaining and expanding
MetroCount is optimising the opportunities for the MC5712, including:
- Test sites in the USA, UK and Australia.
- Brochures and other support material.
- Staff training and product workshops.

Competitive advantage
MetroCount supports the global market, providing competitive advantage by:
- Including our MetroCount Traffic Executive® software with the hardware.
- Exhibiting at major overseas trade shows, staffed by key personnel.
- Marketing mainly to government and their contractors. MetroCount carefully identifies prospects in transport departments in each country, state or municipality.
- Freely supplying equipment for in-house evaluation. These systems are digitally protected and can be made fully operational with signature codes supplied by email.
- Providing “MTE Certification Training” and “Advanced Training”, ensuring proper utilisation and maximum client benefit. Clients are thus more likely to upgrade, buy additional systems, or refer MetroCount to others.
Innovative marketing

MetroCount’s innovative approach includes:

- An in-house sophisticated computer-based CRM system supporting all company activities. The CRM facilitates:
  - Complete dossiers on customer and supplier communications,
  - Complex pricing mechanisms,
  - Product installation history,
  - Accurate, automatic quote generation with prices and currency in the client’s ‘region’.
- Virtual Network Computing via the Internet to assist sales to any country in the world from the Perth or regional offices. Clients are referred to a prescribed web page to participate in real-time demonstrations on their computer screens.
- Website [www.metrocount.com](http://www.metrocount.com) providing product and related information. The web site is used by existing clients for:
  - Support and contact information,
  - New software, product brochures, technical documentation and news bulletins.
- A proprietary system for e-mail, fax, Voice Mail and SMS messaging to enable rapid global response to any sales inquiry.
- Multi-lingual software for countries with other languages, providing for local translations, identifying MetroCount as a genuine international supplier.

Brand promotion

- MetroCount trades globally under the MetroCount® brand. MetroCount USA Inc is registered in USA and MetroCount (UK) Ltd is registered in UK. Both are wholly owned subsidiaries of MetroCount Australia.
- MetroCount has registered many trademarks in multiple countries.
- All MetroCount products and associated material incorporate the MetroCount logo and colours.
- The word “MetroCount” resonates with the application and target

Financial Management

MetroCount has computer-based accounting and administration in Perth for all global entities, for timely and accurate day-to-day management and forward planning. The accounting systems provides:

- Profit and loss, sales, inventory, and cash position.
- Debtor and creditor control for each entity.
- Cash management with cash flow reporting incorporating export and domestic sales projections.
- Production planning.

MetroCount operates essentially debt-free. Conservative management policy does not expose MetroCount to undue risk, by self-funding all activities from available finances. MetroCount has never sought borrowings for any venture.
13. Level of import replacement

Employment growth

Employment growth is steady and well planned, with staff recruited as markets expand. The emphasis is on the Perth office. Although the UK and USA operations create some overseas employment, we strategically maintain minimal staff in those offices.

Commitment

MetroCount is committed to export market development, demonstrated by achievements over 15 years with clients in over 80 countries. Detailed commitments:

- Offices in the UK and USA solely for developing and supporting exports.
- Considerable presence at major international trade shows.
- Senior executives and technical personnel regularly visit regional offices, attend trade shows and meet with agents and major customers.
- Sales support systems customised to provide Internet access to MetroCount’s CRM outside Australia.
- Release of MetroCount’s multi language software.

14. Attention to value adding

Like many consumer electronic devices, the individual components of the MC5712 are very low cost. The value adding in this project is by way of intellectual property being incorporated into the hardware and software, and therefore extremely high margins can be derived.

15. Attention given to the needs of users

The MC5712 project was instigated to fulfill a need from Main Roads WA. Recognising the broader application of this product, MetroCount has consulted many potential users. Throughout this project, from design of the hardware, deployment considerations and data reporting and analysis, user needs were sought and fully incorporated.

Please see the attached user Testimonials.

16. Environmental implications

The MC5712 is a non-polluting device consuming virtually zero power (it operates continuously from its battery pack for more than 9 months). The design deliberately incorporates lead-free components, including the battery pack.

Moreover, the strong potential for the conservation of human life resulting from effective use of this project must be taken into consideration under this heading.

17. Quality and extent of research

MetroCount’s high quality research was very extensive throughout this project. With reference to the attached letter from Mr Bob Peters, Manager Road Asset Planning from Main Roads Western Australia, MetroCount’s quality and extent of research is described as follows:

“I believe they [MetroCount] may be the best in the world when it comes to the development, design and construction of hardware and software to support traffic data collection and analysis. Microcom is an outstanding engineering company – not in the usual west Australian areas of big civil projects, but in innovative electronics and brilliant engineering software.”
18. Demonstrates significant skills transfer and professional development of the team

Resources
MetroCount has a strong focus on human resources as the key to continuing success.

Company Values
At MetroCount, we:

Encourage our People
- We attract talented people and encourage them to flourish through gaining experience, skills and knowledge. We value team achievements and individual accomplishments: ideas are traded, tested and put in practice.

Recognise and Value
- We encourage and value personal growth and professional development, through recognition and reward for individual effort.

Are Professional
- We uphold the highest standards of conduct. We act with integrity, honesty and fairness and respect the interests of everyone with whom we do business.

Champion Excellence
- We deliver a quality product and promote excellence, to meet and go beyond the customer’s expectations and to make a positive difference for our people, our clients and our communities.

Create a Harmonious and Flexible Workplace
- We nurture shared ideas, values, interests and goals. We foster diversity, value our people and their contributions and treat them equitably, fairly and with dignity, care and respect.

Communicate, Consult & Cooperate
- We willingly work with one another, combining our skills, knowledge and experience in an open and generous environment.

Drive Innovation
- We persistently pursue innovation through research and development, promoting technology and looking for opportunities to create ever-more valuable solutions.

Are Profitable and Sustainable
- We focus on business viability to continue sharing wealth and supporting lifestyles.

Enjoy
- Our work-life is both challenging and enjoyable.

