INTERNATIONAL ROAD DYNAMICS INC.

LTPP WIM DATA COLLECTION SYSTEMS

WIM INSTALLATION PLAN FOR MINNESOTA SPS-5 LTPP ID 270500

June 30, 2006
CLIN 2002 TASK ORDER 11

Submittal For:
Federal Highways Administration

CONTRACT NO. DTFH61-05-D-00001

U.S. Department of Transportation
Federal Highway Administration

LONG TERM Pavement PERFORMANCE

TABLE OF CONTENTS

1 Coordination Activities

1.1 Contact Information

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Nichols
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Jean Wallace (Division Representative)
FHWA
ph: 303-969-6730 x382

State of Minnesota DOT
George Cepress ph: (651) 296-0217
Mark Novak ph: (651) 296-2607
Ben Worel ph: (651) 779-5522

Bruce Myers
International Road Dynamics (Phase 2 Contractor)
ph: 717-264-2077
c: 717-860-1817
e: bruce.myers@irdinc.com

1.2 Correspondence

March 29, 2006 - Phone conversation George Cepress Minnesota DOT:
IRD to provide lane closure, three additional lanes will be instrumented with Kistler sensors. MNDOT DOT already has possession of Kistler sensor's for additional lanes.

March 29, 2006 - Left Message with Roger Hilly – Planning Engineer District 2 - (218) 281-6057 cell 218-289-1564

April 4, 2006 – Roger Hilly returned my call said there should be no restriction on lane closure times. He also stated there plan is to use 8 Kistler sensors per lane (two - full lane width sensor arrays).

June 12, 2006 – Spoke with George Cepress about cabinet location and site layout. He referred me to Mark Novak for all construction related issues.

July 13, 2006 – Spoke with Mark Novak about cabinet, conduit and pull box requirements.

2 Site Drawings

2.1 SPS Site Location Information

This plan will deal where and how the SPS site will be instrumented with a bending plate WIM system. The site is located along US-2, in the outside west bound lane at mile marker 91.8 The WIM site is located approximately 5.4 miles downstream of the end of SPS section 270503. The site is located in the County of Clearwater.

EXISTING ROADWAY SURROUNDING THE WIM SITE

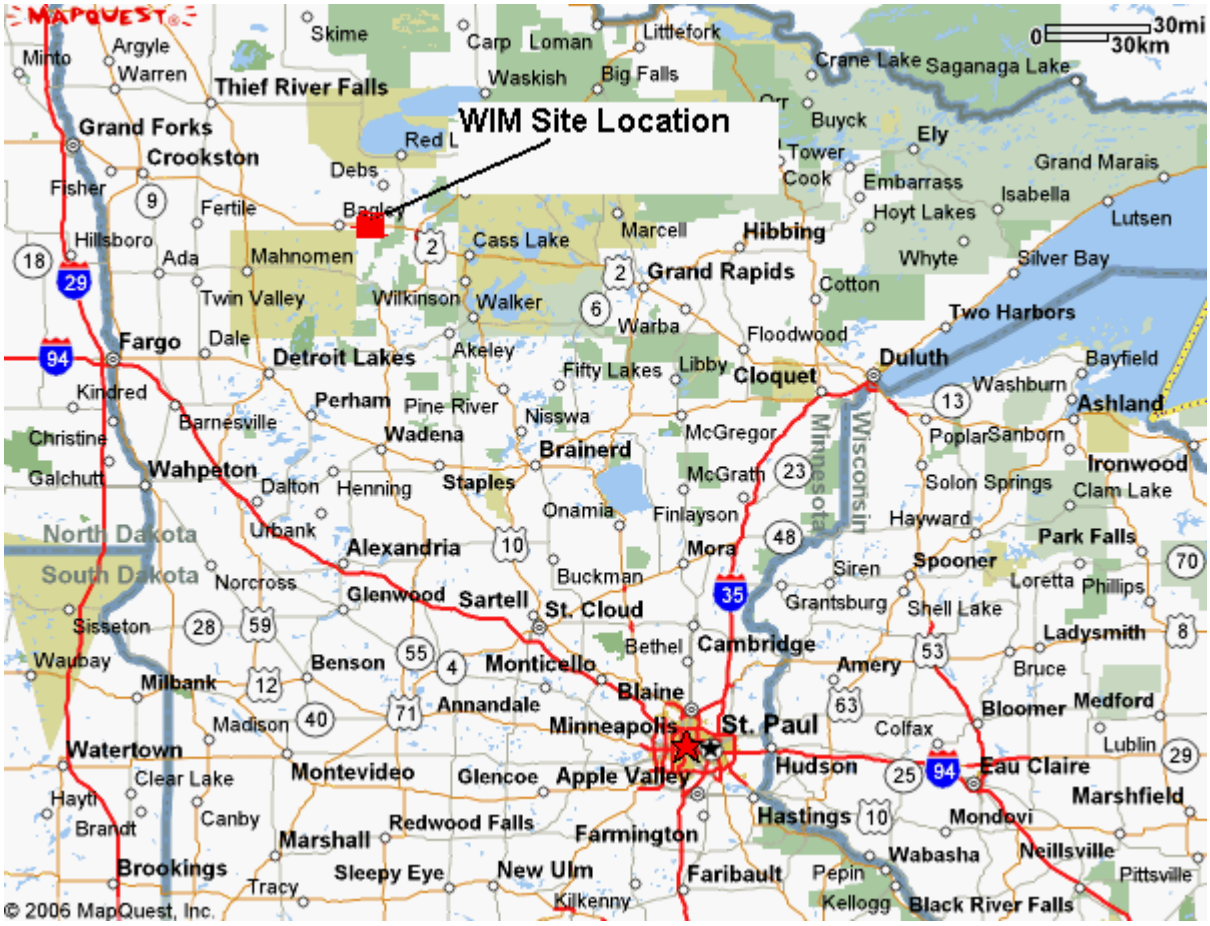
Type Pavement: AC Pavement Age: Top lift placed in 1998

Lane Width: 12 feet Thickness: 11 inches

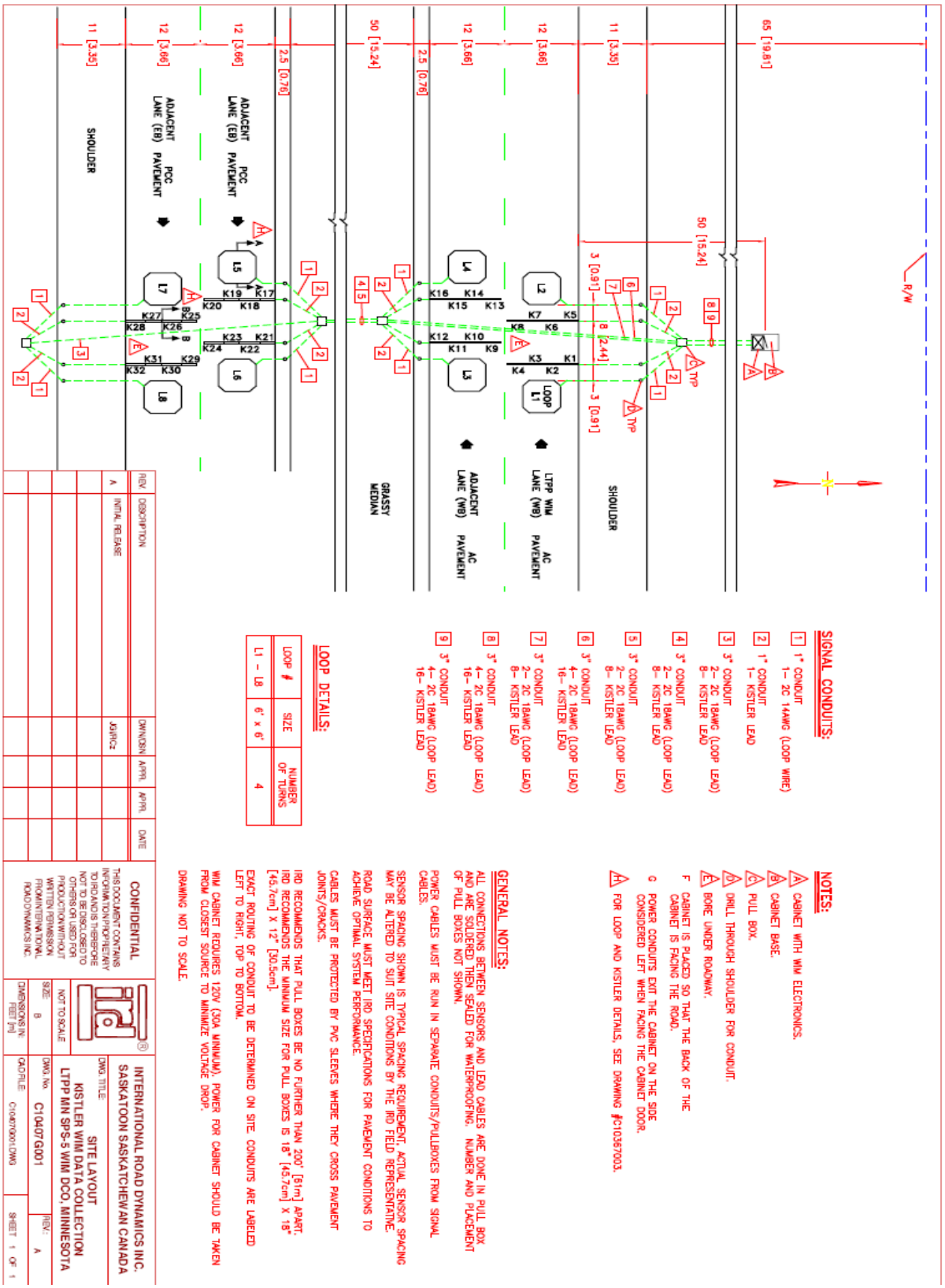
Outside WB Shoulder Type: AC Width: 11 feet

PAVEMENT 325' PRIOR AND 75' FOLLOWING WIM SCALE LOCATION

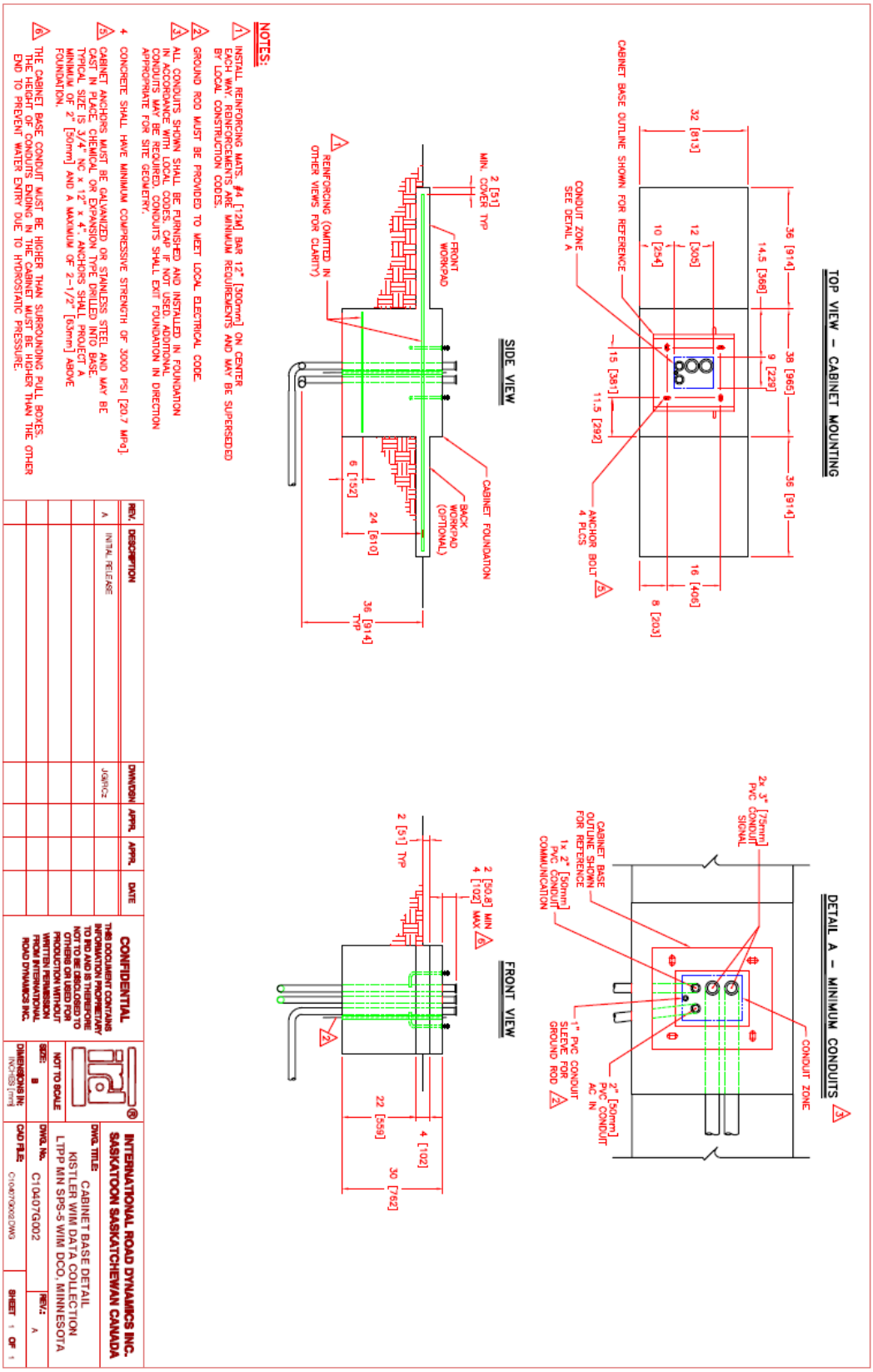
Type: AC Thickness: 11 inches Jointed or Continuous: N/A



2.2 Site Layout



2.3 Cabinet Base

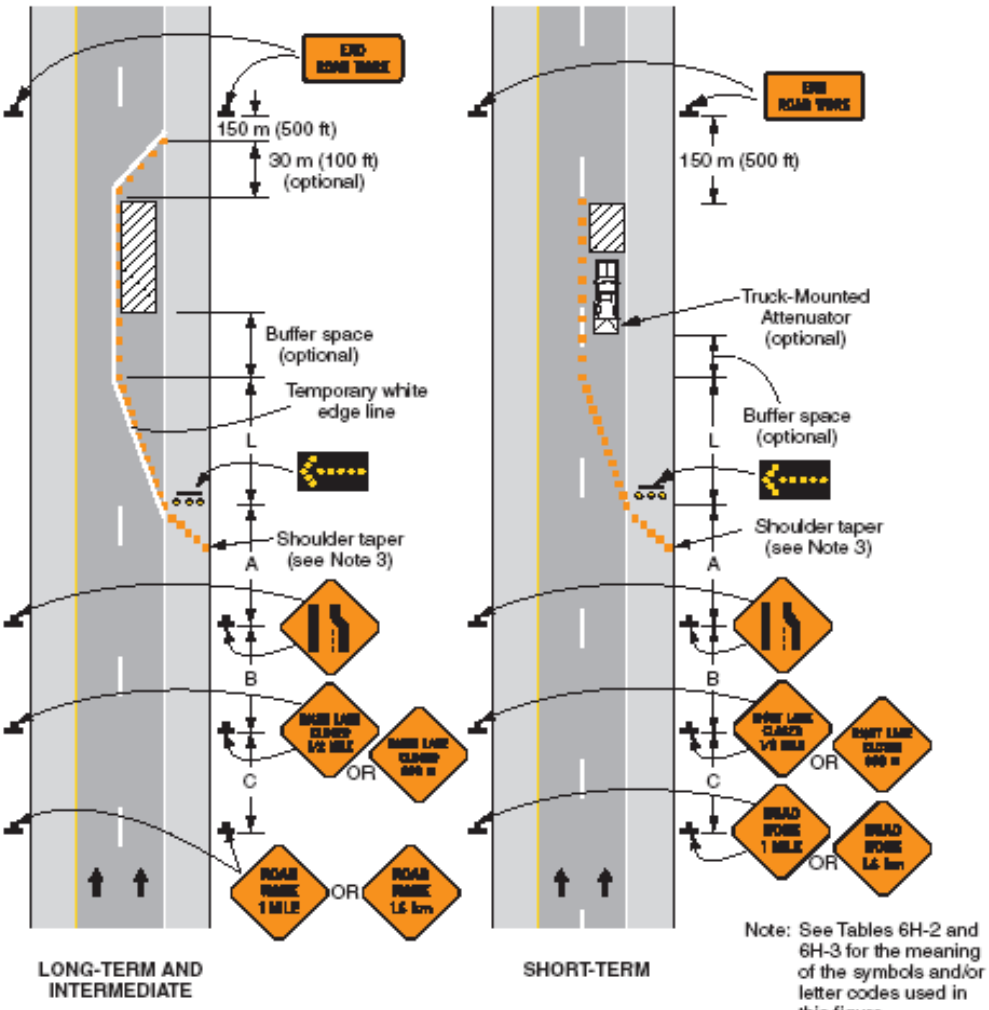


3 Minnesota Traffic Control Plan

3.1 Traffic Plan To Be Used

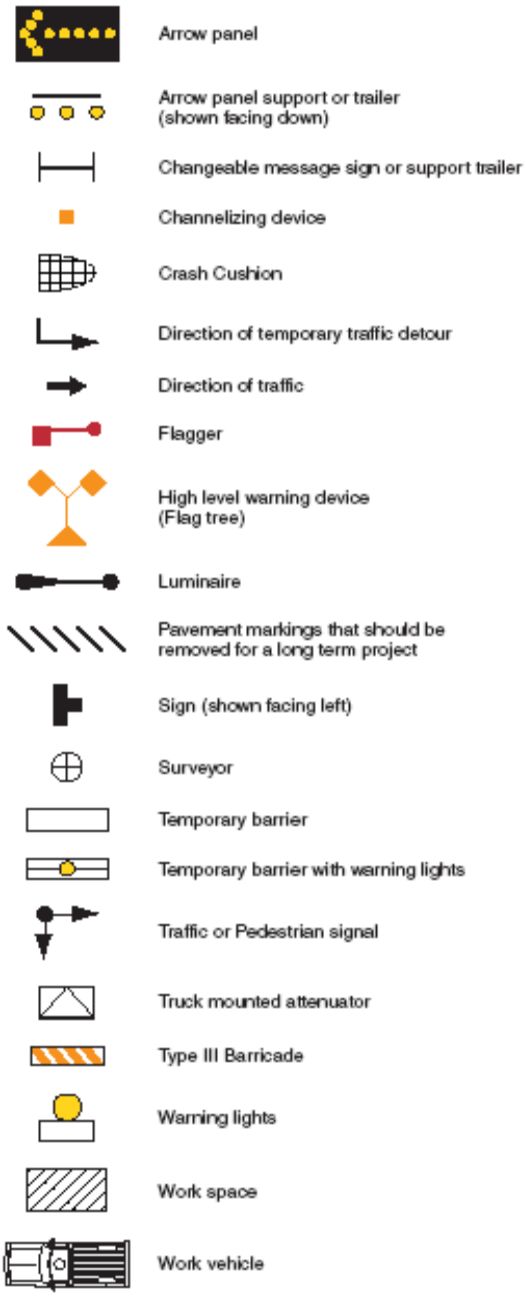
The Traffic Control Plan to be used is the plan suggested by MUTCD (Manual on Uniform Traffic Control Devices) as follows.

Figure 6H-33. Stationary Lane Closure on Divided Highway (TA-33)



Typical Application 33

Table 6H-2. Meaning of Symbols on Typical Application Diagrams



	Arrow panel
	Arrow panel support or trailer (shown facing down)
	Changeable message sign or support trailer
	Channelizing device
	Crash Cushion
	Direction of temporary traffic detour
	Direction of traffic
	Flagger
	High level warning device (Flag tree)
	Luminaire
	Pavement markings that should be removed for a long term project
	Sign (shown facing left)
	Surveyor
	Temporary barrier
	Temporary barrier with warning lights
	Traffic or Pedestrian signal
	Truck mounted attenuator
	Type III Barricade
	Warning lights
	Work space
	Work vehicle

Sect. 6H.01

Table 6H-3. Meaning of Letter Codes on Typical Application Diagrams

Road Type	Distance Between Signs**		
	A	B	C
Urban (low speed)*	30 (100)	30 (100)	30 (100)
Urban (high speed)*	100 (350)	100 (350)	100 (350)
Rural	150 (500)	150 (500)	150 (500)
Expressway / Freeway	300 (1,000)	450 (1,500)	800 (2,640)

* Speed category to be determined by highway agency

** Distances are shown in meters (feet). The column headings A, B, and C are the dimensions shown in Figures 6H-1 through 6H-46. The A dimension is the distance from the transition or point of restriction to the first sign. The B dimension is the distance between the first and second signs. The C dimension is the distance between the second and third signs. (The third sign is the first one in a three-sign series encountered by a driver approaching a TTC zone.)