Employment Factors
MetroCount maintains all functions in Perth with integrated systems providing seamless services to clients outside Australia. Skills training includes coaching in selling techniques, product knowledge and an appreciation of cultural differences. Multi-lingual contract staff attend trade shows for face to face presentations. In Perth, Spanish, Turkish, Danish, Swedish and other language consultants are engaged as required.
19. Integration and innovative use of computer automation, intelligence, modelling systems or multi-media techniques

**Systems**

MetroCount has a tried-and-tested supply chain supporting international operations.

- Minimum stock levels are held at the Perth and at regional offices.
- Bulk shipments to regional offices minimises freight and handling costs.
- The Signature System means that MetroCount only ever manufactures and stocks a single model of each product.
- Where an existing client elects to ‘upgrade’ to a new model, no new physical stock is required.

**Technology**

MetroCount can promptly meet substantial increases in production because:

- All final assembly and testing are conducted from the Perth factory which has spare capacity.
- Production is in batches, with parallel batches as required.
- Only one model of the roadside unit is manufactured simplifying production.
- Parts are outsourced from multiple suppliers ensuring limited dependence on any one supplier.
- Engineers constantly evaluate alternative supply, with Australian components selected where practical.
- Fabrication of sub assemblies and all final assembly is carried out in Perth.
- Software can be produced in any quantity when required with little effort.

20. Maintenance efficiency and effectiveness

**After-sales Service**

MetroCount provides comprehensive after-sales service including:

- Hardware warranty with prompt replacement should a rare fault occurs.
- Software support via an on-line ‘help’ facility, web site request forms, telephone support service and “MCPS”, a premium subscription support service.
- Fully documentation with technical and software manuals that can be downloaded from the MetroCount Internet site.
- Prompt investigation of very rare software issues and amendments incorporated immediately and delivered across the Internet or included in the next release.

21. Heritage value

Not applicable.
Appendices

Independent Testimonials

West Midlands Police UK, Mr Derek Young, Manager Traffic Data Unit
ARRB Group, Dr Peter Cairney, Principal Research Scientist
Main Roads Western Australia, Mr Doug Morgan, Director Heavy Vehicle Operations
Main Roads Western Australia, Mr Bob Peters, Manager Road Asset Planning
Road Infrastructure Traffic Management, Mr Geoffrey Miller and Mr Peter Pennisi

Technical Documents

MetroCount 5712 Timing Analysis Roadside Unit flyer
MC5712 Timing Analysis RSU
MC571X Installation for Traffic Signal Analysis

External Reports

The economic cost and impact of the road toll on South Australia, Centre for Automotive Safety Research
Independent Testimonials

West Midlands Police UK, Mr Derek Young, Manager Traffic Data Unit
ARRB Group, Dr Peter Caimey, Principal Research Scientist
Main Roads Western Australia, Mr Doug Morgan, Director Heavy Vehicle Operations
Main Roads Western Australia, Mr Bob Peters, Manager Road Asset Planning
Road Infrastructure Traffic Management, Mr Geoffrey Miller and Mr Peter Pennisi
Dear Mike,

I feel that the time is right for me to write to you with some thoughts and observations on the MC5712 Timing Analysis unit. As you know, we conducted a series of test and trial installations at a series of traffic signal controlled junctions and pedestrian crossings. The results from those trials were, to say the least, compelling.

During the initial stages of our series of surveys we were asked by our Crash Investigation Team to gather data from the scene of a fatal collision at a Pelican Crossing on a three-lane dual-carriageway. The two survey points that were set up – one using the MC5600 on the approach to the crossing, and one using a 5712 linked to the Crossing lights – revealed that although incidences of red-light running were comparatively few, the approach speeds to the crossing were significantly high. This information was made available to the Local Authority for appropriate action and the data evidence provided the Coroner with helpful background guidance.

The considerable help and guidance given by Metrocount and data collected from the junctions convinced me and the Local Authority Road Safety Engineers of two facts: West Midlands has a problem with red-light running, and we have the means to determine the degree of that problem. We now have twenty-three MC5712 units and the results we are obtaining are already having significant input into the decision-making process for targeting red-light offenders. The liaison we have with the Signal Engineers is improving and we currently have over fifty junctions ‘on the books’ waiting for surveys (I don’t doubt I shall be asking Finance for more units in the future!).

As far as I am aware we are the only Police Force in the UK currently able to gather factual evidence of red-light running, which although it is quite pleasing for us to be at the forefront of this type of survey work, it is also a position that I hope will change. As you are undoubtedly aware, although the number of risk-takers at traffic lights are thankfully few, it only takes one to cause a death. I believe Metrocount have provided the means to respond to anecdotal evidence of red-light running and substantiate, with factual evidence, the degree of non-compliance at our signal-controlled junctions.

Yours sincerely,
Derek.

Derek Young
Manager, WMP Traffic Data Unit.
22 June 2009

Mr M Berger
Sales and Support, Metrocount,
PO Box 1182
Fremantle WA 6959

Dear Maurice,

Performance of MetroCount 5712 Timing Analysis Roadside Units

I am writing to acknowledge how useful our organisation has found your Metrocount 5712 Timing Analysis Roadside Units to be in two recent projects investigating different aspects of railway level crossing safety.

In the first study, a pilot study undertaken for the Australian Level Crossing Behavioural Coordination Group, the 5712 units were set up at four treatment sites and four control sites. The treatment sites were the subject of an awareness campaign, delivered through features and interviews in the local media and through distributing leaflets in the local community. This was backed by police enforcement of the road rules at railway level crossings, conducted at low levels which police considered would be sustainable in the long term. At the control sites, which were geographically removed from the treatment sites, no interventions were undertaken. As it turned out, it was only at the site controlled by a 'stop' sign that substantial changes in behaviour were evident. However, this pilot study was very useful in scoping programs that would be required in similar circumstances, in quantifying road user behaviours at level crossings, and in demonstrating the strong level of support for such programs from train crews. The alternative to using the 5712 units to measure behaviour would have been to have observers at the crossing recording behaviour, or to use a video camera to record behaviour at the crossing and to assess the behaviour from the video record later. Both approaches would have required a considerably larger budget and, due to limited availability of equipment and personnel, required much longer to run.