Table 6H-4. Formulas for Determining Taper Lengths

Speed Limit (S)	Taper Length (L) Meters
60 km/h or less	$L = \frac{WS^2}{155}$
70 km/h or more	$L = \frac{WS}{1.6}$

Speed Limit (S)	Taper Length (L) Feet
40 mph or less	$L = \frac{WS^2}{60}$
45 mph or more	L = WS

Where: L = taper length in meters (feet)
W = width of offset in meters (feet)
S = posted speed limit, or off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed in km/h (mph)

4 iSINC

4.1 iSINC Technical Specifications and Brochure

***iSINC* SYSTEM ELECTRONICS**
WIM TECHNICAL SPECIFICATIONS

GENERAL

The iSINC Weigh-In-Motion (WIM) System Electronics is an integrated vehicle information processing package that implements sensor input signal conditioning, system software to transform the inputs into the required outputs and a user interface. The System Electronics consist of a WIM Control Unit, Sensor and Output Modules to interface the various devices specific to a site's requirements, terminal panels with over-voltage protection and isolation for each input and output line, system controlled AC power outputs and an integral Power Supply, all housed within a weatherproof enclosure.

The system software is pre-loaded and automatically starts when the system is powered up. The electronics use a modular design based on the Controller Area Network (CAN) communication bus for easy of maintenance, troubleshooting and in-field servicing.

iSINC WIM CONTROL UNIT DETAILS

Communication:

-CAN Bus environment for very extensive sensor and control configuration
-On-board Ethernet interface
- One RS-232 serial interface dedicated to external system interface
- One RS-232 serial interface dedicated to remote administration facilities (modem dial-in)
- Local user interface for system configuration and fault diagnosis
- Remote administration via Telnet
- Remote file download via FTP

Peripherals:

-Non-volatile storage for vehicle information to prevent data loss during power outages: Compact Flash cards from a minimum of 32 MB up to 4 GB
- Sensor inputs from SLC, SSWIM, Bending Plate, Kistler, Piezo, Dynax, Serial and Digital devices
- Output control options for a wide variety of Serial, Digital and AC powered devices (CMS, VMS, OCS, LCS, DMS, printers, signal lights, toll gates, etc.)

Software:

-Processes up to eight lanes of traffic
-Records data logs on operational status, power supply condition, and safety system activity
-Weight Compliance and Classification with user-definable classification scheme
-Serial output compatible with HELP, I75 and others
-Compatibility with IRD's complete line of optional application specific software packages:
-Automated Ramp Weigh Station
-Automated Mainline Weigh Station
-Data Analysis and Reporting

User Interface

-Local through a handheld keypad or laptop PC in terminal mode
-Remote through a dial-up modem to a PC in terminal mode
-Telnet over the Ethernet interface

SENSOR AND CONTROL MODULE DETAILS

Each module includes built in signal conditioning. All sensor modules are field replaceable. Every module features self testing and built in fault diagnosis.

Scale Sensor Module
-Three lanes of SLC, SSWIM or PAT Bending Plate scales
-One lane of IRD Bending Plate scales

Piezo/Kistler Sensor Module
-Four piezoelectric sensor inputs plus temperature sensor
-Class 1 or Class 2 sensors
-Four Kistler sensor inputs plus temperature sensor

Digital I/O Module
-Eight isolated contact closure inputs or outputs
-Report on rising edge, falling edge or both
-Adjustable input debounce
-Control output state, single pulse, or square wave
-Adjustable timeout on inputs

Serial Control Module
-RS232C compatible asynchronous serial port for communication with serial devices such as printers and VMS

Serial Bridge Module
-RS232C compatible asynchronous serial port for devices communicating directly with the CAN Bus

Loop Sensing Module
-Four magnetic sensing loop inputs
-Adjustable for sensitivity and frequency

iSINC ENCLOSURE DETAILS

The iSINC electronics enclosure houses the following components:
-WIM control Unit
-One or two chassis for iSINC modules; each chassis accommodates up to 10 modules
- I/O Signal Panels with terminals and over-voltage protection for each channel
-iSINC controlled AC power outputs with 4 channels per panel
-Power supply
- All components mounted in a 19” rack
-Brushed aluminum panels
-Enclosure size required is dependant on the options selected for an installation. The available sizes are:
  - 117 cm high x 61 cm wide x 52 cm deep (46 in. x 24 in. x 20 in.)
  -170 cm high x 61 cm wide x 76 cm deep (67 in. x 24 in. x 30 in.)
-Multiple enclosures may be connected together for expansion up to 160 modules

iSINC POWER SUPPLY DETAILS

Power Supply
-30 Watts supply. Power consumption varies with the options selected, but typically is in the range of 5 Watts

-90 to 264 VAC, 47 to 63 Hz operation
-Surge protection
-One GFI and three AC duplex outlets for peripheral equipment
-Optional Solar power, 40 W to 85 W panels
-Optional 12 VDC battery for backup or extended operation (up to 30 days). Integral charge controller for battery conditioning

SYSTEM EXPANDABILITY

The iSINC Electronics may be expanded with any combination of the above modules up to a maximum of 160 modules per installation. Each enclosure accommodates up to 20 modules; multiple enclosures may be connected together for larger installations. Using the built-in Ethernet or a Serial Bridge Module for expansion and connection of multiple WIM Control Units, expansion at a single location is virtually unlimited.

INTERNATIONAL ROAD DYNAMICS INC.

www.irdinc.com

We make highways talk™

- *MANAGEMENT*
- *SAFETY*
- *PRESERVATION*

International Road Dynamics Inc. develops and maintains traffic management products and systems technology that make highways talk. What are they saying? They are providing information that roadway administrators need to manage traffic, preserve infrastructure and provide safety warnings to drivers.

IRD's multi-discipline, innovative and customer-focused team is expert in advanced technologies, advanced traffic solutions and custom-designed systems.

CUSTOMER DRIVEN™

iSINC Systems Electronics

The iSINC Electronics forms the core of IRD's traffic and truck Weigh-In-Motion (WIM) systems, controlling numerous functions and processes for multiple applications. The iSINC is designed to accommodate new and future applications.

Features

- **Advanced Design**
- **Modularity and Convenience**
- **Powerful Software**

- **Commercial Vehicle Operations (CVO)**
- **Virtual Weigh Stations**
- **Traffic Data Collection**
- **Safety Systems**
- **Border Crossing and other ITS Applications**

JULY, 2005 REV. B
PRINTED IN CANADA

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Specifications

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ISINC WIM CONTROL UNIT DETAILS

- Processor: 32-bit RISC
- Memory: 32 MB RAM, 32 MB Flash
- I/O: 10/100BASE-T Ethernet
  - Modem Port
  - Terminal Port

COMMUNICATION
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International Road Dynamics Inc.

ISO 9001:2000 Quality System Registered to Canadian Corporate Office

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Pubically Traded on the TSX (Symbol IRD)
Find out more about IRD on our website: www.irdinc.com

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4.2 Cabinet Specifications

Rack Mount

IRD #580065 Mfg #RM462420

APX Enclosures, Inc.

RACK MOUNT

APPLICATION - NEMA 3R

APX Enclosures, Inc. 3R 19" rack mount enclosures are designed to house electronic controls, terminals, and instruments, and to provide protection from rain, sleet, snow, dripping water and corrosion, while providing ventilation.

APPLICATION - NEMA 4X

APX Enclosures, Inc. 4X 19" rack mount enclosures are designed to house electronic controls, terminals, and instruments, and to provide protection from rain, sleet, snow, dripping water and corrosion, as well as hosedown, splashing water, oil or coolant seepage.

INDUSTRY STANDARD:

U.L. Type 3R, 4X

A. ENCLOSURE:

1. The complete enclosure is made from .125" thick aluminum alloy type 5052-H-32 to provide a strong and rigid construction. Alternative material is 14 gauge type 304 stainless steel. (Specifier must choose the material to be used.)
2. Each enclosure is equipped with bracket provisions for rigid mounting of an optional EIA 19" rack frame assembly for mounting components. (See page C8 for E.I.A. rack specifications and catalog numbers.)
3. The door frame opening is double flanged on all four sides. These flanges increase the strength of the door opening and help prevent dust and liquids from dropping into the enclosure when the door is opened.
4. All exterior seams are ground smooth or sealed weathertight with silicone sealant.
5. All hardware is either stainless steel or aluminum.
6. Each (3R only) enclosure has provisions for mounting a forced-air fan system that can be thermostatically controlled, and air is exhausted through a screened vent system in the enclosure top.

B. DOOR: (Front-hinge on left, rear-hinge on right)

1. Equipped with three-point latching mechanism with nylon rollers at the top and bottom.
2. The door handle is .75" stainless steel round bar and has provisions for a padlock.
3. (3R only) The standard main door lock is Corbin #1548-1 or equal.
4. (3R only) A louvered air vent with reusable metal filter and retaining brackets is provided.
5. The main door is sealed with closed-cell neoprene gasket.
6. The continuous door hinge is .075" thick stainless steel with a .25" stainless hinge pin.

C. FINISH:

1. Natural aluminum enclosures are mill finish per federal specification QQA-250/8.

NEMA 3R SHOWN

Optional rack frame shown installed

2. Painted enclosures are treated with an iron phosphate coating and dried by radiant heat. The standard finish coat is baked polyester powder.

FOR NEMA TYPE 4X RATING:
DELETE *all vents and main door lock (Corbin #1548-1), and switch compartment assembly.*
ADD *all through holes are sealed.*

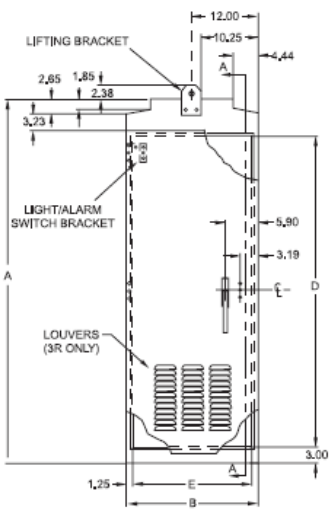
200 Oregon Street, Mercersburg, PA 17236-1630 · Tel (717) 328-9399 · Fax (717) 328-2447 · www.apx-enclosures.com

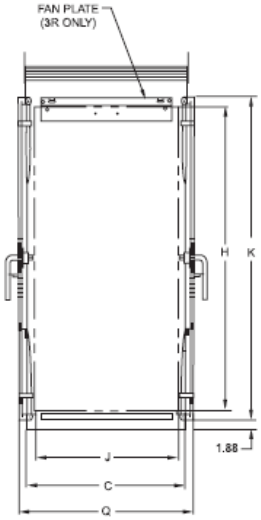
A15

APX Enclosures, Inc.

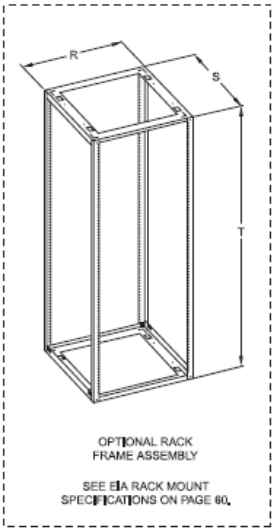
Rack Mount Enclosure

RACK MOUNT ENCLOSURE



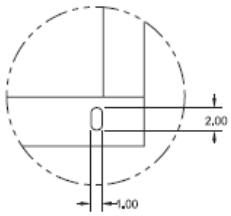


SECTION A–A

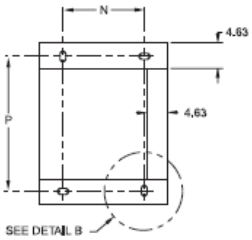


OPTIONAL RACK FRAME ASSEMBLY

SEE EIA RACK MOUNT SPECIFICATIONS ON PAGE 60.



DETAIL B

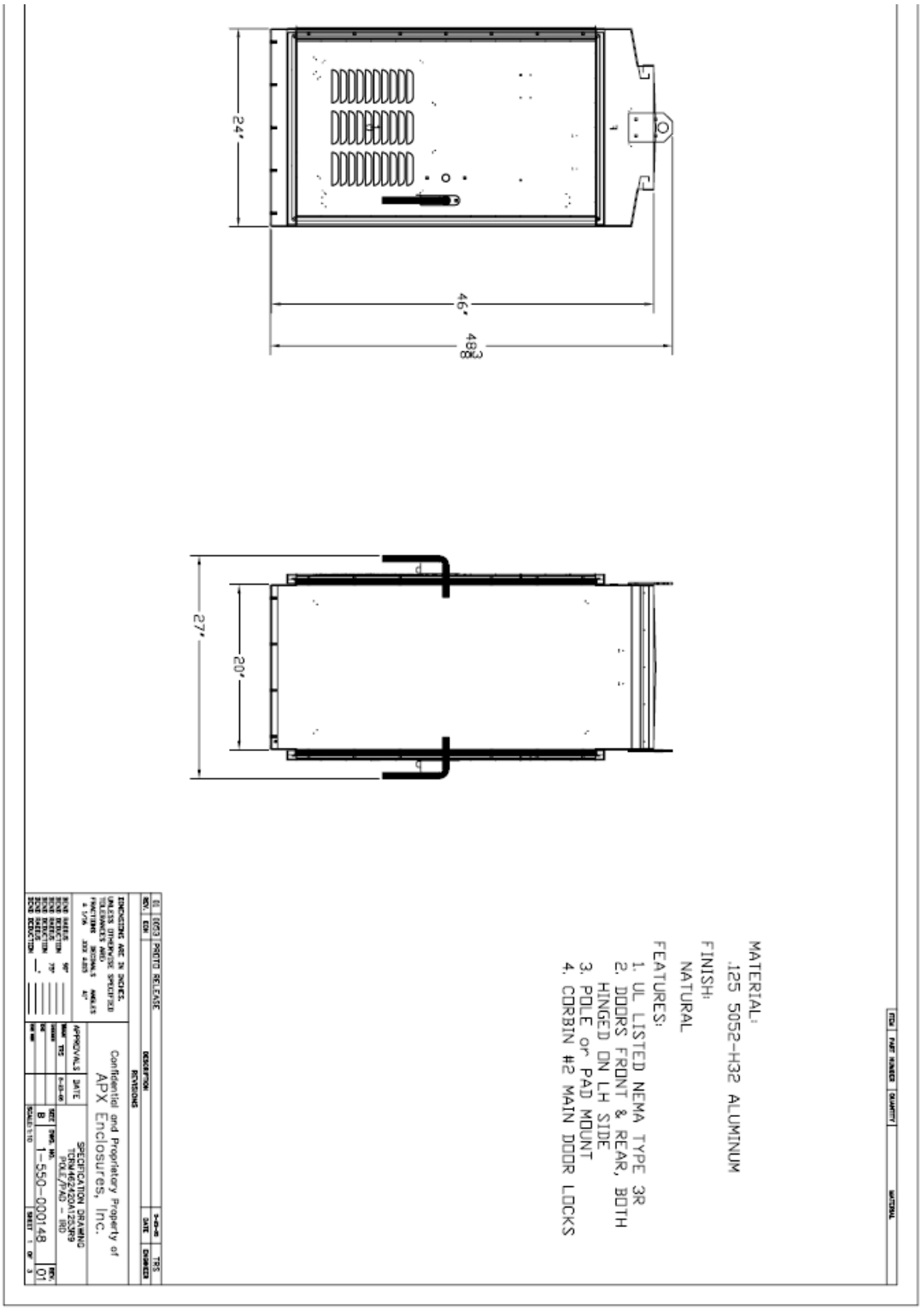


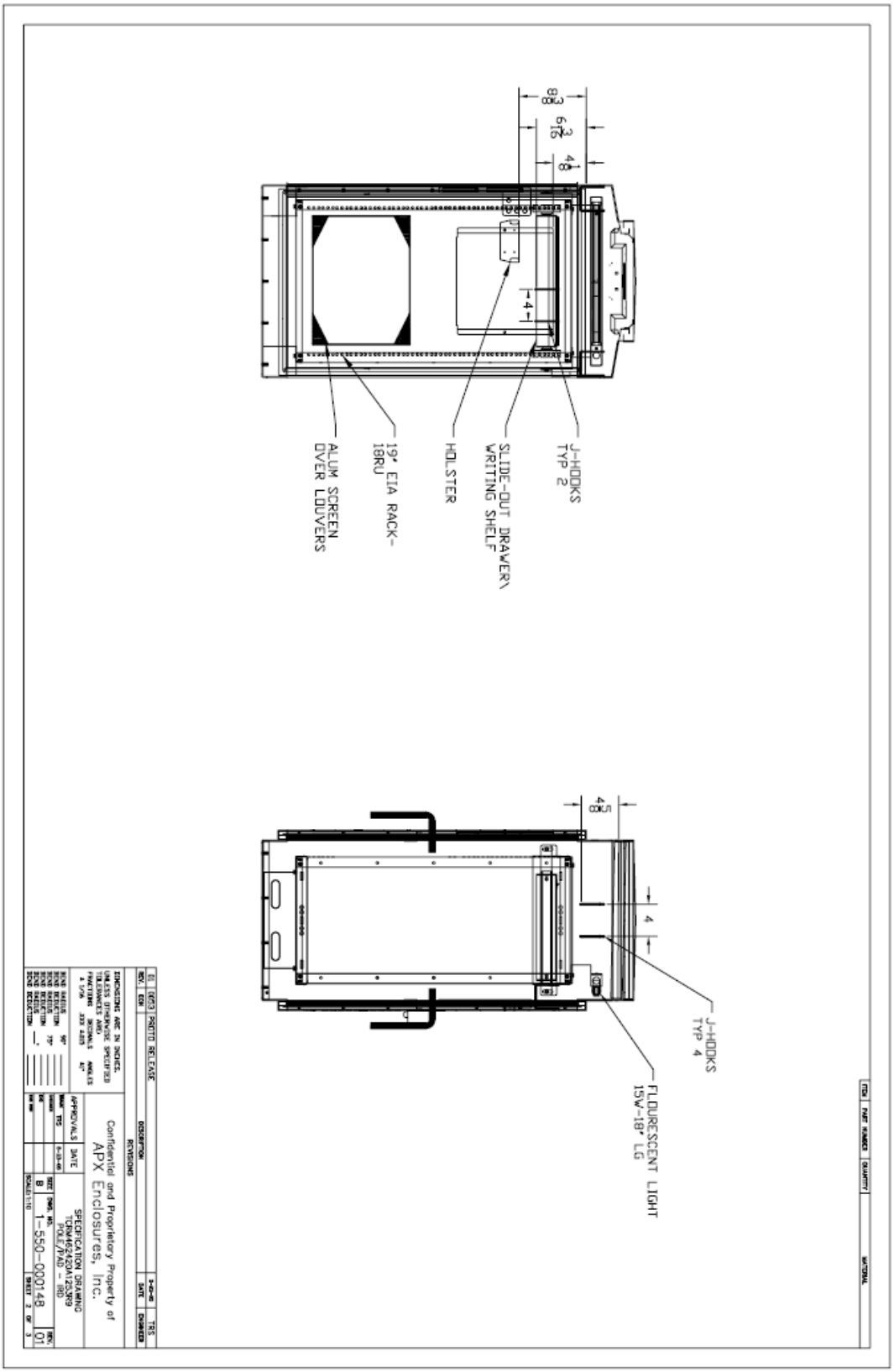
PAD MOUNTING PATTERN

OPTIONS:

- Locks: Keying, Other Than Standard
- Rack Frame Assembly
- Switch Compartment
- Custom Equipment Mounting
- Climate Control
  - Air Conditioner
  - Sunshields
  - Insulation
  - Heater
  - Forced-Air Ventilation Fan (3R only)