The second study was carried out for VicRoads, the Victorian state road authority. It involved comparing driver compliance with level crossing signals at conventionally-equipped sites and sites which had traffic signals present as well as flashing lights and boom barriers. Compliance was also compared with compliance at conventional traffic signals, using the 5711 Timing Analysis Units to measure driver behaviour at the traffic signal sites. Compliance was found to be better at the level crossings where traffic signals were provided, although compliance at these sites was not as good as compliance at signalised intersections.
The two features of the equipment have been particularly useful for our purposes. First, the non-contact connection to the railway level crossing signalling equipment; without this, it would be very difficult to obtain permission from the rail track owners to use the equipment. Second, the detailed recording and storing of the traffic data; our investigations have required non-standard analysis which the Metrocount data system was able to accommodate.

As indicated above, it would have been much more time consuming and expensive to collect the required data without the counters. I therefore very much appreciate the possibilities for recording and analysing road user behaviour at railway level crossings which the 5712 Units have opened up, as well as their ease of use and reliability in service.

Yours sincerely,

[Signature]

Dr Peter Cairney
Principal Research Scientist
ARRB Group
Dear Sir/Madam

ENGINEERING EXCELLENCE AWARDS
METROCOUNT’S TIMING ANALYSIS ROADSIDE UNIT

As an engineering professional working with Main Roads Western Australia and a member of Engineers Australia I support the nomination of Metrocount’s “Timing Analysis Roadside Unit” for the 2009 WA Engineering Excellence Awards.

I consider the Timing Analysis Roadside Unit to be a world-first, unique product, that for the first time allows the traffic engineer to examine large statistical samples of driver behaviour at intersections and level crossings, with vehicle speed, class and timing relative to the traffic signals. I also consider that the conceptualisation and development of this unit demonstrated an original and ingenious approach by Metrocount to addressing a longstanding problem of how to obtain detailed timing information over a long period at such locations.

This new system provides the traffic engineer with valuable intersection performance indicators which allows rapid assessment of any strategies or remedial works, before and after - without having to accumulate future accident statistics. Thus, the system has the potential to, by providing the professional engineer with previously unavailable design and performance insights, contribute to improving road safety and therefore the amenity of the general public.

I therefore support Metrocount’s application for this award and commend this Timing Analysis Roadside Unit to the WA Division of Engineers Australia.

If you require any further information please contact me on (08) 9311 8438.

Yours faithfully

Doug Morgan MIEAust
DIRECTOR
HEAVY VEHICLE OPERATIONS
Mr M Kenny
Managing Director
Microcom
15 O’Connor Close
NORTH COOGEE WA 6163

ATTENTION: MIKE KENNY

Dear Mike

METROCOUNT MC5712 "TIMING ANALYSIS ROADSIDE UNIT"

I am very pleased to be able to support Microcom’s nomination of the MetroCount MC5712 "Timing Analysis Roadside Unit" for an Engineering Excellence Award. Although I am not very familiar with its use I know it was keenly sought by our traffic engineers and road safety managers to assist them in their analysis of traffic signal controlled intersections and railway crossings.

I have had a close relationship with Microcom for many years. I believe they may be the best in the world when it comes to the development, design and construction of hardware and software to support traffic data collection and analysis. Their customer focus is excellent, in that they ensure they fully understand the needs of road and traffic engineers – and then produce the hardware and software that is needed. Microcom is an outstanding engineering company – not in the usual Western Australian areas of big civil projects, but in innovative electronics and brilliant engineering software.

I have no hesitation in wishing them all the best with this award application.

If you require any further information please contact me on 93234184.

Yours faithfully

Bob Peters
MANAGER ROAD ASSET PLANNING
Dear Mike,

As you are aware of some of our work in the field of Traffic Engineering and upgrading the Main Roads WA traffic count network, I feel compelled to support your MC5712 Timing Analysis Roadside unit as one of the most significant developments over the past 10 years in the following major categories:

- **Road Safety** – The more Information collected at signalised intersections & rail crossings that show unsafe behaviour at level crossings the better chance of planning to save lives.
- **Light Phases** are mostly controlled by SCATS or a similar computer system based on vehicle volumes passing the intersection. The current information collected via induction loop presence detection systems become unreliable when vehicles are queued.
- **Reports** – The reports detail vehicle classification data binned in each Phase (Red, Yellow, Green) This makes it easier for the Traffic Engineer to examine traffic behaviour at a particular intersection and examine conflicts.

Road Infrastructure Traffic Management have just upgraded the six (6) Main Roads WA MC5711 Loggers to the fibre optic based MC5712 Timing Analysis Roadside Unit and are very happy with the benefits and time savings on site.

MetroCount have had a significant affect on the development of quality and reliable products for Traffic Engineers and Transport Economists and are in the front line of continued development of their existing products.

Mike, you have our full support for a nomination of the MC5712 as an advanced Timing Analysis Roadside Unit in the Engineering Excellence Awards.

We wish you all the best.

Geoffrey Miller FIEAust

Peter Pennisi

25<sup>th</sup> June 2008
Technical Documents

- MetroCount 5712 Timing Analysis Roadside Unit flyer
- MC5712 Timing Analysis RSU
- MC571X Installation for Traffic Signal Analysis
MetroCount 5712 Timing Analysis Roadside Unit for intersection monitoring…

“Measure the hazards, know the risks”

Do you need to determine the hazard ranking of traffic signal intersections and rail level crossings?

With our new MetroCount 5712 Timing Analysis Roadside Unit, we have completely revolutionised intersection and level crossing monitoring and hazard ranking. Instead of relying only on sparse crash data to make your assessments, you can now monitor the behaviour of all drivers.

The MC5712 uses MetroCount’s latest two-channel technology. Installed at signal-controlled intersections, pedestrian crossings and rail crossings, and readily interfaced to the signals, the MC5712 records traffic data on one channel and signal changes on the other.

How the system works

Like our other classifier systems, the MC5712 gathers time-stamped axle data for every vehicle using two air tubes spaced one metre apart and approximately 200mm on the junction or crossing side of the stop line. (Note: non-metric users may use a tube spacing of three feet.)

The second “timing” channel simultaneously logs the signal changes via the “Optical Interface”. You configure two software “triggers”, one on the start of Green, for instance, and one on the start of Yellow (i.e. pre Red). As the signals change, these triggers are instantaneously transmitted and stored in a simple cycle (Yellow-Red-Green).

Timing analysis with “Traffic Executive”

As with our other traffic monitoring systems, we include our world-leading Traffic Executive software package with the MC5712 at no extra cost, completing the system.

Using Traffic Executive’s “MCReport” traffic analysis module and MetroCount’s proven time-stamped individual axle approach, you can easily analyse the speed, vehicle type (car, van, bus, truck, etc), headway, gap, and more, of every vehicle entering the intersection, all relative to the signal phases.
**MCReport's Phase Map**

Signal timing is interpreted using MCReport’s new “Phase Map”. The Phase Map is entirely user-controlled after the survey. You configure a Phase Map to match the surveyed intersection, then command MCReport to calculate statistics relative to it. You define and name timing channel triggers and additional fixed timing phases to your Phase Maps. For example, given a fixed yellow time of four seconds, the complete Yellow-Red-Green cycle can be deduced.

You can create and save as many Phase Maps as you need, applying common Phase Maps to other survey locations, or even hypothetical Phase Maps to examine different effects and treatments against the same data.

**MCReport's Timing Analysis Reports**

MCReport now includes a range of detailed timing analyses and reports for traffic signals and controlled railway crossings. Timing analysis can also be applied to controlled pedestrian crossings.

Vehicles can be selected in the “phase reports” by enabling and disabling phases in the Phase Map. All the normal vehicle filtering of MCReport is still available.

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**Phase Statistics report for each phase, and combined phases**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Vehicles</th>
<th>Dr Speed</th>
<th>Wb</th>
<th>Hdwy</th>
<th>Gap Ax</th>
<th>Gp</th>
<th>Rho</th>
<th>Cl</th>
<th>Nm</th>
<th>Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>314 (40.4%)</td>
<td>60 km/h, Exceeding = 128 (12%), Mean Exceeding = 68.8 km/h</td>
<td>250 (32%)</td>
<td>72 (22%)</td>
<td>36 (11%)</td>
<td>7 (2%)</td>
<td>12 (3%)</td>
<td>0.3 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Red</td>
<td>182 (23%)</td>
<td>60 km/h, Exceeding = 55 (12%), Mean Exceeding = 68.6 km/h</td>
<td>237 (69%)</td>
<td>72 (22%)</td>
<td>36 (11%)</td>
<td>7 (2%)</td>
<td>12 (3%)</td>
<td>0.3 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Green</td>
<td>126 (16%)</td>
<td>60 km/h, Exceeding = 47 (13%), Mean Exceeding = 68.2 km/h</td>
<td>227 (55%)</td>
<td>72 (22%)</td>
<td>36 (11%)</td>
<td>7 (2%)</td>
<td>12 (3%)</td>
<td>0.3 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
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<tr>
<td><em>Virtual Day</em></td>
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</table>

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**Phase Custom List report, showing virtual day and week for yellow and red phases**

<table>
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<tr>
<th>Time</th>
<th>Total</th>
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<td>07:00</td>
<td>7</td>
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</tr>
</tbody>
</table>

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**Phase Flow report, demonstrating a tail into the red phase**

**Phase Speed report, showing an increasing speed trend approaching the red phase**

**Phase Speed report, showing driver behaviour at the beginning of the green phase**

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**Data Phase report - individual vehicles with phase timing**

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**Phase A Trigger**

- **A Trigger** = 10860
- **B Trigger** = 10860
- **Green** = 482313 sec (63.3%)

### A-A (Yellow-Yellow)
- **Maximum** = 3324.630, **Minimum** = 27.056, **Mean** = 69.509
- **Vehicles** = 85.725, **Mean Speed** = 16.912, **Max Speed** = 24.509
- **B-A (Green-Green)**: **Maximum** = 3324.630, **Minimum** = 4.704

**Specifications & features may change without notice**
Introducing the MC5712

MetroCount's MC5712 Roadside Unit introduces a new mode of analysis called Timing Analysis, which adds an extra dimension to vehicle classification.

The MC5712 is a two-channel RSU, where channel 0 is used to time-stamp vehicles using tubes, and channel 1 is used to synchronously time-stamp the RSU's fibre optic input. Timing events from the second channel form user-definable Phases, into which vehicles from the first channel are grouped. MCReport provides a range of new Phase reports for detailed analysis and statistics of vehicles grouped by phase, and of the timing source itself.

Timing Analysis is of particular use for traffic signals. Tubes are placed the intersection-side of a stop line, and timing is derived from one of the traffic signals facing the corresponding aspect. The resulting data can be used to examine:

- Driver behaviour, especially surrounding phase changes.
- Volume and Speed statistics for each phase.
- Individual vehicle transgressions.
- Performance statistics, such as average cycle times.
- Queuing and Capacity.
Timing Analysis is not limited to traffic signals. The MC5712 can be applied to controlled pedestrian or railway crossings. In fact, any application where there is a detectable timing parameter, can be investigated. For instance, traffic behaviour during icing conditions could be investigated with a simple on-road temperature sensor. Other environmental conditions such as rain or light level could also be used.

The MC5712’s optical timing input is connected via a plastic fibre optic cable. This has several advantages:

1. Complete electrical isolation of the fibre and RSU from the signal controller.
2. No backward channel or possibility of damage to the signal controller.
3. Immune from electrical interference.
4. Rugged and easily terminated.