CATALOG NUMBER	SUGGESTED MOUNTING OPTIONS			CABINET			DOOR OPENING		SWITCH COMPARTMENT LOCATION		AVAILABLE SPACE		DOOR HEIGHT	PANEL		PAD MTG. PATTERN		GENERAL INFORMATION			
	PED	POLE	PAD	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T
RM392420	YES	YES	YES	39.00	24.00	20.25	9.00	21.50	OPTIONAL		25.75	16.50	31.25	N/A	N/A	15.00	15.00	22.75	20.00	15.75	27.25
RM462420	NO	YES	YES	46.00	24.00	20.25	36.00	21.50	OPTIONAL		32.75	16.50	38.25	N/A	N/A	15.00	15.00	22.75	20.00	15.75	34.25
RM463026	NO	YES	YES	46.00	30.00	26.25	36.00	27.50	OPTIONAL		32.75	22.25	38.25	N/A	N/A	21.00	21.00	28.50	20.00	20.75	34.25
RM553026	NO	YES	YES	55.00	30.00	26.25	44.00	27.50	OPTIONAL		41.75	22.25	47.25	N/A	N/A	21.00	21.00	28.50	20.00	20.75	43.25
RM672430	NO	NO	YES	67.00	24.00	30.00	57.00	21.50	OPTIONAL		53.75	26.25	59.25	N/A	N/A	15.00	25.00	32.50	20.00	20.75	55.25
RM672438	NO	NO	YES	67.00	24.00	38.00	57.00	21.50	OPTIONAL		53.75	34.25	59.25	N/A	N/A	15.00	33.00	40.50	20.00	29.25	55.25


24"
46"
48 3/8
27"
20"
MATERIAL:
.125 5052-H32 ALUMINUM
FINISH:
NATURAL
FEATURES:
1. UL LISTED NEMA TYPE 3R
2. DOORS FRONT & REAR, BOTH HINGED ON LH SIDE
3. POLE or PAD MOUNT
4. CORBIN #2 MAIN DOOR LOCKS
ITEM
PART NUMBER
QUANTITY
MATERIAL
01
10/03
PROTO RELEASE
DESCRIPTION
DATE
DRAWN
REVISIONS
Confidential and Proprietary Property of
APX Enclosures, Inc.
APPROVALS
DATE
SPECIFICATION DRAWING
TCRN462420A125RB
POLE/PAD – RD
SIZE
DWG. NO.
REV.
B
1-550-000148
01
SCALE 1:10
SHEET 1 OF 3


J-HOOKS
TYP 2
SLIDE-OUT DRAWER\
WRITING SHELF
HOLSTER
19" EIA RACK-
18RU
ALUM SCREEN
OVER LOUVERS
J-HOOKS
TYP 4
FLOURESCENT LIGHT
15W-18" LG
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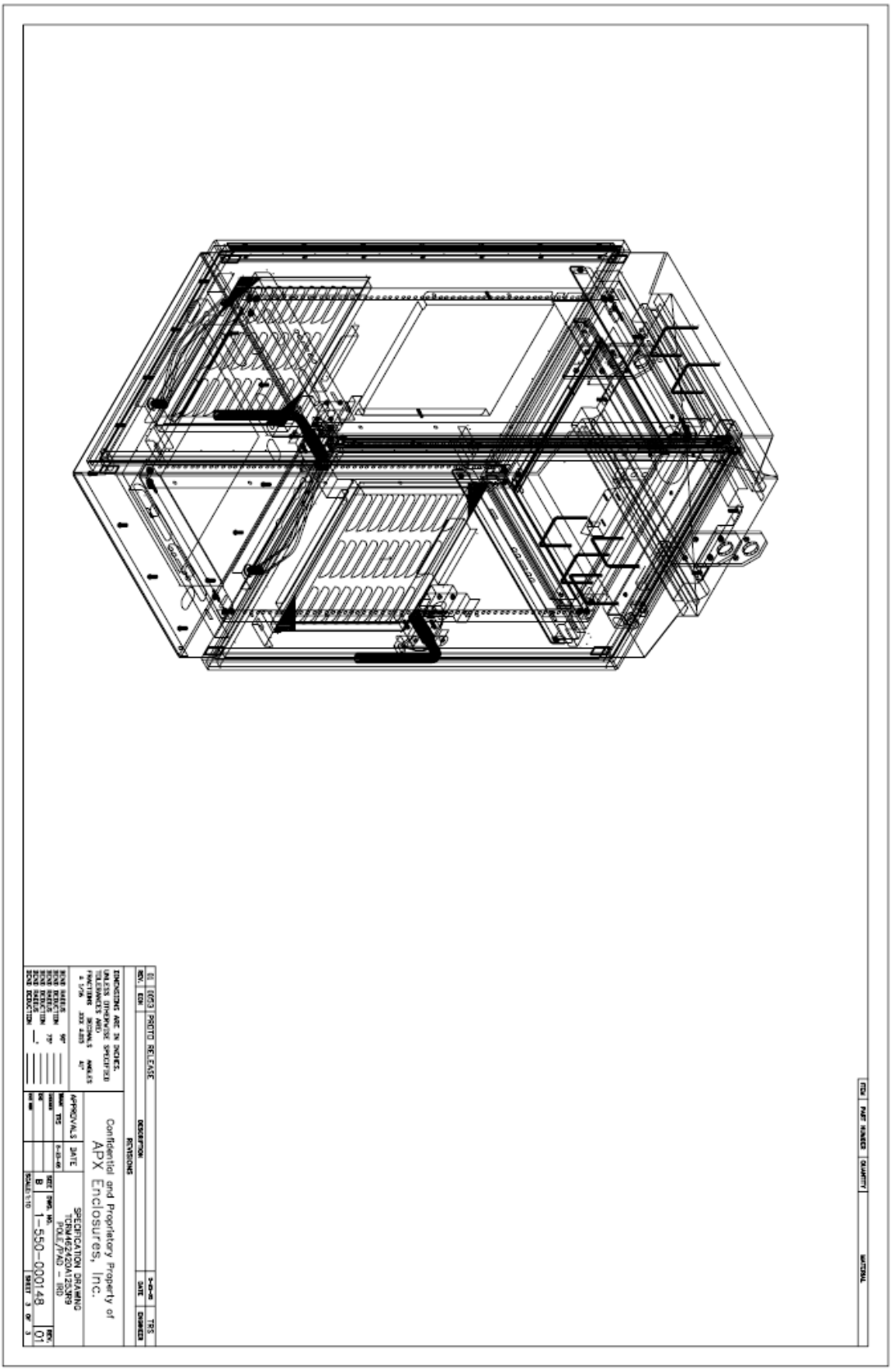
APX Enclosures, Inc.
SPECIFICATION DRAWING
TORN46420A12S3R9
POLE/PAD - IRD
1-550-00014B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QUANTITY
MATERIAL

4.3 Operator's Manual

4.3.1 Introduction

4.3.1.1 Scope

This manual describes the components of the IRD iSINC Data Collection system, normal operation of the system and outlines some basic maintenance and trouble-shooting. It deals in detail with the components of the iSINC controller assembly. This manual does not cover assembly, installation or configuration procedures for the component parts of the Data Collection system. Refer to section 4.3.3, References, for sources of this information.

4.3.1.2 System Overview

The IRD iSINC (intelligent Systems Interface and Network Controller) Data Collection system is a reliable, automatic data collection system that determines vehicle weights and dimensions, classifies the vehicles according to a pre-defined set of criteria and stores the vehicle records for future analysis.
The IRD iSINC Data Collection system consists of two groups of components: the in-road sensors and the iSINC data processing system.
The in-road sensors for each lane of traffic being monitored consists of a Weigh-In-Motion scale to determine axle weights, axle sensors to determine the axle spacings and detection loop sensors to track vehicle progress through the system.
The iSINC processor takes all the input from the sensors, calculates weights, axle separations, speed, vehicle classification and potential violations, and outputs the resulting vehicle record to the datafiles stored on the system.

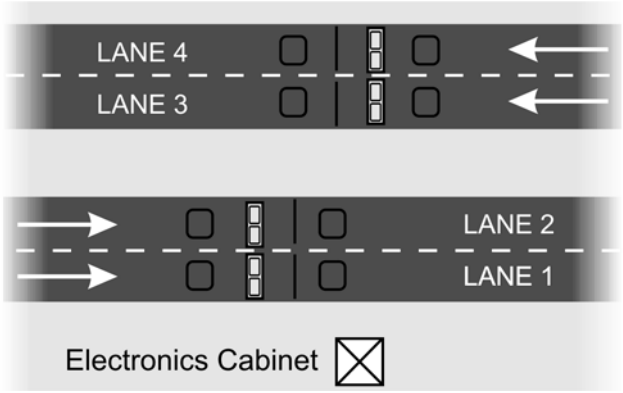


Figure 1- iSINC data collection system

The iSINC is a self contained sensor and interface controller that integrates all the system components. The iSINC electronics are enclosed in a secure, weather resistant cabinet. Also in the cabinet are the power connections, power supplies, input connections for the sensors, over voltage protection and optional modem and network connections. With the modem or network connection the system can be accessed and maintained remotely.
The IRD iSINC Data Collection system will weigh trucks at speeds between 10 and 250 kph (6 and 155 mph) with a minimum axle spacing of 60 cm. (24 inches).
The system is designed to function with minimal maintenance in an all-weather environment with minimal operator input.

4.3.2 Conventions

Labels on system components or of items displayed on the workstation monitor (window titles, lists, buttons, etc.) are printed in **Bold**.
Anything that is to be typed in on the workstation keyboard or handheld terminal keypad is enclosed in angle brackets < > and printed in ***Bold Italic***.
Any items of special note are printed in *italic*, with a ***Note:*** header.

4.3.3 References:

- IRD iSINC Data Collection System Installation Manual 821002
- ASTM E1318-02 Standard Specification for Highway Weigh-in-Motion (WIM) Systems with User Requirements and Test Methods
- NTCIP 1206 V01.18 Feb. 2002 Object Definitions for Data Collection and Monitoring (DCM) Devices (Draft), National Transportation Communications for ITS Protocol *http://www.ntcip.org/library/documents* document 1206

4.3.4 System Components

4.3.4.1 Electronics Cabinet

The electronics cabinet houses the iSINC processor, the termination panels for the signal and power cables, the breaker panel, and the internal wiring and components to interconnect the parts of the system. If the system is equipped with the optional solar/battery power source, the batteries and charging control circuitry are located in the cabinet. The electronics are housed in a 46” x 24” x 20” weather resistant metal cabinet.

Figure 2 - Electronics cabinet

The electronics cabinet contains the rack mounted system hardware.

Figure 3 - Typical electronics system hardware

The component layout of the front on the assembly is illustrated in Figure 4:

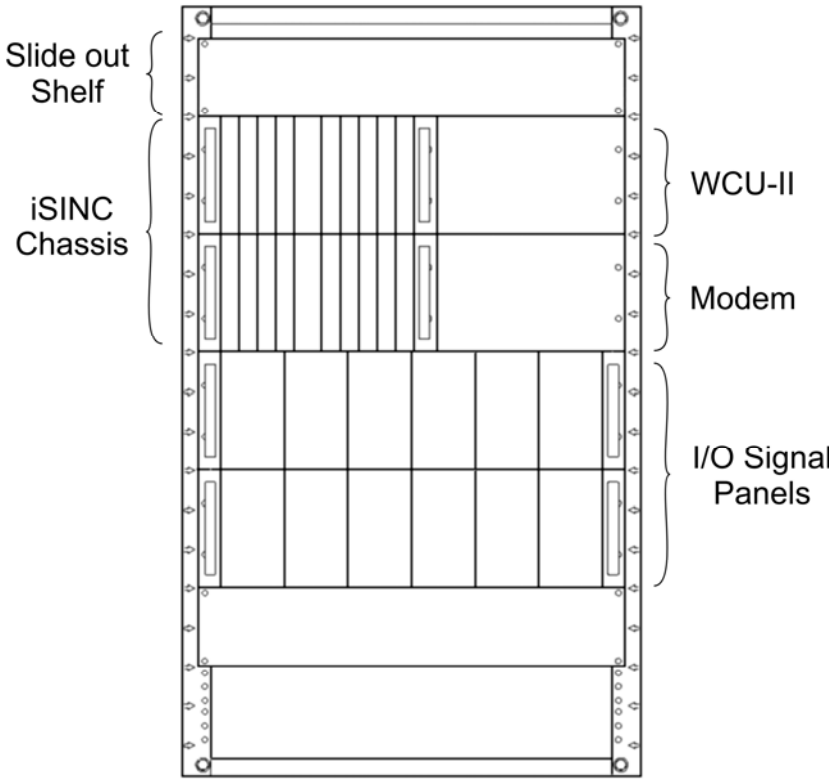


Figure 4 – Typical panel locations in rack assembly

The sections below give a more detailed description of the components in the electronics cabinet and their operation.

4.3.4.2 iSINC Controller

The iSINC (intelligent Systems Interface and Network Controller) receives all inputs from the sensors, processes the raw inputs into vehicle records and outputs the vehicle records to a data file.

The iSINC is made up of a 3U 42HP sub-rack chassis that houses the signal processing modules and the WIM Control Unit (WCU) that mounts beside it. The WCU is the processor that configures the system, controls system operations, handles external communications and stores vehicle data.
Note: *The iSINC Data Collection system uses the uprated WCU-II controller. In this manual the terms WCU and WCU-II are used interchangeably.*
The chassis has slots for up to ten electronics cards (modules), a CAN Bus backplane and the plug-in electronics modules that handle the signals to and from the various sensors. The modules that are present in an iSINC system will depend on which optional sensors are installed with the system. The iSINC also retains system performance data and diagnostics that are accessed through a hand held keypad terminal, a PC operating in terminal mode, or a remote computer connection.

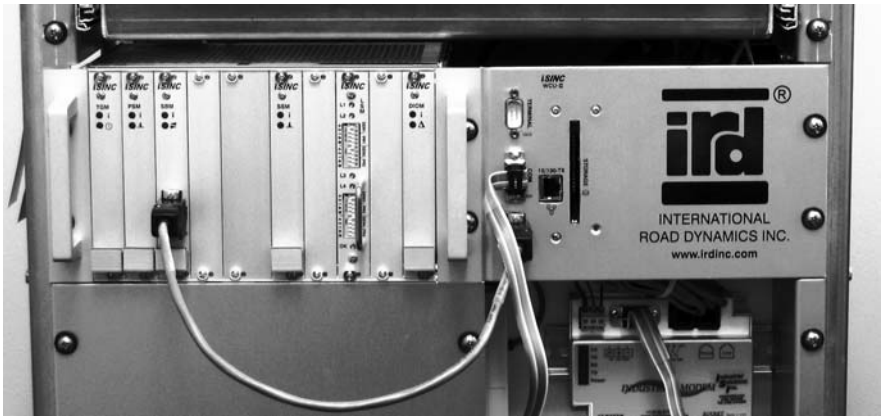


Figure 5 – iSINC controller

The front of the iSINC is made up of the face plates for the component modules. Depending on which options are installed with the system, some face plates illustrated may not be present. Blank panels cover the slots in the iSINC case with no modules installed.
Each module contains firmware to identify signals on the CAN Bus that are relevant to the module, process the input signals it receives, place the results of its processing on the CAN Bus, and take the appropriate action for any messages on the CAN Bus that it has been programmed to respond to.
The iSINC system operates on **Events**. An event may be triggered by an input from one of the sensors, by an input from the communications interface (network or terminal), by the end of a time interval or by another event message on the CAN Bus. An event may cause a message to be broadcast on the CAN Bus. When an event message is put on the bus, each module examines the message to determine whether or not it needs to take any action. If so, the module reads the message, does the required processing, and, if necessary, outputs the results to the appropriate destination (CAN Bus, communications port or signal channel).

4.3.4.3 iSINC CAN Bus Backplane

Signals between modules in the iSINC chassis are put on the CAN Bus backplane. Each module (card) plugs into an edge connector attached to the backplane. The position of the edge connectors corresponds to the slide in slots for the cards.
The iSINC is configured so that the slot number where each module is located in the chassis corresponds to the connections for the various system inputs and outputs on the Signal I/O panels; any given slot must be occupied by a specific card type to function correctly (i.e. cards of different types may not swap positions). A card may be replaced with another of the same type.

Each card in the system is uniquely identified by a Unit Identification number (UID). The UID is made up of two parts:
Card position – the slot number between 0 and 9 that the module occupies in the iSINC chassis.

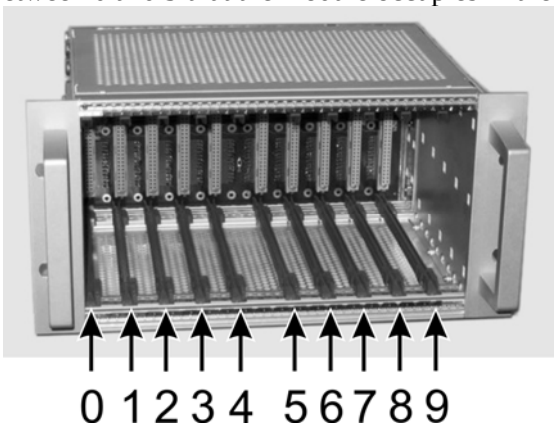


Figure 6 - iSINC UID slot numbering

Specific slots are designated for specific card types in each iSINC chassis. Refer to Appendix A.1.4 for a table listing of the system options available.
Chassis ID – each iSINC chassis in a system is identified by the 4 element DIP switch located on the CAN Bus backplane. The 4 bits of the switch settings make up the chassis ID part of the UID. The first chassis (topmost in the electronics cabinet) ID is number 0; if an additional chassis is required, it will have the ID number 1.

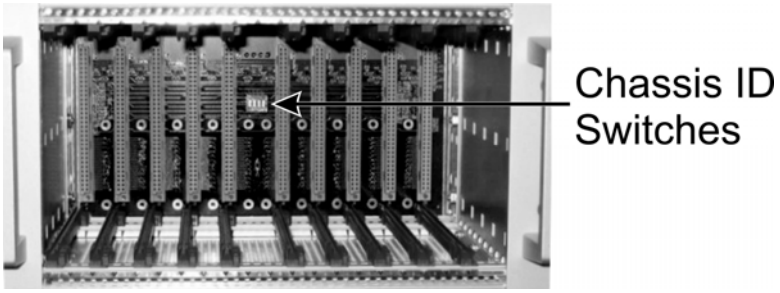


Figure 7 - iSINC chassis ID switches

On the rear side of the backplane are the 4 pin power connector and the 24 pin ribbon cable connectors for each slot in the chassis. Through a backplane ribbon connector, the module in a slot is connected to one of the Signal I/O panels for communication with external devices.

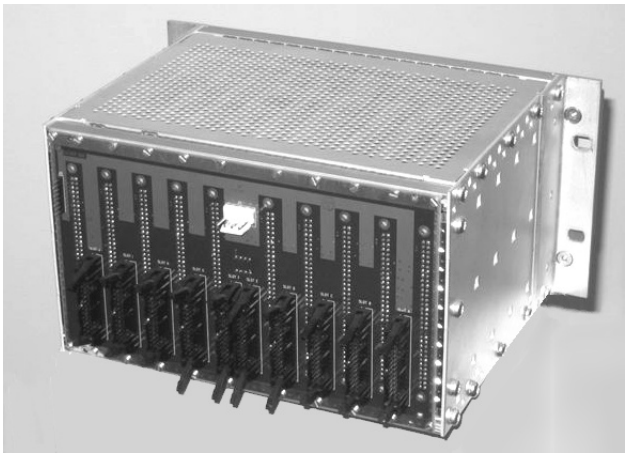


Figure 8 - Rear view of iSINC chassis

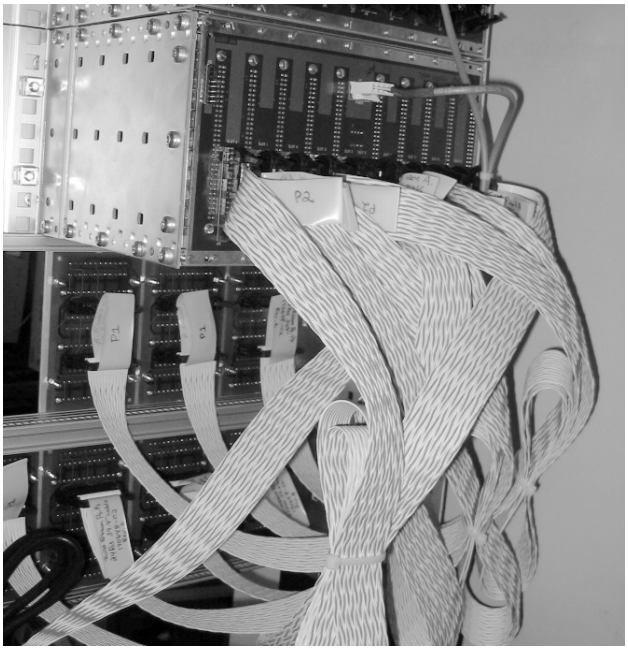


Figure 9 - Ribbon cables connecting backplane to I/O panels

4.3.5 iSINC Modules

4.3.5.1 WCU

The WIM Control Unit stores and runs the program that controls the system, records system data, and communicates with other computers.
The WCU is mounted on a separate 3U 42 HP panel that fits adjacent to the iSINC chassis in the mounting rack.