The MetroCount RSU Optical Interface is used to drive the MC5712’s optical input. Optical Interfaces are small enough to be mounted directly in a traffic signal head, or can be installed in a controller cabinet, with up to 100 metres of fibre. Optical Interfaces are available in two versions:

- Low Voltage - for 9-24VDC or 9-24VAC (50-60Hz)
- High Voltage - for 100-240VAC (50-60Hz)
Consider the typical application of a straight-through aspect of a controlled intersection. The start and end of a complete cycle of the traffic signals can be derived entirely from the Green light. With the addition of fixed-length phases during analysis with MCRreport, the varying length of the Red phase can be deduced.

The MC5712's timing channel (channel 1) time-stamps transitions on its optical input, called Trigger events. The unit's default configuration is for an Optical Interface connected to the Green signal. The Green light going off will generate an A-trigger, indicating the start of the Yellow. The Green light coming back on then generates a B-trigger, indicating the end of the Red.
For other applications, the MC5712 can be reconfigured using MCSetup or MCSetLite. Several default configurations are provided to cover most scenarios, and new configurations can be easily created if nothing suitable exists.

For long-term analysis, the vehicle channel can be controlled by the timing channel. In this mode, known as Gated Timing Analysis, vehicles will only be logged when a configurable, static level (high or low) is present on the timing channel. Note that using this mode will result in some loss of information, especially vehicles leading up to and spanning the phase change, but provides much greater vehicle capacity.

**Phase Signature Type**

Timing Analysis introduces a new signature type called **Phase**, which provides access to MCReport's Timing Analysis reports, in addition to all the **Plus** reports.
Phase Reports

MCReport's Timing Analysis reports include:

- **Data Phase Report** - individual vehicles ordered by phase.
- **Phase Statistics** - timing statistics for each phase.
- **Phase Flow Chart** - plot of vehicle volume versus phase.
- **Phase Speed Chart** - plot of average vehicle speed versus phase
- **Phase Spectrum** - distribution of phase timing.
- **Phase Cycle** - average phase length versus time.

Interpretation of the timing channel data is defined using MCReport's **Phase Map**, which is displayed as part of the Report Wizard for Phase reports. Initially, MCReport constructs a simple two-phase map for the A and B triggers from the timing channel.

From here, more complex Phase Maps can be constructed by adding phases with fixed lengths, and assigning names and colours to each phase. Phases can be enabled and disabled to examine driver behaviour under combinations of phases, such as only the Yellow and Red phases for traffic signals.
Signal Timing Example

Consider the typical signal timing application described previously. A MC5712 was connected to a pair of tubes, spaced one metre apart, and approximately 200mm on the junction side of a stop line. An Optical Interface was connected by signal technicians to the Green light on the signal pole adjacent to the stop line being monitored. The MC5712’s timing channel was configured to detect a rising-edge as the A trigger (light off), and a falling-edge as the B trigger (light on). In its simplest form, this is represented by the following Phase Map.

For the intersection in question, several fixed-length phases are known. The Yellow phase is always four seconds, followed by a two-second phase where all aspects of the intersection are Red. These phases can be easily added, so that they may be analysed in detail.

The optional pretrigger filter removes vehicles for a specified window prior to a trigger event. This feature is useful for traffic signals for removing vehicles at the end of a phase that may be jumping the phase transition.

The following sample reports give an insight into the types of information that can be derived from Timing Analysis data.
Phase Statistics

The Phase Statistics report displays MCReport's standard speed statistics block for each phase in the Phase Map, and for all phases combined. A summary block of statistics from the timing channel is also included.

<table>
<thead>
<tr>
<th>Vehicle Statistics</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Phase</td>
<td>(Yellow + All-Red + Red + Green)</td>
<td>Vehicles: 11628 [100%]</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Posted speed limit: 60 km/h, Exceeding: 22156 (18.98%), Mean Exceeding: 67.06 km/h</td>
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<td></td>
<td></td>
<td>Maximum: 199.1 km/h, Minimum: 0.9 km/h, Mean: 36.4 km/h</td>
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<td></td>
<td></td>
<td>85% Speed: 61.6 km/h, 95% Speed: 68.4 km/h, Median: 35.9 km/h</td>
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<td></td>
<td></td>
<td>20 km/h Pace: 10 - 30, Number in Pace: 20717 (63.95%)</td>
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<td></td>
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<tr>
<td>Phase</td>
<td>Yellow</td>
<td>Vehicles: 7098 [7.11%]</td>
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<td></td>
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<td>Maximum: 120.1 km/h, Minimum: 0.6 km/h, Mean: 54.6 km/h</td>
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<td></td>
<td></td>
<td>85% Speed: 67.2 km/h, 95% Speed: 73.4 km/h, Median: 68.6 km/h</td>
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<td></td>
<td></td>
<td>20 km/h Pace: 65 - 72, Number in Pace: 5522 (64.76%)</td>
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<td></td>
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<td>Variance: 230.73, Standard Deviation: 15.19 km/h</td>
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<tr>
<td>Phase</td>
<td>All-Red</td>
<td>Vehicles: 458 [0.46%]</td>
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<td>Maximum: 112.6 km/h, Minimum: 0.7 km/h, Mean: 57.6 km/h</td>
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<td>85% Speed: 77.4 km/h, 95% Speed: 85.7 km/h, Median: 64.1 km/h</td>
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<td></td>
<td></td>
<td>20 km/h Pace: 60 - 60, Number in Pace: 230 (49.10%)</td>
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<td></td>
<td>Variance: 417.56, Standard Deviation: 20.43 km/h</td>
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<td>Phase</td>
<td>Red</td>
<td>Vehicles: 119 [0.10%]</td>
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<td>85% Speed: 33.8 km/h, 95% Speed: 64.1 km/h, Median: 8.3 km/h</td>
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<td>20 km/h Pace: 0 - 30, Number in Pace: 76 (69.66%)</td>
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<td>Green</td>
<td>Vehicles: 10786 [91.79%]</td>
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<td>Maximum: 199.1 km/h, Minimum: 1.0 km/h, Mean: 34.4 km/h</td>
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<td></td>
<td>85% Speed: 68.5 km/h, 95% Speed: 73.0 km/h, Median: 28.4 km/h</td>
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<td></td>
<td>20 km/h Pace: 0 - 30, Number in Pace: 40939 (46.52%)</td>
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<td></td>
<td>Variance: 421.92, Standard Deviation: 20.54 km/h</td>
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</tr>
</tbody>
</table>

**Timing Statistics**

A Trigger = 19212
Yellow = 78648.0 sec (6.666)
All-Red = 36343.0 sec (2.038)
Red = 36973.0 sec (28.114)

B Trigger = 19214
Green = 856090.0 sec (62.848)

AA: [Yellow/Yellow] Maximum: 34627.999, Minimum: 0.999, Mean: 71.575
A-B: [Yellow/Green] Maximum: 34627.999, Minimum: 0.999, Mean: 26.977
B-B: [Green/Green] Maximum: 34627.999, Minimum: 0.999, Mean: 71.575
B-A: [Green/Yellow] Maximum: 33061.411, Minimum: 0.999, Mean: 45.906

Phase Statistics report for each phase, and combined phases
Data Phase Report

The Data Phase report displays individual vehicles, interspersed with phase timing. Phases can be disabled in the Phase Map to show only vehicles in phases of interest. The Gap column is the time since the last phase transition.

<table>
<thead>
<tr>
<th>DG</th>
<th>X-Cnt</th>
<th>Y-Cnt</th>
<th>M-Type</th>
<th>M-Ext</th>
<th>M-Cnt</th>
<th>M-Maxas</th>
<th>M-Minus</th>
<th>M-Sum</th>
<th>M-Speed</th>
<th>Gap</th>
<th>Gp</th>
<th>RhE</th>
<th>Ch</th>
<th>Rh</th>
<th>Hn</th>
<th>Vehicle</th>
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<td>-----</td>
<td>-----</td>
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<td>8.4</td>
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<td>-----</td>
<td>1004000</td>
<td>43.6 Green</td>
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<td>0003-07-08</td>
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<td>82.6</td>
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<td>3</td>
<td>00000002</td>
<td>5</td>
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<td></td>
</tr>
</tbody>
</table>

Data Phase report - individual vehicles with phase timing

Phase Flow Chart

The Phase Flow report represents average vehicle volume versus time from the start of a Phase Map cycle. Each phase is indicated by a vertical line on the chart.

This report is particularly useful for examining driver behaviour, and characterising a given site. For instance, this site shows a definite tail of vehicle flow into the All-Red phase.

Phase Flow report, demonstrating a tail into the All-Red phase

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Behaviour at the end of a cycle (start of the Green) can also be examined.

Phase Flow report, showing driver behaviour at the beginning of the green phase

**Phase Speed Chart**

The Phase Speed report shows average vehicle speed versus time from the start of a Phase Map cycle. For sporadic events, the average speed may be just a single vehicle.

Like the Phase Flow report, this report highlights driver behaviour. In this case, there is an increase in average speed approaching the Red phases.

Phase Speed report, showing an increasing speed trend approaching the red phases

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The Phase Spectrum report is useful for examining the distribution of time between trigger events. For example, the A-to-B distribution represents the variable cycle length.

Phase Spectrum showing distribution of cycle length

Phase Cycle

The Phase Cycle report plots average phase length (between trigger events) versus time, highlighting the change in behaviour of the timing signal at varying times of the day and week. The total number of cycles can optionally be plotted on the same report.

The following example demonstrates a traffic signal flipping between a demand-driven cycle, and a simple fixed-timed cycle.
A special version of the Custom List report also supports Timing Analysis. Any of the Custom List's features can be applied to selected vehicles using the Phase Map. For instance, complete speed statistics can be calculated for vehicles in the first two seconds of the green, and so on.

### Phase Custom List Report

A special version of the Custom List report also supports Timing Analysis. Any of the Custom List’s features can be applied to selected vehicles using the Phase Map. For instance, complete speed statistics can be calculated for vehicles in the first two seconds of the green, and so on.

#### Phase Cycle graph, showing average phase length versus time

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
<th>C10</th>
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<th>C12</th>
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<td>0</td>
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</tr>
</tbody>
</table>

#### Phase Custom List report, showing virtual day and week for yellow and red phases

©2009 MetroCount® - MC5700 Series RSUs - MC5712 Timing Analysis RSU
The MC571X Series RSU's synchronous-channel mode can be used for analysing driver behaviour at controlled intersections. Channel 0 is used to time-stamp vehicles, and channel 1 is used to time-stamp changes in the traffic signals.

There are two MetroCount RSUs designed for traffic signal analysis, using pneumatic tubes as the vehicle sensors, and a dedicated signal timing input:

- MC5711 - screw-terminal electrical input.
- MC5712 - Polymer Optical Fibre (POF) input.

The MC5712's optical interface is preferred, as it provides complete electrical isolation between the RSU and traffic signals.

Installation of this equipment will usually involve two separate entities:

- The traffic signal maintenance authority or contractor, to authorise, provide and install the necessary control signal.
- A traffic survey contractor, to install the MetroCount RSU and sensors.

The MetroCount RSU must be located adjacent to the lanes being monitored, to connect to the axle sensors. The control signal can be provided from an adjacent signal head, or direct from the signal controller cabinet through existing conduits. The choice of electrical or optical input does not change the required infrastructure, simply the method by which the signal is transferred.
Control Signal

Signal Source

Complete signal phase timing can be derived from the Green lamp of the corresponding aspect, for a simple Yellow-Red-Green cycle. The Green lamp going off indicates the start of the fixed-length Yellow phase, and the Green lamp coming on indicates the end of the Red.

Electrical Signal (MC5711)

The MC5711’s timing input requires a volt-free, contact-closure to ground. One SPST relay is sufficient, however if extra contacts are available (such as a dual-pole relay), they should be ganged for added reliability.

Relays with appropriate coil drive voltages will need to be selected to match the switched voltage of the traffic signals where the equipment is to be installed.

The MC5711’s screw terminals will accept cable up to 0.2mm² / 14AWG. Alternatively, cable may be terminated using 1/4” tab receptacles.