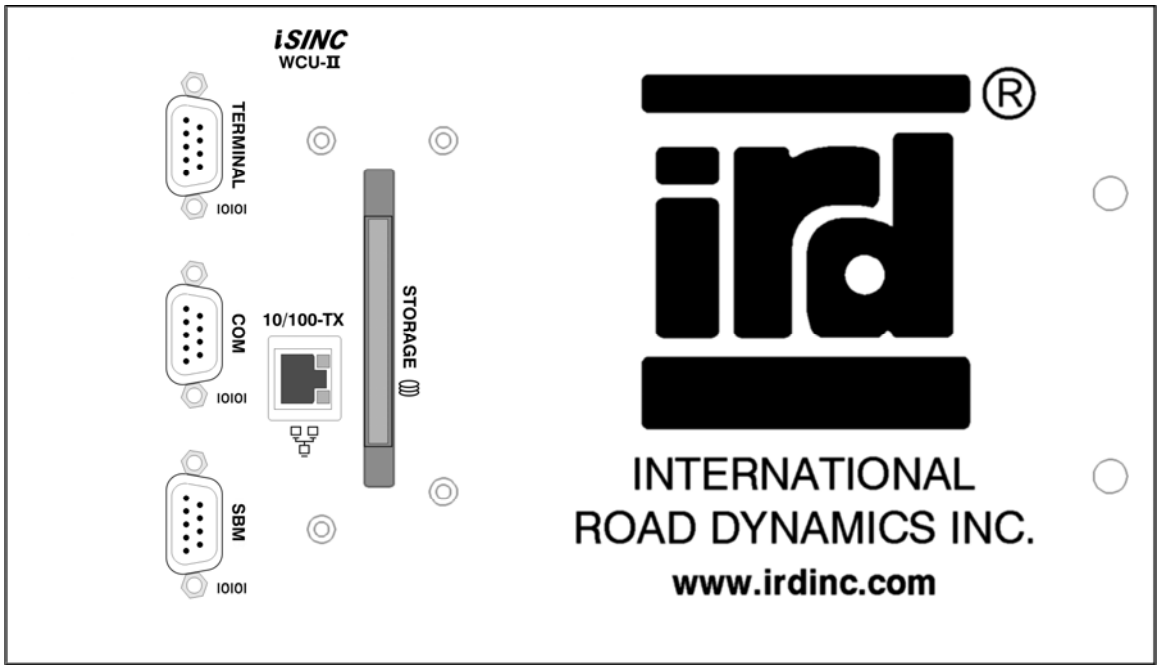


Figure 10 – WCU panel

The WCU communicates with iSINC chassis CAN Bus through an SBM in slot 2 of the iSINC chassis connected to the port labeled **SBM** on the WCU panel.
The removable memory flash card (labeled **Storage**) holds the database of vehicle records produced by the system. It also contains the system configuration settings.
The RJ45 connector labeled **10/100-TX** provides a 10 baseT Ethernet connection (refer to section 4.3.10.4 for details)
The connector labeled **Terminal** provides a serial connection link to a local terminal (refer to section 4.3.10.1).
The connector labeled **COM** provides a serial communications link for a remote connection through an optional modem (refer to section 4.3.6.1)
The connector labeled **SBM** is a serial link between the WCU and the iSINC CAN Bus.

4.3.5.2 TGM

The Timing Generation Module provides the synchronizing pulse for all other system modules and keeps accurate time for the system.

Figure 11 - TGM faceplate

The TGM supplies the time synchronization for all other modules in the system and the current date and time as the count of seconds from midnight (00:00:00) on January 1st, 1970. Time resolution is .25 milliseconds (1 "tick").

Inputs:

- Current time/date
- Requests for time of day

Outputs:

- Time synchronization event (every second)
- Time of day

The lower LED, labeled , will flash every second to indicate that the clock is running.

4.3.5.3 SSM

The Scale Sensor Module handles signals to and from single load cell or bending plate weigh-in-motion scale platforms to produce an axle weight.

Figure 12 - SSM faceplate

An SSM can process the signals for up to six weigh scale sensors. The excitation signals to and load signals from the scale sensors are connected to the iSINC through a Signal I/O panel (refer to section 4.3.5.8).
The SSM is programmable for the following values:

- Type of weighing sensor: single load cell, bending plate or slow speed weigh-in-motion sensor.
- Threshold – input value above which weight sampling will begin.
- Debounce factors – the lengths of time (in ticks) after the input signal rises above threshold or falls below threshold to wait before switching states (from sampling to not sampling or vice versa).

Inputs:

- Signals from up to 6 weight sensor (between 0 and 5 volts)

Outputs:

- Weight
- Time that the weight samples were taken

The sensor inputs should be in the range 0 to 5 volts. The analog input signals are converted to a 12 bit (0 to 4095) digital value.

The lower LED, labeled ⤓ will light whenever a weight is reported.

4.3.5.4 PSM

The Piezo Sensor Module processes signals from Piezoelectric Class 1 axle sensors, Piezoelectric Class 2 weigh-in-motion sensors, Kistler weigh-in-motion sensors and from temperature sensors.

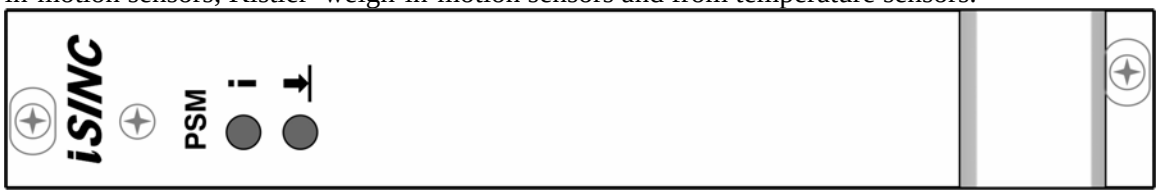


Figure 13 - PSM faceplate

It can process the signals for up to four piezo sensors plus one temperature sensor. The excitation signals to the temperature sensor and input signals from the piezo and temperature sensors are connected to the iSINC through a Signal I/O panel (refer to section 4.3.5.8).
The PSM is programmable for the following values:

- Type of piezoeletric sensor: Class I, Class II, Kistler.
- Threshold – input value above which an axle is detected (weight sampling will begin for Class I sensors).
- Debounce factors – the lengths of time (in ticks) after the input signal rises above threshold or falls below threshold to wait before switching states.

Inputs:

- Signals from up to 4 weight sensors (between 0 and 1 volts)
- A temperature sensor signal

Outputs:

- Weight
- Time that the weight samples were taken

The sensor inputs should be in the range 0 to 1 volts. The analog input signals are converted to a 12 bit (0 to 4095) digital value.
The lower LED, labeled ⤓ will light whenever an axle is detected or vehicle weight is reported.

4.3.5.5 LSM

The Loop Sensing Module detects a vehicles presence in an inductive detecting loop.

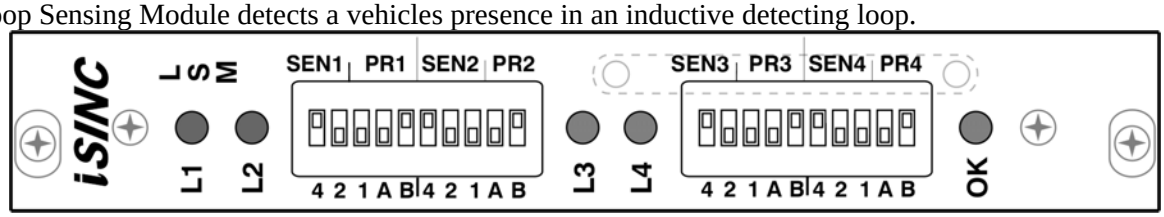


Figure 14 - LSM faceplate

The LSM is different from other modules in that it does not report the results of its sensor inputs on the CAN Bus. It receives the input signals from the sensing loops and transforms them into digital signals which are transmitted to the Digital I/O module via jumper wires between the LSM and DIOM I/O Signal Panels (refer to Appendix 0).

The LSM can process the signals from up to four sensing loops. The indicator lights on the LSM faceplate labeled **L1**, **L2**, **L3** and **L4** will light when a vehicle passes over the loop associated with the light.

The LED labeled **OK** will be on if the loops are operating normally. If the LED is off there is a problem with one of the loops.

The two blocks of DIP switches adjust the sensitivity of the loops and operating mode of the loop detectors; the switch settings shown in the illustration above (sensitivity of 4, presence B) should produce consistent detection of most vehicles. Refer to Appendix A.1.1 for a detailed description of the operations of the LSM switches.

Inputs:

- Signals from up to 4 magnetic sensing loops

Outputs:

- Digital signals for the DIOM

4.3.5.6 SBM

The Serial Bridge Module connects the CAN Bus to another serial communication device, such as the WCU or another iSINC chassis in a system where more than eight modules are required.

Figure 15 - SBM faceplate

The lower LED, labeled ◤, will flash when the serial link is active.

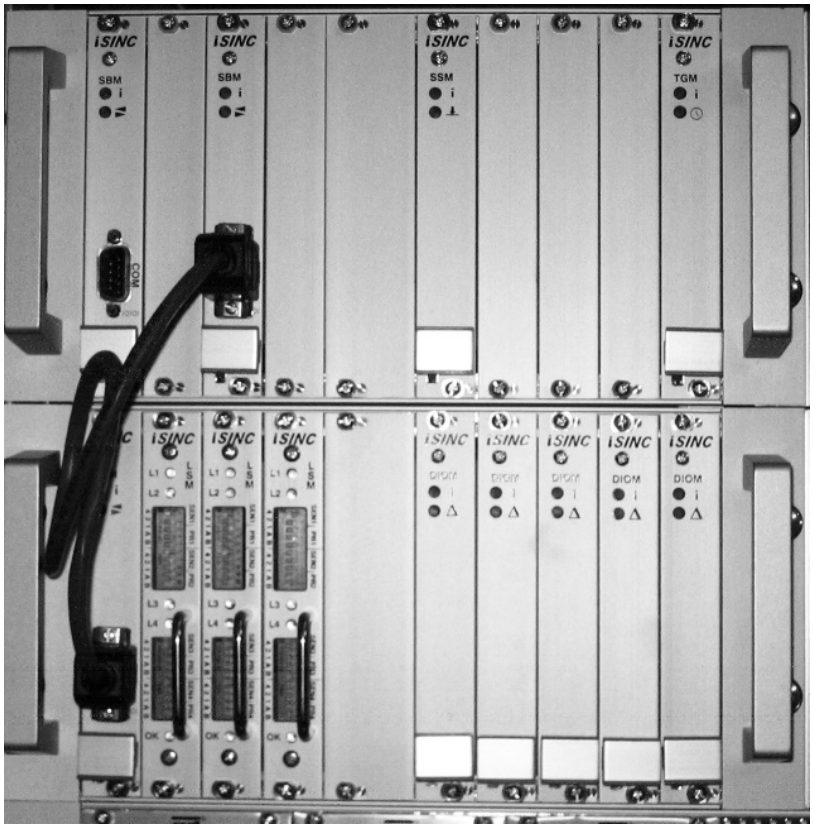


Figure 16 - Two iSINC units joined via SBM modules

4.3.5.7 DIOM

The Digital Input/Output Module handles all the digital signals to and from the iSINC. These include:

Dynax axle sensors (after signal conditioning by the Dynax input panel)
Sensing loops (after signal conditioning by the Loop Sensing Module)

Figure 17 - DIOM faceplate

The input and output signals to and from the DIOM are connected to the iSINC through a Signal I/O panel (refer to section 4.3.5.8).
Each channel of a DIOM can be set independently. The DIOM is programmable for the following values:

- Debounce factors – the lengths of time (in ticks) after an input signal activates or deactivates to wait before switching states.

Inputs:

- Up to 8 digital loop signals output from LSMs
- Signals from up to 8 Dynax axle sensors or off-scale sensors (or combination thereof)

Outputs:

- "Vehicle entering sensor array" event if DIOM input is from the first magnetic sensing loop in the sensor array.
- Time (in .25 msec ticks) from when the first loop in the sensor array was triggered if DIOM input is from the second magnetic sensing loop in the sensor array.
- Time (in .25 msec ticks) from when the first axle triggered the axle sensor to current axle if DIOM input is from a Dynax is acting as an axle sensor or;
- "Off-scale" event if DIOM input is from a Dynax is acting as an off-scale sensor.

The lower LED, labeled Δ, will flash when any digital I/O signal changes (a vehicle enters or leaves a loop, a wheel rolls onto an axle sensor, an output signal is changed, an off-scale detected, etc.).

4.3.5.8 Signal I/O Panels

The Signal Input/Output panels serve as the connection point for the wiring from the various sensors and low voltage input and output devices that send signals to and receive signals from the iSINC. There will be a Signal I/O panel for each module that receives input from the sensors (e.g. LSM, SSM, PSM, DIOM). Up to six 3U height, 14 HP width panels will fit in a standard 84 HP width sub-rack chassis.
Each panel houses three 12 connector terminal blocks. Refer to Appendix A.1.2.1 for the terminal block connector number assignments for the I/O signal wiring for each type of module. The low voltage signal lines should be fitted with ferrules prior to attachment to the connector to enhance wire-to-connector reliability.

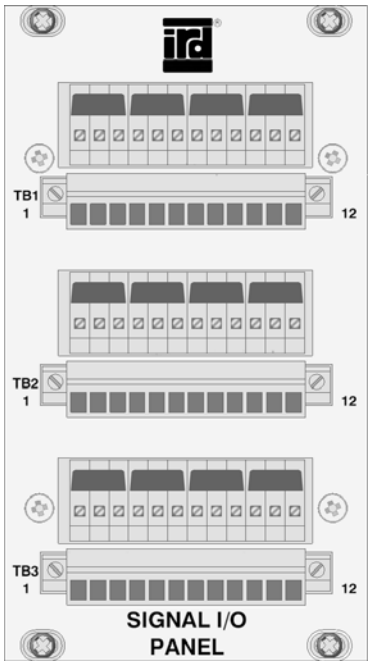


Figure 18 – Signal I/O panel

On the back of each Signal I/O panel are two 24 pin ribbon cable connectors, one for signals to and from a Loop Sensing Module and one for all other signals. If an I/O panel is handling the signals for an LSM, the ribbon cable must be attached to the lower connector. If the panel is handling signals for any other type of module, the cable must be attached to the upper connector.

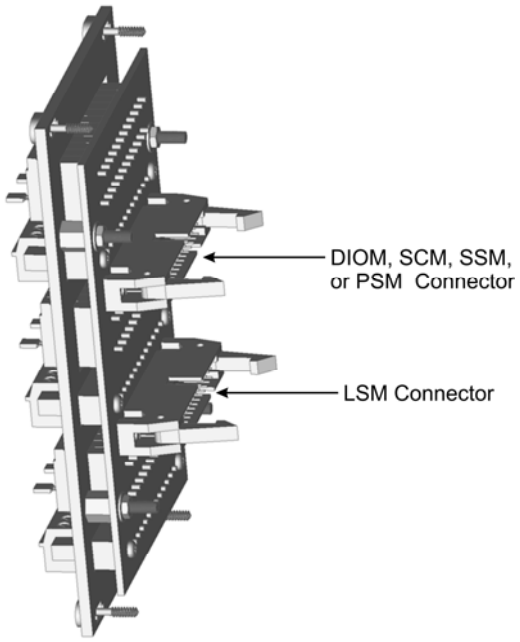


Figure 19 - Back of Signal I/O Panel

The Signal I/O panel also houses primary over-voltage protection. Each I/O line is protected by a solid state over-voltage protection device (refer to Appendix D for specifications). Each over-voltage device protects the I/O line located immediately below it on the Signal panel.

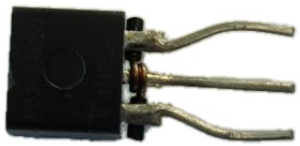


Figure 20 – Over-voltage Protection Device

The over-voltage device will protect the iSINC circuitry by automatically switching the line closed when a transient spike occurs. For very powerful transients, the device acts as a fuse and will short to ground; in this case, the device will be sacrificed to save the downstream electronics and it will be necessary to replace the over-voltage protector. If the iSINC indicator lights show that a signal is not being received, check the over-voltage protection for that component. The screw clamps below each pin of the over-voltage protectors also serve as a test points; use an ohmmeter to check for a short to ground between the signal lines and the center ground line. The Signal I/O panels are assigned specific locations in the mounting rack, which correspond to the modules in the iSINC chassis to which they are connected. If a module is not present in the iSINC chassis, then that Signal I/O panel position will have a blank panel installed. Refer to Appendix A.1.4 for descriptions of the various system layout options.

If the system uses Dynax axle and/or off-scale sensors, these will interface through a unique Signal I/O panel. The Dynax signal input panel houses signal conditioning hardware behind the panel:

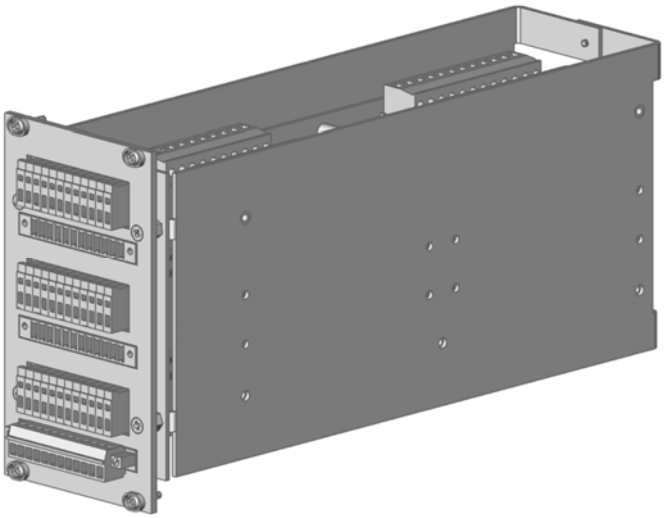


Figure 21 - Dynax Signal Input panel

Refer to Appendix A.1.2.1 for the terminal block connector number assignments for the Dynax input signal wiring.

4.3.6 Ethernet

If the system is to be connected to an Ethernet network, the connection is made via the 10/100-TX Ethernet connector on the front panel of the WCU. Refer to section 4.3.10.4 for information on establishing a network connection.

4.3.6.1 Modem

An optional modem provides a dial-up connection for remote system administration such as downloading data, operational checks and resetting weight limits.

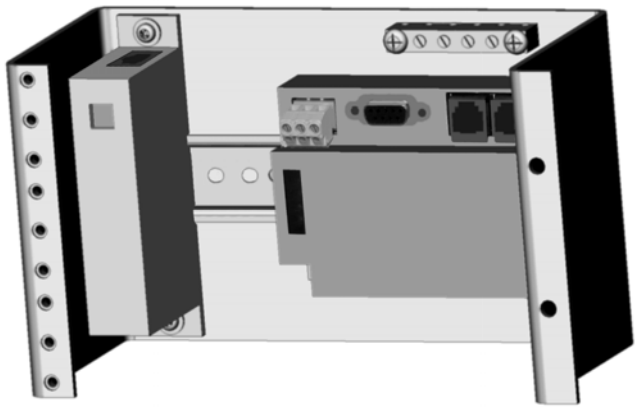


Figure 22 - Modem panel

The modem connects to the WCU through a serial cable to the port labeled **COM** on the WCU
Transient over-voltage protection on the telephone line is provided by a Zone Barrier surge protector.
Refer to section 4.3.10.4 for information on establishing a remote phone line connection.