MC5711 RSU, with electrical input for Timing Analysis
Optical Signal (MC5712)

The MC5712's optical receiver accepts standard 1000µm clad polymer optical fibre.

MetroCount's Optical Transmitter is mounted at the signal source. Its input accepts 100-250VAC, and has sufficient optical output power to cover 100m / 300ft of fibre. The unit has a standard TS35 DIN rail mount.

Signal-Head Connection

Providing the control signal from a signal head adjacent to the RSU is the simplest installation method.

The selected relays, or MetroCount Optical Interface, can be mounted at the top of the signal pole, and connected in parallel with the Green lamp in the signal head. A suitable weather-proof, plastic junction box may be required for housing the devices. The electrical cable or POF should then be run down the signal pole in a protective conduit, which is then connected directly to the appropriate RSU.

Signal Controller Connection

A control signal may need to be supplied directly from the traffic signal controller cabinet for intersections where there is no signal pole adjacent to where the RSU will be located. The selected control signal hardware is installed in the controller cabinet, and the control signal run through existing conduits. The conduit could optionally terminate in a below-ground cable pit adjacent to the lanes to be monitored, which could also house the RSU. If using a cable pit, ensure that it has a drainage hole.
RSU Installation

RSU Placement

The RSU can be housed in a standard MetroCount RoadCase, or another suitable enclosure, and optionally mounted on the base of the signal pole. Slight modification may be required to provide control signal access.

Mounting the MC5711 vertically with the input terminals facing downwards is recommended to avoid condensation or rain affecting the terminals.

Sensor Placement

The first axle sensor should be placed approximately 200mm / 8in on the intersection side of the stop line. The second sensor should then be placed further into the intersection per normal classifier installation spacing (1m / 3ft). Try to avoid running the sensors too close to adjacent lanes that are controlled by a different signal, such as turning pockets, to avoid picking up unrelated vehicles.

Note that sensors should be placed perpendicular to the flow of traffic, which is not necessarily parallel to the stop line. Use the closest wheel-track to measure the distance from the stop line.

Two to three lanes can be successfully monitored. Vehicles of interest, particularly those passing under the Red, are normally well separated, and travelling at a constant velocity. Approximate volume and speed data can still be derived from vehicles passing under the Green phase.
The RSU’s Configuration should be checked before use, to select the correct input polarity and sensitivity. In MCSetup select **Technical» Configure RSU**, or in MCSetLite select **RSU » Configure** from the main menu button.

### MC571X Configuration

Several standard configurations are provided under the **571X Timing Analysis** headings. The control signal trigger polarity will depend on the setup used. As a general rule, the A trigger should be the start of the Yellow phase (end of the Green Phase). The following table covers typical installations.

<table>
<thead>
<tr>
<th>RSU</th>
<th>Control Signal</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC5711</td>
<td>Normally-open contact connected to Green lamp. Closed on Green.</td>
<td>Volt-free contact: A-trig = opening, B-trig = closing</td>
</tr>
<tr>
<td></td>
<td>Normally-closed contact connected to Green lamp. Open on Green.</td>
<td>Volt-free contact: A-trig = closing, B-trig = opening</td>
</tr>
<tr>
<td>MC5712</td>
<td>MetroCount Optical Interface connected to Green lamp.</td>
<td>Fiber-optic: A-trig = light off, B-trig = light on</td>
</tr>
</tbody>
</table>

There are two categories of Timing Analysis configurations:

- **Not Gated**: all vehicles on channel 0 are time-stamped. This is the most common mode as statistics can be calculated for all phases.
- **Gated**: only vehicles passing between the A and B triggers (Yellow and Red) are time-stamped. This mode is useful for long-term surveys, but all Green vehicles will be lost.

MC571X RSUs configured for Timing Analysis have a capacity of approximately 450,000 vehicles.
RSU Setup

The normal RSU setup procedure is used once the RSU has been configured for Timing Analysis. The site details are automatically copied to both channels, and both are started synchronously. From here, the vehicle and timing channels are Viewed and Unloaded independently.

Note:
Remember, an Unload must be performed on both channels. The timing channel will default to a filename with a .ECT file extension.
External Reports

The economic cost and impact of the road toll on South Australia, Centre for Automotive Safety Research
The economic cost and impact of the road toll on South Australia

MRJ Baldock, AJ McLean

CASR REPORT SERIES
CASR009
March 2005
The economic cost and impact of the road toll on South Australia

MRJ Baldock, AJ McLean

Centre for Automotive Safety Research
The University of Adelaide
South Australia 5005
AUSTRALIA

Department of Transport and Urban Planning
Post Office Box 1
Walkerville SA 5081
AUSTRALIA

Centre for Automotive Safety Research
http://casr.adelaide.edu.au/reports

The Bureau of Transport Economics (BTE) released a report in 2000 that documented the economic costs of road crashes across Australia in 1996. The present report used the BTE analyses and crash data from 2002 to estimate the annual economic costs of road crashes in South Australia, stating all figures in Australian dollars. It was found that the annual cost to the state is approximately 1.18 billion dollars. The savings to the South Australian economy associated with a relatively modest reduction in road crash injuries (10 fatalities, 100 serious injuries, 1,000 minor injuries) were calculated to be in excess of 60 million dollars.

Accident costs, Economic analysis
Summary

A recent report by the Bureau of Transport Economics (BTE) (now the Bureau of Transport and Regional Economics) provided an analysis of the costs of road crashes in Australia using crash data from 1996 (Bureau of Transport Economics, 2000). This report concluded that road crashes in 1996 cost the Australian economy nearly 15 billion dollars.

By adjusting the costs presented in the BTE report according to inflation since 1996 and applying these costs to the number of crashes occurring in South Australia, it was possible to estimate the economic cost of road crashes in South Australia. This was done using 2004 prices from the March quarter and the most recently available complete set of South Australian crash figures (2002). The resulting estimate of the annual cost of road crashes in South Australia was nearly 1.18 billion dollars. The full details of these costs are provided in Table 1.

<table>
<thead>
<tr>
<th>Cost type</th>
<th>Cost per year in South Australia ($)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
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<td>Human costs</td>
<td></td>
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</tr>
<tr>
<td>Lost labour in the workplace</td>
<td>150,422,908</td>
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</tr>
<tr>
<td>Lost labour in the household and community</td>
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<tr>
<td>Quality of life</td>
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<tr>
<td>Ambulance</td>
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<tr>
<td>Hospital in-patient</td>
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<td>Other medical</td>
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<td>Coroner</td>
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<td>Correctional services</td>
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<td>Travel delays</td>
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<td>Total</td>
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</tbody>
</table>

Given that road crashes in South Australia result in these great costs to the community and economy, considerable savings to the state could be made in the event of reductions in crash numbers. Following the calculation of crash costs in South Australia, the savings that would occur in the event of crash reductions were estimated, using reductions of 10 fatalities, 100 serious injuries and 1,000 minor injuries as a basis for the calculations. The estimate for these savings was
$63,793,751, of which 80% were in human costs, 9% in vehicle costs, and 10% in general costs. These savings, broken down into the separate savings associated with fatalities, serious injuries, and minor injuries, are shown in Table 2. It can be seen in Table 2 that the greatest savings associated with the specified set of crash reductions would come from the reductions in serious injuries.

The various savings components presented in Table 2 can also be described in terms of specific benefits to the state. Some of these annual benefits are:

- a lifetime’s labour for ten people (in the workplace, household and community);
- at least an additional 2,500 days of labour (in the workplace, household and community);
- a saving equivalent to over 850 typical ambulance call-outs;
- the availability of nearly 900 extra hospital bed days;
- approximately 4,400 fewer of each of the following: instances of use of hospital out-patient or emergency care, visits to a general practitioner, consultations with a specialist, use of prescription pharmaceutical products, and sessions of treatment by allied health services;
- no more need for the long term care of 18 people, five of whom would be severely and permanently disabled, thus lessening the need for the provision and co-ordination of carers, which, in turn, would also ease the burden on rehabilitation centres;
- a saving of approximately $5.7 million in insurance costs (legal costs plus administration), which could result in lower insurance premiums;
- a saving of the cost of 535 days of prison time for one person;
- reduced workplace disruption and staff replacement, saving business in the state $1.7 million;
- a saving of over 7,000 hours of police time;
- and reduced travel delays, saving business in the state $4.7 million.
The economic cost and impact of the road toll on South Australia

The savings in Table 2 can also be expressed in terms of the savings per fatality, per serious injury and per minor injury (refer to Table 3). For some cost categories, the savings had to be calculated on a per crash basis and there was no available information to determine the relative cost ratios between crashes of different levels of injury severity. For these cost categories, fatal, serious injury, and minor injury crashes were assumed to cost the same amount. It is likely that the more severe crashes are actually more expensive for these cost categories, and so the savings shown in Table 3 are likely to underestimate the savings from reductions in fatalities and serious injuries, and overestimate the savings from reductions in minor injuries. Table 3 shows that fatalities are the most expensive for the majority of cost categories but that reductions in serious injuries are associated with the greatest savings for various medical services, legal services, and the costs of workplace disruption and staff replacement.
Table 3
Savings in road crash costs in South Australia associated with reductions of a single fatality, a single serious injury and a single minor injury, separately for each crash injury level

<table>
<thead>
<tr>
<th>Cost type</th>
<th>Fatality</th>
<th>Serious injury</th>
<th>Minor injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lost labour in the workplace</td>
<td>649,533</td>
<td>32,767</td>
<td>0</td>
</tr>
<tr>
<td>Lost labour in the household and community</td>
<td>601,419</td>
<td>29,776</td>
<td>0</td>
</tr>
<tr>
<td>Quality of life</td>
<td>383,741</td>
<td>41,171</td>
<td>5,386</td>
</tr>
<tr>
<td>Ambulance</td>
<td>416</td>
<td>361</td>
<td>250</td>
</tr>
<tr>
<td>Hospital in-patient</td>
<td>1,652</td>
<td>6,607</td>
<td>34</td>
</tr>
<tr>
<td>Other medical</td>
<td>1,225</td>
<td>9,919</td>
<td>48</td>
</tr>
<tr>
<td>Long term care</td>
<td>0</td>
<td>108,828</td>
<td>0</td>
</tr>
<tr>
<td>Coroner</td>
<td>671</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Premature funeral</td>
<td>2,045</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Legal</td>
<td>16,296</td>
<td>25,975</td>
<td>1,587</td>
</tr>
<tr>
<td>Correctional services</td>
<td>10,237</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Workplace disruption and staff replacement</td>
<td>9,715</td>
<td>9,985</td>
<td>647</td>
</tr>
<tr>
<td>Vehicle costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle repair</td>
<td>6,660</td>
<td>6,660</td>
<td>6,660</td>
</tr>
<tr>
<td>Towing</td>
<td>83</td>
<td>83</td>
<td>83</td>
</tr>
<tr>
<td>Time lost due to vehicle unavailability</td>
<td>354</td>
<td>354</td>
<td>354</td>
</tr>
<tr>
<td>General costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-vehicle property damage</td>
<td>58</td>
<td>58</td>
<td>58</td>
</tr>
<tr>
<td>Police</td>
<td>7,394</td>
<td>2,540</td>
<td>38</td>
</tr>
<tr>
<td>Fire and emergency services</td>
<td>19</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Insurance administration</td>
<td>1,801</td>
<td>1,801</td>
<td>1,801</td>
</tr>
<tr>
<td>Travel delays</td>
<td>54,203</td>
<td>54,203</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,747,522</strong></td>
<td><strong>331,107</strong></td>
<td><strong>16,965</strong></td>
</tr>
</tbody>
</table>

In summary, road crashes in South Australia cost the state approximately $1.18 billion in a year. Even a relatively small reduction in crash numbers would result in considerable savings to the economy. These savings would enable increased productivity for business in the state and would also reduce the need for government spending on the provision of services.