4.3.7 Power Panel

4.3.7.1 AC Power panel

The panel for utility supplied AC power is accessed through the rear door of the electronics cabinet and is located on the left side of the rack (when viewed from the rear). The panel contains:

Main Circuit breaker box with a 30 Amp, 2 pole breaker

Sub-circuits breaker box with 4 x 15 Amp, single pole breakers

12 Volt power supply for iSINC electronics

Three duplex outlets

One Ground Fault Interrupt duplex outlet

Over-voltage protection

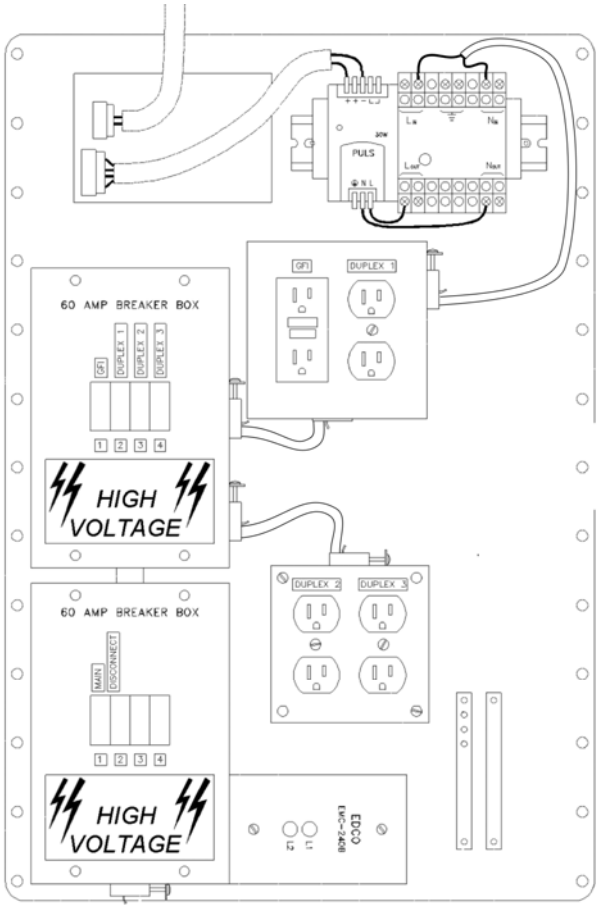


Figure 23 - AC Utility power panel

The AC main input is a 240 Volt utility supply. This is divided into two 120 volt circuits in the Main (lower) circuit breaker box which then feed up to the Service circuit breaker box. In the Service box the supply is divided into four 15 Amp circuits:

Circuit 1 – the GFI outlet

Circuit 2 – the iSINC power supply and Duplex outlet 2

Circuit 3 – Duplex 3

Circuit 4 – Duplex 4

The incoming line is connected to a primary over-voltage surge protection device attached to the Main breaker box. There are two indicator lights on the over-voltage protection box, labeled **L1** and **L2** for the two 120 volt circuits. Under normal operating conditions these lights will be on. If the power is off or the over-voltage device has been overloaded, the light for that circuit will be off.

4.3.7.2 Solar Panels & Battery Supply

The system may be equipped with an optional battery back-up power supply. The battery charging system may be from the main AC power supply or from an optional solar panel.
The length of time that the back up battery will provide power to keep the system operational will depend on the number and type of sensors in the system; the minimum operation time will be 10 hours at a very large, high traffic volume installation, a more typical installation would operate for approximately 48 hours without external power.

4.3.8 Sensors

The set of sensors in a traffic lane used to measure a vehicle's speed, dimensions and weights is know as a sensor array. The array may include any of the following sensors:

4.3.8.1 Single Load Cell Scales

Single Load Cell (SLC) Weigh-In-Motion scales determine axle weights using a hydraulically activated load cell mounted in the center of a scale pad. Typically two SLC scales placed side by side across the lane will be used in an array and can measure the weight of each side of an axle separately.

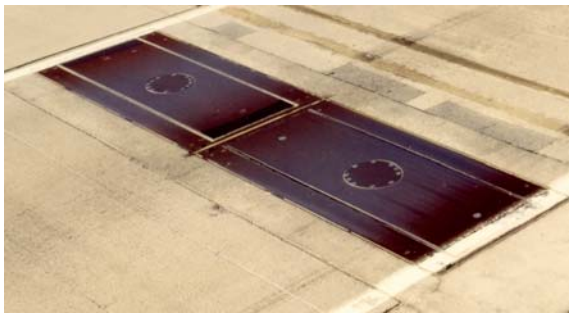


Figure 24 – Single Load Cell scales

4.3.8.2 Bending Plate Scales

Bending plate Weigh-In-Motion scales determine axle weights using strain gauges to measure the deflection of a steel pad. Typically two bending plate scales placed side by side across the lane will be used in an array and can measure the weight of each side of an axle separately.

Figure 25 - Bending Plate scales

4.3.8.3 Piezo Class I Scales

Piezo Class I and Kistler Quartz Lineas Weigh-In-Motion scales generate a piezoelectric current that is proportional to the vehicle's weight from the deformation of a crystal embedded in the sensor.

Figure 26 - Piezo Class I sensor

4.3.8.4 Inductive Loop Sensors

Sensing loops produce a current by magnetic induction when a vehicle passes over them. They are used to determine the vehicle's length and speed.

Figure 27 - Loop sensors

4.3.8.5 Piezo Class II Axle Senors

The Piezo Class II axle sensors generate a piezoelectric current from the deformation of a crystal embedded in the sensor. They are used to accurately determine axle spacing for vehicle classification and bridge formula calculations.

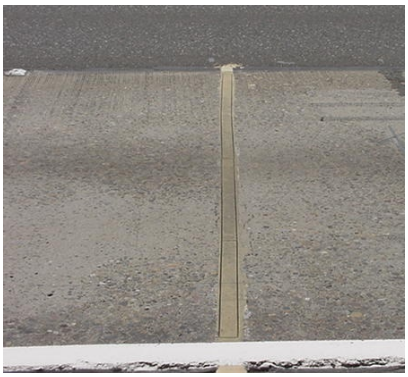


Figure 28 - Piezo Class II sensor

4.3.8.6 Dynax Axle Sensors

The Dynax axle sensors change resistance when pressure is applied on them. They are used to accurately determine axle spacing for vehicle classification and bridge formula calculations.
Dynax sensors may also be used at the outside edges of the WIM scales to act as off- scale detectors

Figure 29 - Dynax sensor

4.3.9 iSINC Data Collection System

4.3.9.1 Operation

IRD iSINC Data Collection Systems weigh and identify vehicles and store the resulting data records for use in analyzing traffic flows and/or the durability of roadways.
Weigh-In-Motion (WIM) technology uses sensors and/or scales imbedded in the road surface to collect data on passing traffic. This data includes measurements on vehicle spacing, speed, axle counts as well as axle and gross vehicle weight. The weight data collected is dependent on several factors, the most important of which is vehicle dynamics.

4.3.9.2 Factors Affecting WIM Operation

The WIM system measures the actual forces applied to the scale, which include forces caused by vehicle dynamics. Vehicle dynamics is the term used to describe the bouncing, load shifting, lateral sway, etc which occurs when a vehicle is in motion. A truck which is bouncing on a scale can cause an inaccurate reading (just as the weight reading on a static scale changes while a vehicle is moving on the platforms). To standardize the performance requirements of WIM systems, specifications for the smoothness and slope of roads used in WIM applications have been developed (refer to ASTM E1318-02 Standard Specification for Highway Weigh-in-Motion (WIM) Systems).

Where a high level of accuracy is required (WIM sorting at a weigh station), stringent controls on road quality and a high performance WIM system must be employed. These are to ensure that the road is smooth up and downstream of the scale and that the road is relatively flat. By reducing the impact on the vehicles the loads are more stable and the WIM system is more accurate.
Although these specifications reduce the effect of dynamics, vibration, etc, they cannot be completely avoided. This is especially true when a vehicle is hauling liquid loads (fuel tankers, etc). Due to the variable nature of these types of loads, they are not considered when determining a WIM system's accuracy. Additionally, since the dynamics cannot be completely removed by the above controls, the accuracy requirements for WIM systems allow for error and use statistics to determine the actual performance.

4.3.10 System Software Operation

The software program that controls iSINC operations runs on the WCU. The program runs from the WCU memory. A copy of the current system configuration is stored on the flash card; if no flash card is present, the default settings are used; if any changes to system settings are made, they must be saved to the flash card if they are to be used for future system operations (refer to section 0).
The iSINC program is menu driven. A complete layout of the menu tree is displayed in Appendix E.
The menus are accessed through a terminal connection.

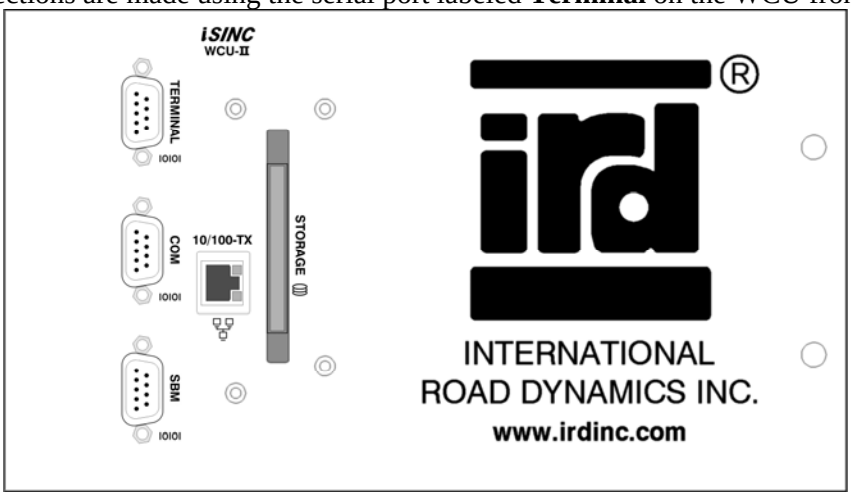
4.3.10.1 Terminal Connection

There are three options for making a terminal connection to the iSINC controller:

Through a PC (Personal Computer) set to terminal mode
Through a terminal keypad
Via a *secure shell* remote connection

4.3.10.2 Local terminal Emulation on a PC

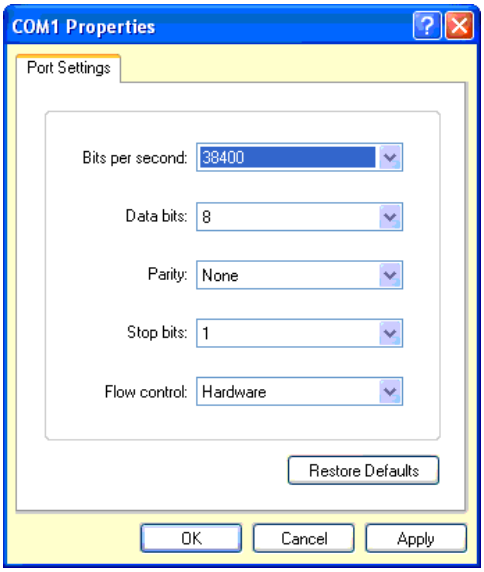
Local terminal connections are made using the serial port labeled **Terminal** on the WCU front panel:



To connect to the iSINC directly a Personal Computer acting as a terminal:

- Using an RS232 null modem cable, connect the serial COM port on the PC to the iSINC serial port labeled **Terminal**.
- Start a terminal emulation program such as MS Windows Hyper Terminal.
- Skip (click on the Cancel button) past any requests for telephone connection information.
- Select the computer COM port that the PC end of the cable is plugged into:

- Enter the following port settings:
  connection speed – **38400** Bits per second
  data bits – **8**
  parity – **None**
  stop bits – **1**
  control – **Hardware**



- The terminal screen will appear, Press the left arrow key < ← >, the iSINC will reply with the login screen; proceed to section 4.3.10.5 for log in instructions.

4.3.10.3 Keypad Terminal

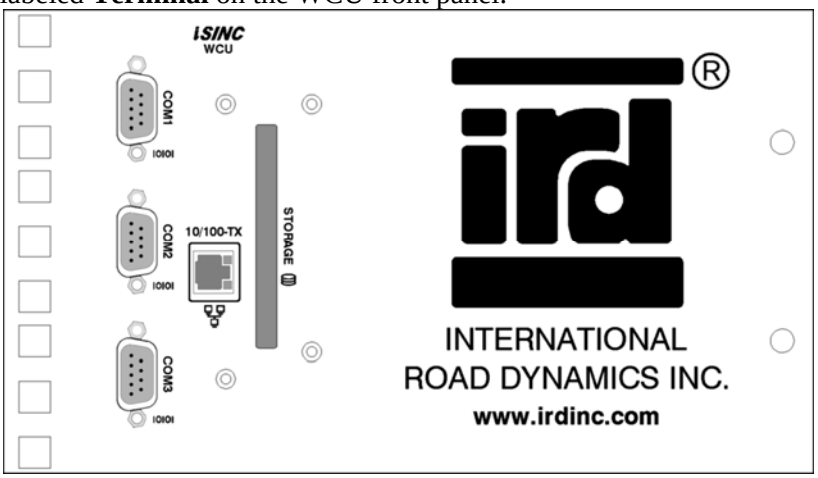
To connect the iSINC with a keypad terminal:

- Connect a straight RS232 cable between the female connector on the front panel of the iSINC serial port labeled **Terminal** and the keypad terminal.
- Press the left arrow key (◁) , the iSINC will reply with the login screen, proceed to section 4.3.10.5 for log in instructions.

Figure 30 - Keypad terminal

4.3.10.4 Remote (Network) Connection

The iSINC can establish a network connection over either a 10/100Base-T Ethernet cable, or through a telecom link to the modem. The 10/100 Ethernet connection is through a standard RJ45 Ethernet cable plugged into the socket labeled **10/100TX** on the iSINC front panel. The modem connection is through a 9 pin RS232 cable plugged into the port labeled **Terminal** on the WCU front panel.



> **Note**: a remote connection cannot be established if a local terminal is logged in. It is important that the local terminal be logged out when a session is finished if there is a remote link to the iSINC, otherwise no remote connection can be made.

To log in over a LAN/WAN network using a secure shell client, connect to the iSINC using the IP address provided by the system installer or, if none has been assigned, the default address of 127.0.0.1

The terminal screen will appear. Press the <***Enter***> key, the iSINC will reply with the login screen: proceed to section 4.3.10.5 for log in instructions.

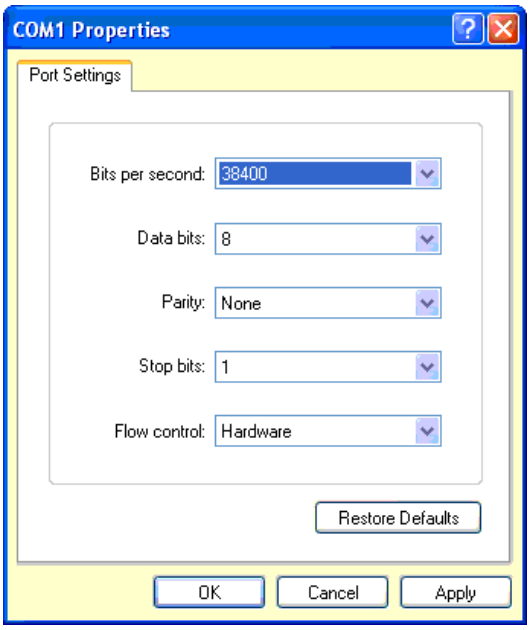
> The IP address and mask of the iSINC can be reset to match the LAN/WAN network configuration. Refer to section 4.3.10.17.

To connect over a dial-up telephone link using a modem:

- Start a terminal emulation program such as MS Windows Hyper Terminal.

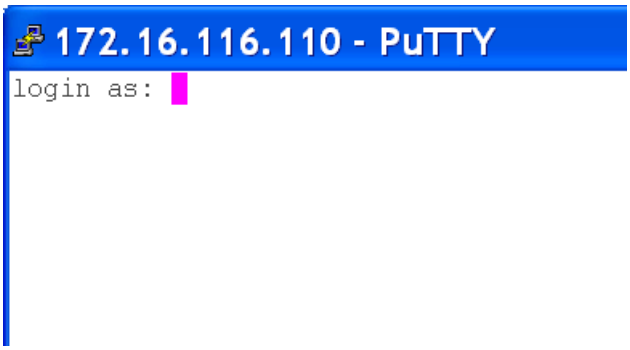
- Enter the for telephone connection information (country, area code and telephone number assigned to the iSINC modem).
- Select the computer COM port the modem is plugged into.

- Enter the following port settings:
  connection speed – **38400** Bits per second
  data bits – **8**
  parity – **None**
  stop bits – **1**
  control – **Hardware**



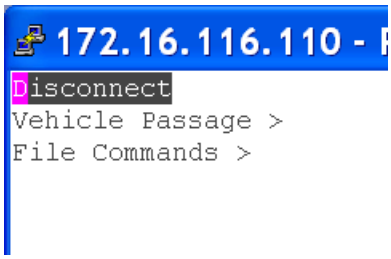
- Press the <***Enter***> key, the iSINC will reply with the login screen; proceed to section 4.3.10.5 for log in instructions.

4.3.10.5 Login

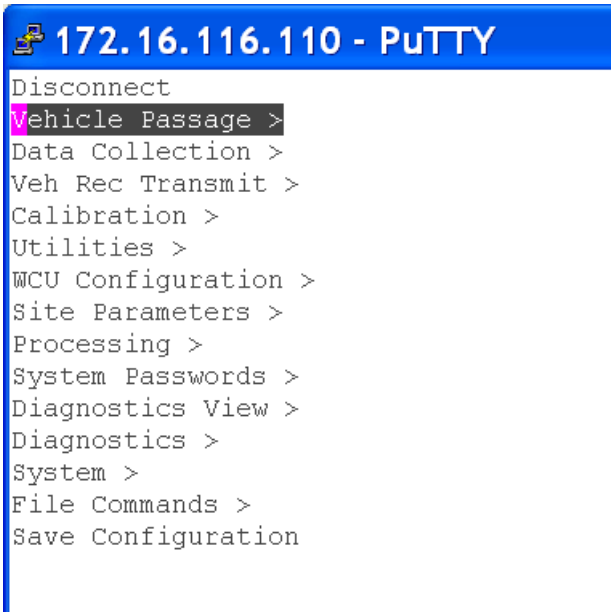


The Login screen will prompt for a name or number. There are four valid user name/numbers available: **4**, **3**, **user,** and **admin**. Login numbers are used because the keypad has only numbered keys; the login number "4" is equivalent to the login name "user" and the login number "3" is the same as the login name "admin". The login name/number entered determines what menu options are displayed; "4" and "user" will see only vehicle record display options, "3" and "admin" will be shown the system configuration menus in addition to the "user" menu options.
Once a name or number is entered, the system will prompt for a password; key in the password that corresponds to the name/number, then press the <***Enter***> key. The default password for "user" is <**user**>, the default password for "admin" is <**admin**>, the default password for "4" is <**4**>, the default password for "3" is <**3**>.
The password for admin level users (login "admin" or "3") may be changed in the **System Passwords Menu**, section 4.3.10.22.Main Menu

Once the password has been successfully entered, the main menu will be displayed. The menu options that appear on the screen will depend on the login.
"user" or "4" will see:



"admin" or "3" will see:

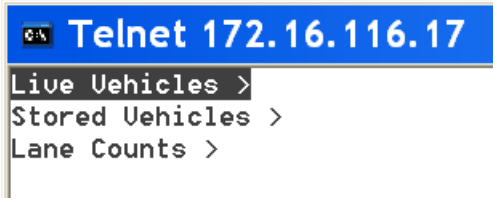


In the sections that follow, menu options available only to admin level login will have an asterisk (*****) following the menu label (as in the "Save Configuration" option below).
All but two of the options on the main menu open sub-menus:

- **Disconnect** – closes the menus and ends the session.
- **Save Configuration *** – Saves the system configuration settings to the flash card. If any changes to the system settings have been made, they must be saved using this selection before they will take effect. If the session is closed without doing a "**Save Configuration**", all changes will be lost.

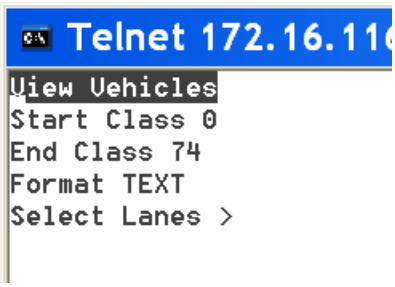
4.3.10.6 Vehicle passage

The **Vehicle Passage** menu lists three sub-menu options to display vehicle data on the terminal:



Live Vehicles

The **Live Vehicles** menu sets options to display vehicle records in real time as the vehicles pass through the selected sensor arrays.



- **View Vehicles** – starts the displaying of vehicle records. To pause the display, press the <***Space***> bar; the stop the display and return to the menu, press the left arrow ← key.
- **Start Class** – the lowest class number of vehicle to display (refer to Appendix 0 for an example of a vehicle classification system)
- **End Class** – the highest class number of vehicle to display. All vehicle classes between the Start and End class will be displayed.
- **Format** – The vehicle record may be displayed in one of two formats:

A.1 Text – which lists the axle separations and weights in a table similar to the following illustration:

```
========================================================================

(3452) LANE   CLASS 0  GVW 27.2 kips LENGTH 49 ft PASS
SPEED 8.9mph  MAX GVW 70.0 kips Wed Jul 28 2004 14:47:15 (3550)
AXLE    SEPARATION     TOTAL WT    ALLOWABLE
          (in)          (lb)         (lb)
 1                      5413         7000
 2          130         5413        13000
 3           47         5446        13000
 4          276         5468        13000
 5           59         5490        13000

========================================================================
```

Or

Graphic – which shows a graphic representation of the axle separations and weights in a diagram similar to the following illustration:

```
========================================================================

(3452) LANE   CLASS 0  GVW 27.2 kips LENGTH 49 ft PASS
SPEED 8.9mph  MAX GVW 70.0 kips Wed Jul 28 2004 14:47:15 (3550)
 |<---------- 42.7ft ---------->|
 O    O            O    O      O
5.5  5.5          5.4  5.4    5.4


========================================================================
```

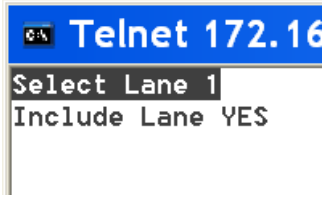
Each vehicle's information record includes:

- **Sequence number** (3452 for the example above). Numbers are sequentially assigned to vehicles in the order they enter the system. Sequence numbers count up to up to 65,000 and then start over at 1.
- **LANE** (blank for the example above). Used in systems with more than one scale to show which scale this record came from.
- **CLASS** (0 for the example above). If the classification mode is **FULL**, this shows the bridge compliance formula class assigned to this vehicle. If the classification mode is **BASIC**, class will be shown as 0.
- **GVW** (46.3 kips for the example above). The gross vehicle weight as calculated by the WIM system.
- **LENGTH** (49 ft for the example above). The total length of the vehicle.
- **TOTAL AXLE SPAN** (not shown in the example above). If the system does not have inductive sensing loops, the distance from the front to the rearmost axle is displayed.
- **PASS/FAIL** (Pass for the example above). This indicates whether or not the vehicle has failed to meet one or more of the compliance settings.
- **SPEED** (8.9 mph for the example above).
- **MAX GVW** (80.0 kips for the example above). In **FULL** compliance mode, the iSINC calculates the bridge formula compliance classification for the vehicle and looks up maximum gross vehicle weight allowed for that class. In **BASIC** compliance mode, the max GVW is set in the Basic compliance table.
- **Date and Time** (Wed Jul 28 2004 14:47:15 for the example above). The day, date and time of day (from the system clock) when the information was recorded. Time is displayed in 24-hour notation.
- **Ticks** (3550 for the example above). The time the vehicle took to pass through the system, measured as a count of .25 millisecond ticks.
- In **Text** display format, a table listing each axle, its separation from the preceding axle, its weight and the allowable maximum weight is displayed.
- In **Graphic** display format, a diagram of the axle spacings and the weight on each axle is displayed. The number between two arrows **|<-----42.7---->|** is the spacing between the front and rear axles; axles are indicated with an open circle **O**, the number below each axle is its weight.

A vehicle with an error in the record (for example vehicle too fast), will display only an error message with no vehicle data.

4.3.10.7 Select Lanes

The **Select Lanes** menu controls which lanes will display vehicle records to the terminal and which do not.

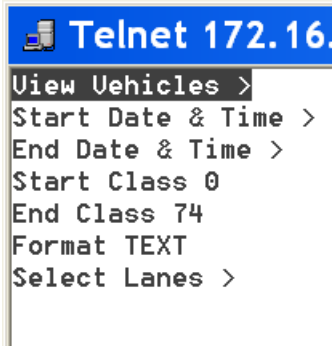


Select lane, press the <***Enter***> key, key in the lane number (between 1 and 8) to be changed, press the <***Enter***> key.

Include Lane, press the <***Tab***> key to toggle the selection between **Y** and **N**, press the <***Enter***> key. Repeat the selection for each lane to be displayed (up to 8 lanes).

Stored Vehicles

The **Stored Vehicles** menu displays vehicle records selected from the data file stored on the iSINC flash card.



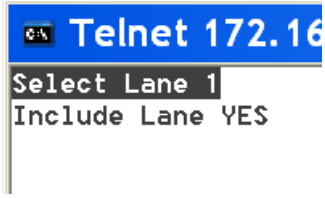
- **Format** – The vehicle record may be displayed in one of two formats:
  - **Text** – which lists the axle separations and weights in a table
  - **Graphic** – which shows a graphic representation of the axle separations and weights in a diagram

Refer to the previous menu (0 - Live Vehicles) for a detailed description of the record displays.
Vehicle records may be filtered based on date & time, class, and lane number:

- **Start Class** – the lowest class number of vehicle to display (refer to appendix 0 for an example of a vehicle classification system)
- **End Class** – the highest class number of vehicle to display. All vehicle classes between the Start and End class will be displayed.
- **Start Date & Time** – The default date and time are those of the oldest record. To change the date and time, highlight the bottom line of the display, then press the <***Enter***> key. Key in the new date and time settings in exactly the same format as displayed in the line above the entry (**DD/MM/YYYY HH:MM:SS**). Hours must be in 24 hour clock notation. Press the <***Enter***> key to activate the new settings.
- **End Date & Time** – The default date and time are those of the most recent record. To change the date and time, highlight the bottom line of the menu display, then press the <***Enter***> key. Key in the new date and time settings in exactly the same format as displayed in the line above the entry (**DD/MM/YYYY HH:MM:SS**). Hours must be in 24 hour clock notation. Press the <***Enter***> key to activate the new settings.

Select Lanes

The **Select Lanes** menu controls which lanes will display vehicle records to the terminal and which do not.



- **Select lane**, press the <***Enter***> key, key in the lane number (between 1 and 8) to be changed, press the <***Enter***> key.
- **Include Lane**, press the <***Tab***> key to toggle the selection between **Y** and **N**, press the <***Enter***> key.

Repeat the selection for each lane to be displayed (up to 8 lanes).

View Vehicles

Starts the displaying of vehicle records. Records are displayed in chronological order, starting from the oldest record.

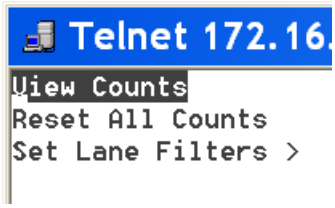
To pause the display, press the <***Space***> bar; the stop the display and return to the menu, press the left arrow ← key.

There are two options for record display:

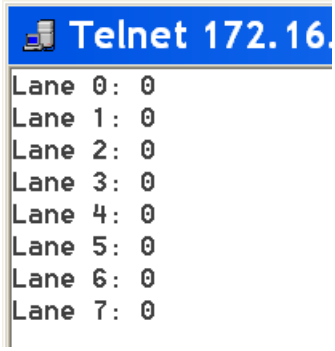
- **One at a Tim**e – displays one complete record and then pauses, press the <***Space***> bar to display the next record.
- **Non Stop** – all the records in the file will be displayed. If the listing fills more than one screen, the up and down arrows can be used to scroll the visible portion of the list up and down on the screen.

4.3.10.8 Lane Counts

The **Lane Count** menu displays a count of the number of vehicles for the selected lanes and classes since the counter was last reset



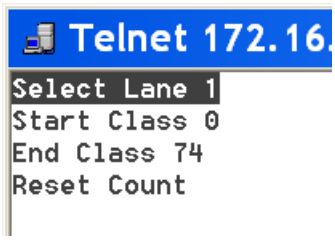
- **View Counts** – displays the vehicle count:



- **Reset All Counts *** – resets the vehicle counters for all lanes to zero.

Set Lane Filters

The **Set Lane Filters** menu sets which classes will be included in the count for a specified lane. The counter for that lane may also be reset.

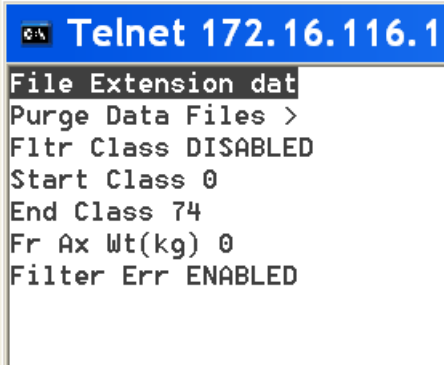


- **Select Lane** – enter the lane number on which to set the class filter.
- **Start Class** – the lowest class number of vehicle include in the lane count.
- **End Class** – the highest class number of vehicle to include in the lane count.

- **Reset Count** – resets the vehicle counter for the specified lane to zero.

4.3.10.9 Data Collection *

The **Data Collection** menu sets the parameters for storing vehicle records on the iSINC flash card.



- **File Extension** * – data collection sites are identified by their three character file extension. Enter the unique 3 character code for this site.
- **Fltr Class *** – enables or disables data filtering based on vehicle class.
- **Start Class *** – the lowest class number of vehicle record to include in the database.
- **End Class *** – the highest class number of vehicle to include in the database.
- **Fr Ax Wt *** – the minimum front axle weight, below which the vehicle record will not be saved (the vehicle will still be added to the vehicle count data).
- **Filter Err *** – enables or disables saving vehicle records in which the error flag has been set

4.3.10.10 Purge Data Files *

The **Purge Data Files** menu deletes all records on the system flash card that were recorded prior to the specified date and time.

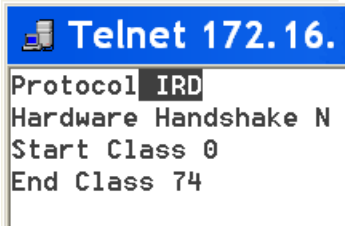
- **Purge *** – highlight this option and press the <***Enter***> key to perform the deletion. An "**Are you sure?**" confirmation message will be displayed. Press the "**Y**" to complete the deletion, press the "**N**" key to cancel and return to the menu.
- **End Date & Time *** – the end of the deletion period; all records prior to this date and time will be deleted. The default date and time are those of the most recent record. To change the date and time, highlight the bottom line of the menu display, then press the <***Enter***> key. Key in the new date and time settings in exactly the same format as displayed in the line above the entry (**DD/MM/YYYY HH:MM:SS**). Hours must be in 24 hour clock notation. Press the <***Enter***> key to activate the new settings.

4.3.10.11 Vehicle Record Transmit *

The **Vehicle Record Transmit** menu sets the parameters used to transmit vehicle records when it receives a request form the WCU COM port or from the SBM in the iSINC chassis.

WIM Bus * – toggles whether or not vehicle records will be transmitted over the iSINC CAN Bus (to the SBM).

4.3.10.12 Serial Port *



- **Protocol *** - There are four options for the protocol used for vehicle record transmission: **None, IRD**, **HELP** or **HELP NO WEIGHT** transfer protocol. These protocols are defined as follows:

  A.2 None – data is not transmitted. Selecting this option turns the function off.

A.3 IRD Transfer Protocol (Non-Error Vehicle)

Bytes	Content	Description	Format
1	STX	Start of Text	C
3	NNN	Message Length in bytes	NNN
1	Message Code	Code Representing the Message Type: 'V' – Vehicle Data	C
1	0x30	Format Code, always 0x30	X
6	Vehicle number	6 digit vehicle sequence number	NNNNNN
2	Lane number	lane number, 1 digit signed number (1-99)	NN
4	Year	Year (0000-9999)	CCYY
2	Month	Calendar Month (01-12)	MM
2	Day	Day of Month (01-31)	DD
2	Hour	GMT hh format (00-23)	HH
2	Minute	GMT mm format (00-59)	MM
2	Seconds	Seconds past the minute (00-59)	SS
2	Hundredths	Hundredths of a minute (00-99)	TT
2	Number External Data Items	The number of external data items attached to the vehicle record	NN
2	Length of String	The length of the 1st external data item string	NN
X	External Data Item Data	The character data in the 1st external item data field	CCC…C
..	..	Repeat preceding 2 rows for every external data item	..
2	Error Code	The error code variable of the vehicle record.	NN
3	Temperature	The road temperature	NNN
2	Record Type	The type of vehicle record	NN
3	Speed	The speed of the vehicle in km/h.	NNN
4	Vehicle Length	The length of the vehicle in cm	NNNN
3	Front Axle Space	The distance between the front axle and the front bumper in cm.	NNN
2	Number of Axles	The number of axles on the vehicle.	NNN
4	Inter-Axle Space	The axle space between the 1st and 2nd axles in cm.	NNNN
..	..	Repeat above row for every inter-axle space	
5	Axle Weight	The axle weight of the 1st axle in kg	NNNNN
..	..	Repeat above row for every axle weight	
1	ETX	End of Text	C
4	Checksum	CRC16 Checksum	XXXX
1	EOT	End of Transmission	

Table 1 - IRD Protocol (Non-error Vehicle)

A.4 IRD Transfer Protocol (Error Vehicle)

# of Bytes	Content	Description	Format
1	STX	Start of Text	C
3	NNN	Message Length in bytes	NNN
1	Message Code	Code Representing the Message Type: 'V' – Vehicle Data	C
1	0x30	Format Code	X
6	Vehicle number	6 digit vehicle sequence number	NNNNNN
2	Lane number	lane number, 1 digit signed number (1-99)	NN
4	Year	Year (0000-9999)	CCYY
2	Month	Calendar Month (01-12)	MM
2	Day	Day of Month (01-31)	DD
2	Hour	GMT hh format (00-23)	HH
2	Minute	GMT mm format (00-59)	MM
2	Seconds	Seconds past the minute (00-59)	SS
2	Hundredths	Hundredths of a minute (00-99)	TT
2	Number External Data Items	The number of external data items attached to the vehicle record	NN
2	Length of String	The length of the 1st external data item string	NN
X	External Data Item Data	The character data in the 1st external item data field	
..	..	Repeat preceding 2 rows for every external data item	..
2	Error Code	The error code variable of the vehicle record.	NN
3	Temperature	The road temperature	NNN
1	ETX	End of Text	C
4	Checksum	CRC16 Checksum	XXXX
1	EOT	End of Transmission	

Table 2- IRD Protocol (Error Vehicle)

A.5 HELP Transfer Protocol

# of Bytes	Content	Description	Format
1	SOH	Start of Header	C
1	Message content	Message ID 0 – WIM 1 – Remote Console 2 – WIM2 3 – Sort Decision Override	C
1	STX	Start of Text	C
1	<	Start of the vehicle record	C
1	L=lane	lane number, 1 digit signed number (1-8)	N
1	Ld=lane direction		N
2	Mo=month	Calendar Month (01-12)	MM
2	DD=day	Day of Month (01-31)	DD
2	YY=year	Year (00-99)	YY
2	HH=hour	Hour format (00-23)	HH
2	MM=minutes	Minute format (00-59)	MM
2	SS=seconds	Seconds past the minute (00-59)	SS
2	HS=hundredths of sec	Hundredths of a minute (00-99)	TT
6	Vehnum=vehicle num	5 digit vehicle sequence number (1-65000)	NNNNN
2	NA=number of axles	Number of Axles (0-99)	NN
2	CL=class	Vehicle Classification (0 -13)	NN
4	GROS=gross weight /100	Gross Vehicle Weight (0 -9999)lbs / 100	NNNN
4	LENG=overall length *10	(bumper to bumper) (0 -9999) ft*10	NNNN
4	SPED=speed *10	MPH *10	NNNN
3	SP1=axle spacing 12*10	Axle spacings (0-1400) ft*10	NNN
3	SP2=axle spacing 23*10	Axle spacings (0-1400) ft*10	NNN
3	SP3=axle spacing 34*10	Axle spacings (0-1400) ft*10	NNN
3	SP4=axle spacing 45*10	Axle spacings (0-1400) ft*10	NNN
3	SP5=axle spacing 56*10	Axle spacings (0-1400) ft*10	NNN
3	SP6=axle spacing 67*10	Axle spacings (0-1400) ft*10	NNN
3	SP7=axle spacing 78*10	Axle spacings (0-1400) ft*10.	NNN
3	SP8=axle spacing 89*10	Axle spacings (0-1400) ft*10	NNN
3	WT1=weight of axle 1/100	Axle weight (0- 999)lbs / 100	NNN
3	WT2=weight of axle 2/100	Axle weight (0- 999)lbs / 100	NNN
3	WT3=weight of axle 3/100	Axle weight (0- 999)lbs / 100	NNN
3	WT4=weight of axle 4/100	Axle weight (0- 999)lbs / 100	NNN
3	WT5=weight of axle 5/100	Axle weight (0- 999)lbs / 100	NNN

3	WT6=weight of axle 6/100	Axle weight (0- 999)lbs / 100	NNN
3	WT7=weight of axle 7/100	Axle weight (0- 999)lbs / 100	NNN
3	WT8=weight of axle 8/100	Axle weight (0- 999)lbs / 100	NNN
3	WT9=weight of axle 9/100	Axle weight (0- 999)lbs / 100	NNN
1	>	End of vehicle record	C
1	ETX	End of text	C
1	LRC	Calculated by XORing from SOH to ETX inclusively. Transmit the MSB first.	XX
1	EOT	End of Transmission	C

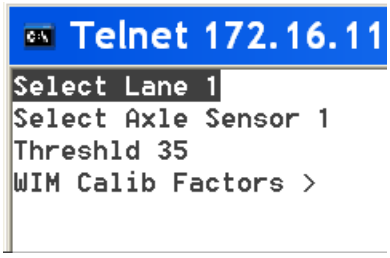
Table 3 - HELP Protocol

A.6 HELP NO WEIGHT Transfer Protocol - Identical to **HELP** format except that the weights, length, axle spacings and speed are filled in with values of zero.

- **Hardware Handshake** – toggles use of hardware handshake on or off
- **Start Class** – the lowest class number for a vehicle record to be transmitted.
- **End Class** – the highest class number for a vehicle to be transmitted; all records with a classification between the Start Class and End class will be transmitted.

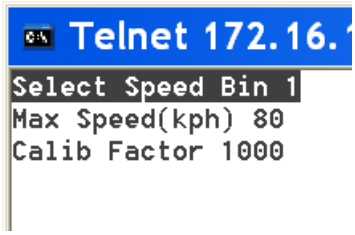
4.3.10.13 Calibration *

The **Calibration** menu options set the weigh-in-motion axle sensor parameters. Each WIM sensor will require periodic tuning to adjust for changes in the road surface and the scale hardware.



- **Select Lane *** – the lane number in which the WIM sensor is located
- **Select Axle Sensor *** – the WIM axle sensor number (between 1 and 4)
- **Threshold *** – There is typically has some noise in the signal from an axle sensor. The threshold value minimizes the effect of the noise by setting the level above which a signal will be considered an axle, and below which it will be considered noise. The threshold value should be set high enough to filter noise but low enough to detect all axle signals. If the threshold is set too high the system will miss axles and if the threshold is set too low the system will falsely register some electronic noise as axles.

4.3.10.14 WIM CaLibration Factors *



The accuracy of WIM measurements may be affected to some degree by vehicle speed. In order to increase accuracy, a different WIM calibration factor may be assigned for up to five different speed groupings (bins). The range of a speed bin is from the max speed of the previous bin to the max speed of the bin being configured (bin 1 has a minimum speed of 1).

- **Select Speed Bin *** – the number of the speed bin being configured (from 1 to 5).
- **Max Speed *** – the maximum speed for this speed bin
- **Calib Factor *** – the WIM sensor calibration factor for this speed bin. The default calibration factor is: 1000 To adjust the calibration factor using a vehicle of a known measured weight and speed, calculate a new calibration factor as follows:

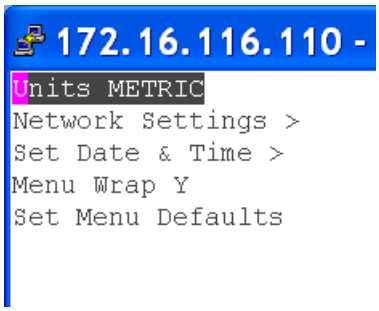
New Calib. Factor = Current Calib. Factor * Actual Weight / Displayed Weight

Repeat for each speed bin (up to a maximum of five) used with this WIM sensor.

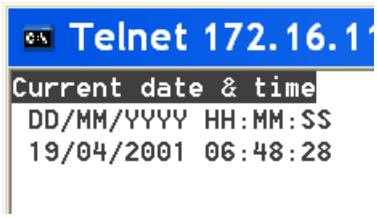
Repeat the calibration for each axle sensor and each lane.

4.3.10.15 Utilities Menu *

The **Utilities** menu sets various system parameters.



- **Units *** – the measuring units currently in use are displayed. Selection options are: Metric, US-Lbs&Ins, and US-KIPs&Ft.
  Note that this setting only effects what is displayed on the terminal, all data is saved in metric units regardless of this setting.
- **Time & Date *** – this sub-menu displays the current time and date and resets the date and time:

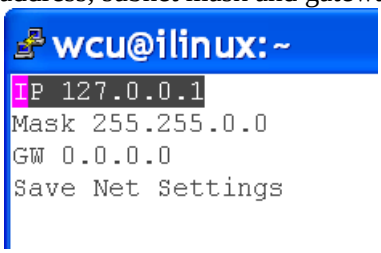


  To change the date and time, highlight the bottom line of the menu (the date and time display) then press the <***Enter***> key. Key in the new date and time settings in exactly the same format as displayed in the line above the entry (***DD/MM/YYYY HH:MM:SS***). Hours must be in 24 hour clock notation. Press the <***Enter***> key to activate the new settings.
- **Menu Wrap *** – toggles menu navigation wrap (menu selection jumps back to the top of the menu when scrolled off the bottom or jumps to the bottom when scrolled off the top) on and off. To change the wrap mode, toggle the selection between **Y** (yes) and **N** (no).
- **Set Menu Defaults *** – resets all menu settings back to the factory defaults. To reset the settings, highlight Set Menu Defaults then press the <***Enter***> key. An "**Are you sure**" confirmation message

will appear, press the <***Enter***> key again to confirm the reset or use the left arrow ← key to return without resetting.

4.3.10.16 Network Settings *

The **Network Settings** menu sets the IP address, subnet mask and gateway used by the iSINC.



- **IP *** – displays the current IP address of the iSINC controller. Key in the IP address for the iSINC.
  Note: *this option is not required if the system will not be connected to a network.*
- **Mask *** – displays the current IP address mask. Key in the IP address mask.
  Note: *this option is not required if the system will not be connected to a network.*
- **GW *** – displays the current address of the network Gateway. Key in the Gateway address.
  Note: *this option is not required if the system will not be connected to a network..*
- **Save Net Settings *** – saves and enables any changes made; if this menu option is not used, any changes made will be discarded after leaving this menu.

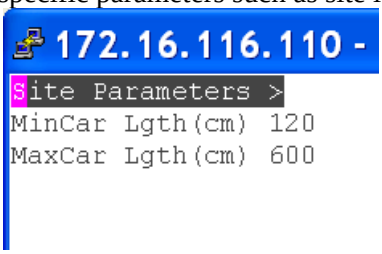
4.3.10.17 WCU Config *

The **WCU Config** menu sets the screen sleep time.

- **Scrn Sleep *** – the length of time the terminal can be inactive before the iSINC will automatically log the user out. Typically set to 10 minutes (the maximum).

4.3.10.18 Site Parameters *

The **Site Parameters** menu sets the site specific parameters such as site identity and system sensor configuration.



Minimum Car Length * and **Maximum Car Length ***- if no axle sensor data is available but a vehicle is detected by the sensing loops, the system will attempt to determine if the vehicle was a car and if it was, repair the record so that it may be used for traffic statistics. The method of determining if the vehicle was a car is to compare the calculated length to the minimum and maximum limits set with these options. If the length is within these limits, the vehicle record has the following data inserted:

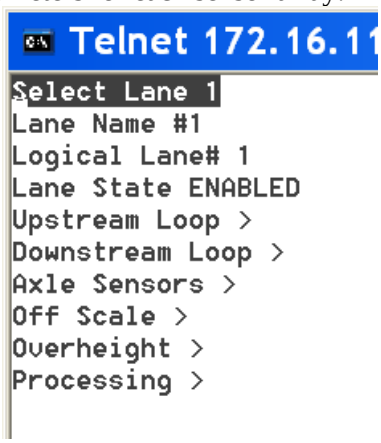
- Number of axles: 2

- Wheelbase: vehicle length minus 60 cm (2 feet)
- Weight: 333 kg per axle (gvw 666 kg,, 1465 pounds)

If the vehicle is outside these limits, the record is flagged as an error record.

4.3.10.19 Site Parameters Sub-menu *

The **Site Parameters** sub-menu sets parameters for each sensor array:

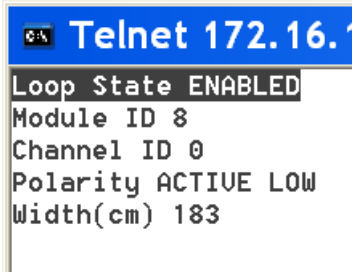


- **Select Lane *** – the lane number in which the sensor array is located. One WCU can process the signals from up to eight lanes of sensors. The lane number is the primary identifier of the sensor array in the iSINC system.
- **Lane Name *** – the lane may be assigned a name of up to 9 characters.
- **Logical Lane# *** –if there are more than eight lanes at this site, multiple WCUs will be present in the iSINC system, each with a set of lane numbers between 1 and 8. In order to uniquely identify each lane at the site in the data files, each lane should be assigned a unique logical lane number. If there are eight or less lanes, the lane number and logical lane number should be set to the same number.
- **Lane State *** – the sensor array associated with the lane number is turned on or off by enabling or disabling this menu option.

The remainder of the menu contains options for the various sensors. (Loops, axle sensors, offscale and overheight sensors). Refer to section 4.3.4.3 for information on module numbering and Appendix A.1.2 for channel and module options. All sensors have the following settings in common:

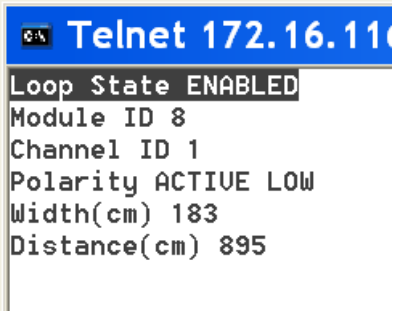
- **State *** – If the sensor is used in this array, set its state to **Enabled**, if the sensor is not present or not to be used, set its state to **Disabled**. ***Note:*** *every sensor listed must be set to the proper state, regardless of whether or not this particular system has that sensor present; having a sensor that is not present set to* ***Enabled*** *could cause problems with the operation of the system.*
  If the sensor is disabled, none of the other settings for that sensor need to be configured.
- **Module ID *** – the identification number of the iSINC module to which this sensor is connected.
- **Channel ID *** – the identification number of the channel on the module to which this sensor is connected. The number of channels available depends on the type of module; DIOM have 8 channels, LSM 4 channels, SCM 6 channels and PSM have 4 piezo and 1 temperature sensor channels. Refer to Appendix A.1.2.1 for information on channel assignments.
- **Polarity *** – the signal polarity used by the sensor; if set to **Active High**, the signal goes positive when the sensor is activated, if set to **Active Low**, the signal goes negative when active.

Upstream Loop *



- **Width *** – the distance, in centimeters, from the leading edge of the loop to the trailing edge of the loop (all distances are parallel to the direction of traffic flow).

Downstream Loop *

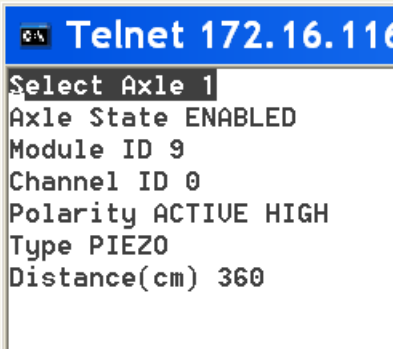


- **Width *** – the distance, in centimeters, from the leading edge of the loop to the trailing edge.
- **Distance *** – the distance, in centimeters, from the leading edge of the upstream loop to the leading edge of the downstream loop.

The sensitivity settings of both loops in a sensor array should be the same (refer to Appendix A.1.1)

Axle Sensor *

There may be up to four axle sensors in a sensor array. The axle sensors may be of different types (for example a Dynax axle sensor and two single load cell weigh pads).



- **Type *** – the type of Axle sensor. Selection choices are:

  A.7 Bending Plate – a Weigh in Motion sensor

  A.8 Single Load Cell – a Weigh in Motion sensor

  A.9 Kistler – a Kistler piezoelectric Weigh in Motion sensor

A.10 SSWIM Scale – not used for data collection

A.11 Piezo II Scale – a type II Piezoelectric Weigh in Motion sensor

A.12 On Scale – a sensor for determining whether the axle being weighed by a WIM sensor is fully on the scale or not.

A.13 Piezo – Piezoelectric Type I axle sensors are used to determine axle spacings. This axle sensor can also function as a backup speed sensor in case of a loop failure.

A.14 Dynax – Dynax axle sensors are used to determine axle spacings. This axle sensor can also function as a backup speed sensor in case of a loop failure.

- **Distance *** – the distance, in centimeters, from the leading edge of the upstream loop to the leading edge of this axle sensor.

Repeat this menu for as many axle sensors as there are in the lane.

Offscale Sensor *

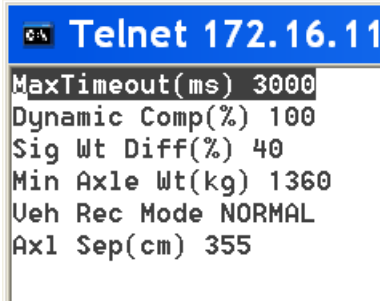
The offscale sensor detects whether the axle being weighed by a WIM sensor is partially off the scale to one side or the other.

Overheight Sensor *

An overheight sensor determines whether or not the vehicle passing through the sensor array is over the sensor height.

Processing *

The processing menu option sets the limits used to determine vehicle record errors and



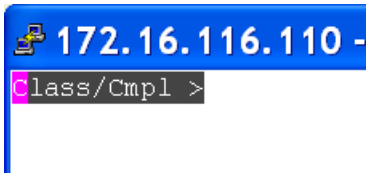
- **MaxTimeout *** – the time, in milliseconds, allowed between when the vehicle triggers the first sensor and when the vehicle will be considered to have left the sensor array and the vehicle record is finished.
- **Dynamic Comp *** – because the physical characteristics of some sites alter the dynamic load which the front axle applies to the WIM sensors, a dynamic compensation factor may be necessary to produce more accurate front axle weights. The default value of 100 makes no adjustment; a setting of 105 will multiply the front axle weight by 1.05, a setting of 95 will multiply it by .95.
- **Sig Wt Diff *** – significant weight difference; the percentage weight difference allowed between left and right WIM sensors, above which the axle weight will be flagged with a warning in the vehicle record.
- **Min Axle Wt *** – the minimum axle weight, below which the significant weight difference will not be checked.

- **Axle Separation *** – a measurement used for axle separation calculations if the sensing loops are not available. For systems with an axle sensor (Dynax or piezo type I) enter the distance from the leading edge of the axle sensor (in cm) to the leading edge of the scale sensor. For systems with only a weigh scale (no axle sensors), enter the width of the scale platform (in cm.).

Repeat the Site Parameters sub-menu for each of the sensor arrays on the site.

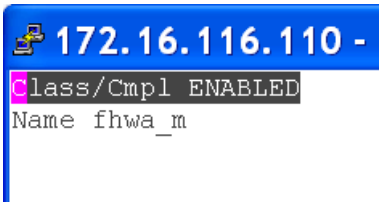
4.3.10.20 Processing *

The **Processing** menu controls the processes used to classify vehicles and to verify whether or not they are in compliance with regulations.



4.3.10.21 Class/Compliance *

The **Class/Compliance** menu controls the configuration of the vehicle classifications and regulation agency compliance factors to be used at this site.

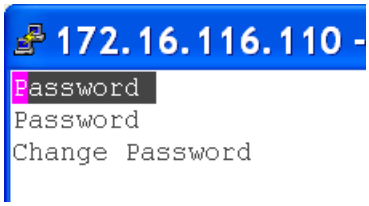


The Class/Compliance sub-menu displays whether bridge compliance formula vehicle classification is enabled or disabled and the file used for bridge compliance formula calculations.

- **Class/Cmpl *** – enables or disables the use of vehicle classification and compliance tables. If this selection is disabled, only axle weights and Gross Vehicle Weight are saved in vehicle records and used for sorting decisions; vehicles are not classified and no axle grouping (bridge formula) calculations are performed.
- **Name *** – The name of the current classification and compliance file in use is displayed. To change the file of tables used in the bridge compliance formula calculations, contact an IRD service representative.

4.3.10.22 System Passwords *

Changes the “admin” password.



To change the admin password:

- highlight the first **Password** menu option, press <***Enter***>, key in the new password, press <***Enter***>.
- highlight the second **Password** menu option, press <***Enter***>, key in the new password again, press <***Enter***>.
- Highlight the **Change password** menu option and press <***Enter***>.

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4.3.11 File Commands

The File Commands menu performs some basic file operations such as listing, copying, renaming, deleting , and closing files.

4.3.11.1 Directory

Selects the directory whose contents will be listed by the next menu option

4.3.11.2 Directory Listing

Lists the files (and the size of each file) from the iSINC Flash card directory selected above.

4.3.11.3 Remove Flash Card

Closes all files in preparation for removing the iSINC Flash Card.

> ***NOTE:*** *Always perform this menu option to close all system files before removing the iSINC Flash Card from its slot. If this is not done, some files on the card may be corrupted and be inaccessible.*

After the **Remove Card** menu option is selected, data will be saved in a memory buffer until the new flash memory card is installed. If the iSINC is powered down before a new card is installed, the data will be lost. Use the left arrow ← key to return to the main menu.

Appendix A – Acronyms and Definitions

A.1.1.1 Acronyms

AASHTO – American Association of State Highways and Transportation Officials
ASTM – American Society for Testing and Measurement
DIOM – Digital Input/Output Module
FHWA – Federal HighWays Administration
GVW – Gross Vehicle Weight
GW – GateWay network device
IP – Internet Protocol
IRD – International Road Dynamics Inc.
iSINC - Intelligent Sensor Interface and Network Controller
KIPs – Kilo Pounds; 1000 pounds of weight
LED – Light Emitting Diode
PC – Personal Computer
PSM – Piezoelectric Sensor Module
SBM – Serial Bridge Module
SSM – Scale Sensor Module
WCU – WIM Control Unit
WIM – Weigh-In-Motion

A.1.1.2 Definitions

Bridge formula – a widely used method of calculating the allowable maximum weight of a vehicle and its axle groups based on the number and spacing of the axles. There are a number of variations to the bridge formula recognized by different regulatory agencies; iSINC provides a selection of bridge formula options.
CAN bus – Controller Area Network bus - an industry standard electronics backplane for connecting together a number of microcontroller cards that need to communicate with one another.
Module – a microcontroller electronics printed circuit board , also known as a card or board.

A.1.2 APPENDIX B – CONNECTOR PINOUTS

A.1.2.1 I/O Signal Panel Connectors

The table on the following page lists the pin assignments for the three terminal block connectors on the I/O Signal Panels.
The vertical columns in the table differentiate panels by the source of the I/O signals and the modules to which the I/O Signal panels are internally connected.
The position of the modules and I/O panels in the rack mounting are standardized and are dependant on the system options at a specific installation; refer to Appendix A.1.4 for a listing of the system configurations.

I/O Signals	Digital	Loops & LSM	Serial	Scale	Piezo	Dynax
Module Connection	**DIOM**	**LSM**	**SBM**	**SSM**	**PSM**	**DIOM**
Capacity	8 ch + 2 inv ch	4 ch in + 4 out	1 RS 232	6 channels	4 piezo + 1 temperature	8 channels
TB1 Terminations						
1	/A0	CH1_LP_A	/RI	V_EXC_A	-	-
2	Cable Shield	Cable Shield	Cable Shield	Cable Shield	-	Cable Shield
3	GND	CH1_LP_B	GND	V_EXC_COM	-	-
4	/A1	CH2_LP_A	/DTR	A+	A+	-
5	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield
6	GND	CH2_LP_B	GND	A-	GND	-
7	A0	CH3_LP_A	RI	V_EXC_B_	-	D0
8	Cable Shield	Cable Shield	Cable Shield	Cable Shield	-	Cable Shield
9	GND	CH3_LP_B	GND	V_EXC_COM	-	GND
10	A1	CH4_LP_A	DTR	B+	B+	D1
11	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield
12	GND	CH4_LP_B	GND	B-	GND	GND
TB2 Terminations						
1	V_EXTA_IN	-	-	V_EXC_C	-	-
2	Cable Shield	Cable Shield	Cable Shield	Cable Shield	-	Cable Shield
3	GND	-	GND	V_EXC_COM	-	-
4	A2	-	CTS	C+	C+	D2
5	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield
6	GND	-	GND	C-	GND	GND
7	A3	-	TX	V_EXC_D	-	D3
8	Cable Shield	Cable Shield	Cable Shield	Cable Shield	-	Cable Shield
9	GND	-	GND	V_EXC_COM	-	GND
10	B0	-	RTS	D+	D+	D4
11	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield
12	GND	-	GND	D-	GND	GND
TB3 Terminations						
1	B1	CH1_SS_OUT	RX	V_EXC_E	-	D5
2	Cable Shield	Cable Shield	Cable Shield	Cable Shield	-	Cable Shield
3	GND	CH2_SS_OUT	GND	V_EXC_COM	-	GND
4	V_EXTB_IN	CH3_SS_OUT	-	E+	-	-
5	Cable Shield	Cable Shield	Cable Shield	Cable Shield	-	Cable Shield
6	GND	CH4_SS_OUT	GND	E-	-	-
7	B2	COM_EMIT	DSR	V_EXC_F	T1_+V	D6
8	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield
9	GND	M_FLT_COL	GND	V_EXC_COM	T1_-V	GND
10	B3	RESET_IN	CD	F+	T1_SIG	D7
11	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield	Cable Shield
12	GND	PS_COM	GND	F-	GND	GND

I/O Signal Panel Connections

A.1.3 LSM TO DIOM JUMPERS

The ouput signals from the Loop Sensing Modules are connected to the inputs of the Digital I/O Modules via jumpers on the I/O panels.
Each LSM can have up to 4 outputs and each DIOM can have up to eight inputs, so a DIOM can handle the signals from two LSM. The loop signals are jumpered as follows:

LSM CH	Signal I/O Panel & Terminal Block	TB connector #	TB connector #	Signal I/O Panel & Terminal Block	DIOM CH
1	LSM 1 Out on TB3	1	7	DIOM In on TB 1	A0
2		3	10		A1
3		4	4	DIOM In on TB 2	A2
4		6	7		A3
Com		7	8		GROUND
1	LSM 2 Out on TB3	1	10		B0
2		3	1	DIOM In on TB 3	B1
3		4	7		B2
4		6	10		B3
Com		7	11		GROUND

The illustration below shows the output from an LSM (four sensing loops) from the Signal I-O Panel on the left of the picture jumpered to the DIOM inputs Signal I/O Panel on the right of the picture.

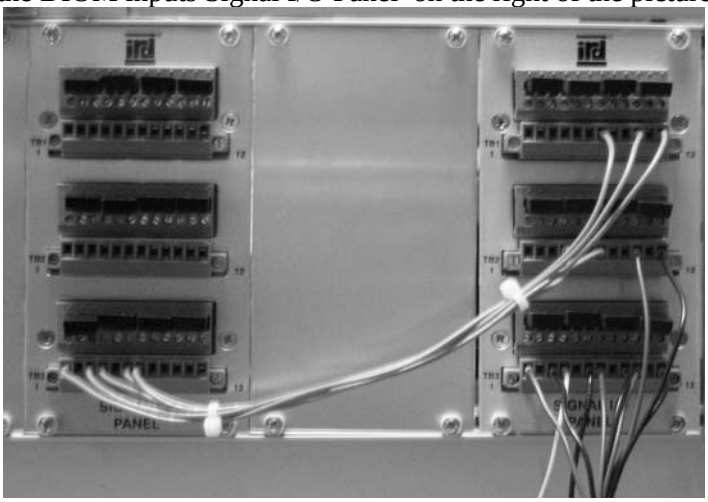
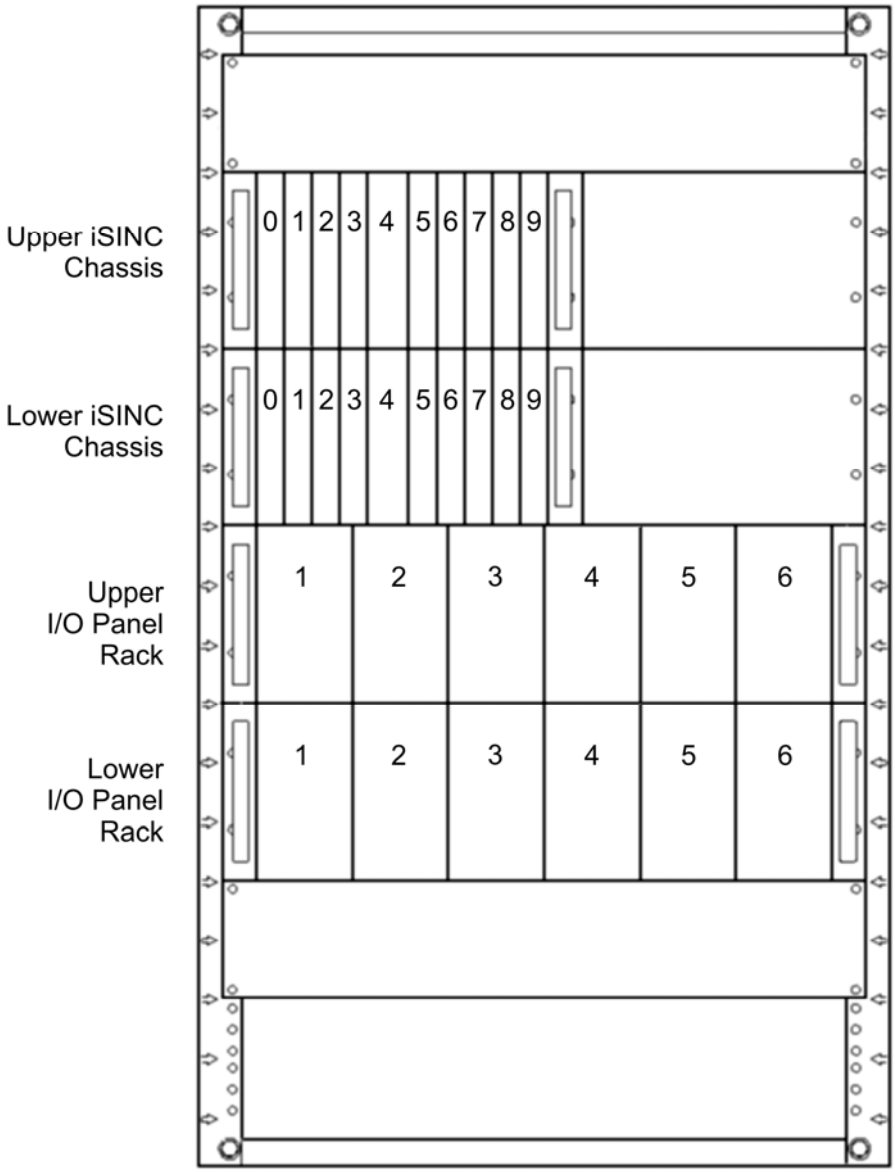


Figure 31 - LSM to DIOM jumpers

A.1.4 iSINC MODULE AND I/O PANEL OPTIONS

The tables on the following pages list the various possible configurations of iSINC modules, the sensor inputs to the Signal I/O panels and the internal ribbon cable connections between the Signal I/O panel and the module
The diagram below indicates the module and I/O Signal Panel positions referred to in the tables:



A.1.4.1 Single iSINC Chassis and I/O Panel Rack Options

Option	**4 Loops**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	blank	SBM	blank	blank	blank	blank	LSM	blank	DIOM
	Signal I/O sensor and internal connections to modules									
Panel #	1	2	3	4	5	6				
Upper Rack	blank	blank	blank	Loops, LSM 7	blank	Digital out from LSM 7, DIOM 9				

Option	**8 Loops**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	blank	SBM	blank	blank	blank	blank	LSM	LSM	DIOM
	Signal I/O sensor and internal connections to modules									
Panel #	1	2	3	4	5	6				
Upper Rack	blank	blank	blank	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9				

Option	**12 Loops**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	LSM	SBM	blank	blank	blank	DIOM	LSM	LSM	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	Loops, LSM 1	blank	Digital out from LSM 1, DIOM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9

Option	**16 Loops**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	LSM	SBM	blank	blank	LSM	DIOM	LSM	LSM	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	Loops, LSM 1	Loops, LSM 5	Digital out from LSM 1+5 DIOM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9

Option	**4 Loops + 4 Piezo**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	blank	SBM	blank	blank	PSM	blank	LSM	blank	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	blank	Piezo PSM 5	blank	Loops, LSM 7	blank	Digital out from LSM, DIOM 9

Option	**8 Loops + 8 Piezo**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	blank	SBM	blank	blank	PSM	PSM	LSM	LSM	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	blank	Piezo PSM 5	Piezo PSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9

Option	**4 Loops + 4 Scales**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	blank	SBM	blank	blank	SSM	blank	LSM	blank	DIOM

	Signal I/O sensor and internal connections to modules					
	1	2	3	4	5	6
Upper Rack	blank	Scale SSM 5	blank	Loops, LSM 7	blank	Digital out from LSM, DIOM 9

Option	**8 Loops + 8 Scales**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	blank	SBM	blank	blank	SSM	SSM	LSM	LSM	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	blank	Scale SSM 5	Scale SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9

Option	**4 Loops + 4 Piezo + 4 Scales**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	PSM	SBM	blank	blank	SSM	blank	LSM	blank	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	Piezo PSM 1	Scale SSM 5	blank	Loops, LSM 7	blank	Digital out from LSM 7, DIOM 9

Option	**8 Loops + 8 Scales + 4 Piezo**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	PSM	SBM	blank	blank	SSM	SSM	LSM	LSM	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	Piezo, PSM 1	Scale SSM 5	Scale SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9

Option	**4 Loops + 4 Scales + 4 Dynax**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	blank	SBM	blank	blank	SSM	DIOM	LSM	blank	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	blank	Scale, SSM 5	Dynax(4) DIOM 6	Loops, LSM 7	blank	Digital out from LSM 7 DIOM 9

Option	**4 Loops + 4 Scales + 4 Piezo + 4 Dynax**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	PSM	SBM	blank	blank	SSM	DIOM	LSM	blank	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	Piezo, PSM 1	Scale, SSM 5	Dynax(4) DIOM 6	Loops, LSM 7	blank	Digital out from LSM 7 DIOM 9

Option	**8 Loops + 8 Scales + 8 Dynax**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	TGM	DIOM	SBM	blank	blank	SSM	SSM	LSM	LSM	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	Dynax, DIOM 1	Scale SSM 5	Scale SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9

A.1.4.2 DUAL iSINC CHASSIS AND I/O PANEL RACK OPTIONS

Modules from the upper chassis connect to the upper rack Signal panels, modules from the lower chassis connect to the lower rack Signal panels.

Option	**12 Loops + 12 Piezo**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	SBM	TGM	SBM	blank	blank	PSM	PSM	LSM	LSM	DIOM
Lower Chassis	SBM	blank	blank	blank	blank	PSM	blank	LSM	blank	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	blank	Piezo, PSM 5	Piezo, PSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9
Lower Rack	blank	Piezo, PSM 5	blank	Loops, LSM 7	blank	Digital out from LSM 7, DIOM 9

Option	**16 Loops + 16 Piezo**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	SBM	TGM	SBM	blank	blank	PSM	PSM	LSM	LSM	DIOM
Lower Chassis	SBM	blank	blank	blank	blank	PSM	PSM	LSM	LSM	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	blank	Piezo, PSM 5	Piezo, PSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8, DIOM 9

Lower Rack	blank	Piezo, PSM 5	Piezo, PSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9

Option	**12 Loops + 12 Scales**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	SBM	TGM	SBM	blank	blank	SSM	SSM	LSM	LSM	DIOM
Lower Chassis	SBM	blank	blank	blank	blank	SSM	blank	LSM	blank	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	blank	Scale, SSM 5	Scale, SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9
Lower Rack	blank	Scale, SSM 5	blank	Loops, LSM 7	blank	Digital out from LSM 7, DIOM 9

Option	**16 Loops + 16 Scales**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	SBM	TGM	SBM	blank	blank	SSM	SSM	LSM	LSM	DIOM
Lower Chassis	SBM	blank	blank	blank	blank	SSM	SSM	LSM	LSM	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	blank	Scale, SSM 5	Scale, SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8, DIOM 9

Lower Rack	blank	Scale, SSM 5	Scale, SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9

Option	**12 Loops + 12 Scales + 8 Piezo**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	SBM	TGM	SBM	blank	blank	SSM	SSM	LSM	LSM	DIOM
Lower Chassis	SBM	PSM	PSM	blank	blank	SSM	blank	LSM	blank	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6
Upper Rack	Piezo, PSM 1 (lower chassis)	Scale, SSM 5	Scale, SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9
Lower Rack	Piezo, PSM 2	Scale, SSM 5	blank	Loops, LSM 7	blank	Digital out from LSM 7, DIOM 9

Option	**16 Loops + 16 Scales + 8 Piezo**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	SBM	TGM	SBM	blank	blank	SSM	SSM	LSM	LSM	DIOM
Lower Chassis	SBM	PSM	PSM	blank	blank	SSM	SSM	LSM	LSM	DIOM

	Signal I/O sensor and internal connections to modules					
Panel #	1	2	3	4	5	6

Upper Rack	Piezo, PSM 1 (lower chassis)	Scale, SSM 5	Scale, SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8, DIOM 9
Lower Rack	Piezo, PSM 2	Scale, SSM 5	Scale, SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9

Option	**16 Loops + 16 Scales + 16 Dynax**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	SBM	TGM	SBM	blank	blank	SSM	SSM	LSM	LSM	DIOM
Lower Chassis	SBM	DIOM	DIOM	blank	blank	SSM	SSM	LSM	LSM	DIOM

Signal I/O sensor and internal connections to modules

Panel #	1	2	3	4	5	6
Upper Rack	Dynax(8), DIOM 1 (lower chassis)	Scale, SSM 5	Scale, SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8, DIOM 9
Lower Rack	Dynax(8), DIOM 2	Scale, SSM 5	Scale, SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9

Option	**8 Loops + 8 Scales + 4 Piezo + 4 Dynax**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	SBM	TGM	SBM	blank	blank	SSM	SSM	LSM	LSM	DIOM
Lower Chassis	SBM	PSM	blank	blank	blank	blank	DIOM	blank	blank	blank

Signal I/O sensor and internal connections to modules

Panel #	1	2	3	4	5	6
Upper Rack	Piezo, PSM 1 (lower chassis)	Scale, SSM 5	Scale, SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8 DIOM 9
Lower Rack	blank	Dynax(4) DIOM 6	blank	blank	blank	blank

Option	**12 Loops + 12 Scales + 8 Piezo + 8 Dynax**									
Module#	0	1	2	3	4	5	6	7	8	9
Upper Chassis	SBM	TGM	SBM	blank	blank	SSM	SSM	LSM	LSM	DIOM
Lower Chassis	SBM	PSM	PSM	blank	blank	SSM	DIOM	LSM	blank	DIOM

Signal I/O sensor and internal connections to modules

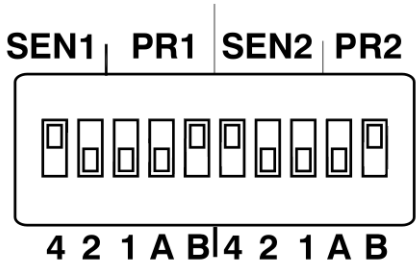
Panel #	1	2	3	4	5	6
Upper Rack	Piezo, PSM 1 (lower chassis)	Scale, SSM 5	Scale, SSM 6	Loops, LSM 7	Loops, LSM 8	Digital out from LSM 7+8, DIOM 9
Lower Rack	Piezo, PSM 2	Scale, SSM 5+6	Dynax(8) DIOM 6	Loops, LSM 7	blank	Digital out from LSM 7+8 DIOM 9

A.1.5 APPENDIX C – LSM

The Loop Sensing Module is used for vehicle detection. A vehicle passing over the loop in the road causes a change in loop inductance which is sensed by the LSM.
Each LSM has four loop channels, with one loop per channel. Each channel has independent sensitivity, presence, and frequency settings. The loop is triggered, or turned on, when a vehicle passing over it causes a change in loop inductance large enough to be detected by the Loop Detector card. The change in loop inductance L is measured as a percentage, $\Delta L/L$ (change in inductance divided by initial inductance).
The sensitivity of the channel determines the amount of change in loop inductance needed to turn the loop on. The **SEN** sensitivity DIP switches are a binary setting, with eight possible levels from 0 to 7. A channel set to a low sensitivity (0, 1, 2) requires more change in inductance to turn the loop on than a channel set to a higher sensitivity (5, 6, 7). Small vehicles, or vehicles with low metal content, will require higher sensitivities to be detected.
The presence hold time determines the amount of time that a slow or stationary vehicle on the loop will continue to be detected. After the loop is triggered, it will stay on for a maximum time of 3.5 seconds, 4 minutes, or 35 minutes, depending on the presence setting. The channel may also be disabled using the presence switches.

A.1.5.1 Configuration

Hardware configuration involves setting several switches per loop channel. The switches on the front panel control sensitivity and presence, while frequency is controlled by switches on the face of the card. On the front panel, the two switch blocks are divided into 5 switches per channel; three for sensitivity, two for presence, as shown below:



Channel Sensitivity and Presence Switches

The channel settings are shown below:

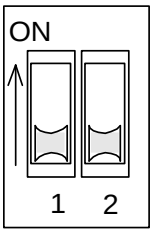
Switch Setting: 4	2	1	Sensitivity Level	ΔL/L
off	off	off	0	1.28%
off	off	**on**	1	0.64%
off	**on**	off	2	0.32%
off	**on**	**on**	3	0.16%
on	off	off	4	0.08%
on	off	**on**	5	0.04%
on	**on**	off	6	0.02%
on	**on**	**on**	7	0.01%

Table 4 - Loop Channel Sensitivity Settings

Switch Setting B	A	Presence Hold Time
off	off	Channel Off
off	**on**	3.5 sec.
on	off	4 min.
on	**on**	35 min.

Table 5 - Loop Presence Settings

There is also an DIP switch block on the card for frequency; this setting should not require adjustment. The frequency of the channel determines the loop frequency. The loop frequency does not affect vehicle detection, but is used in multiple loop configurations; when there are loop lead wires running next to each other, and the loop signals do not go to the same LSM card, different loop frequencies are required to prevent crosstalk. The frequency switches are located on the face of the LSM card and cannot be accessed while the module is in the iSINC.



Channel Frequency Switch (Default shown)

The frequency switch settings are shown below:

Switch Setting 2	1	Frequency
off	off	High
off	**on**	Medium High
on	off	Medium Low
on	**on**	Low

Table 6 - Loop Channel Frequency Settings

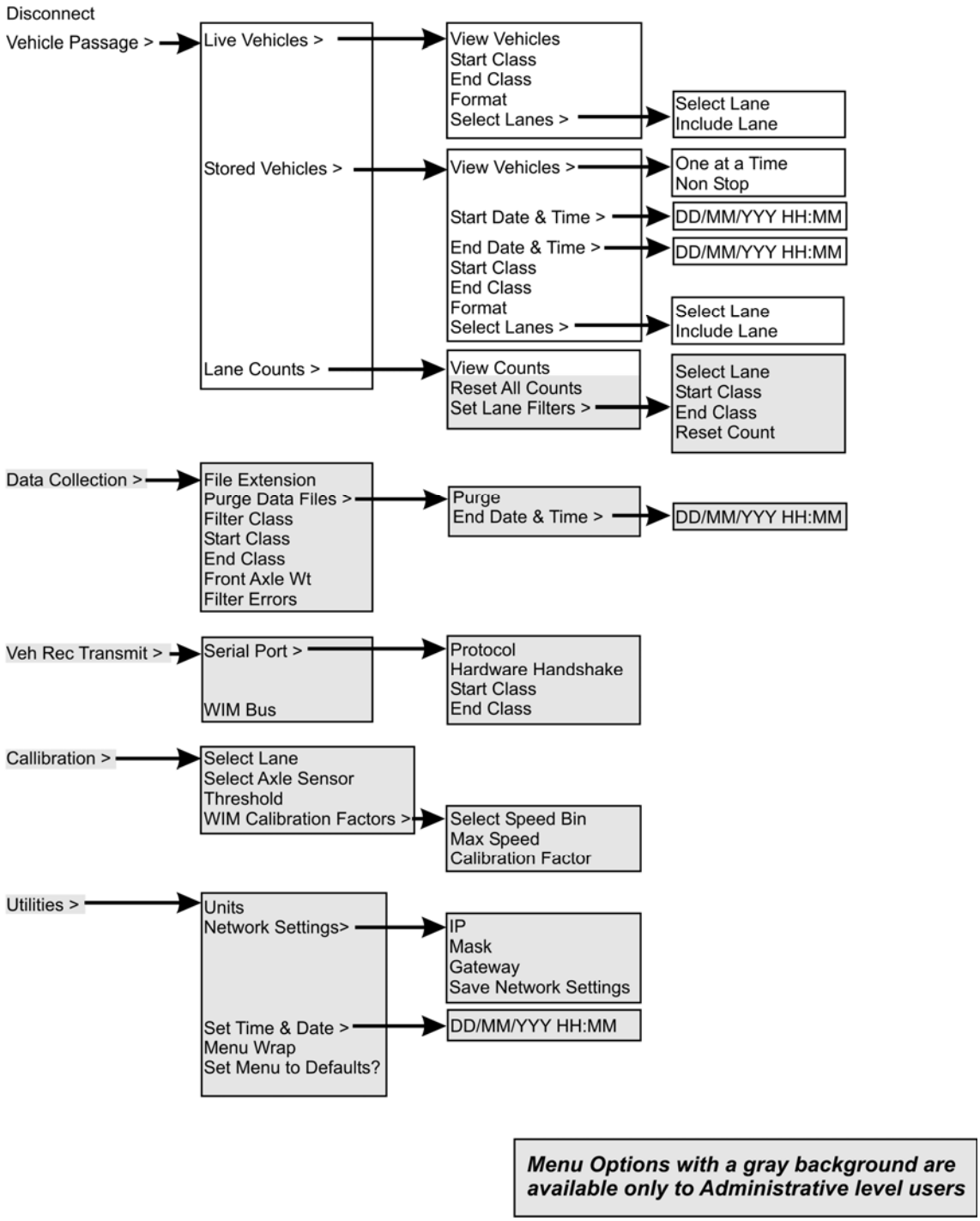
Appendix D – Signal I/O Over-Voltage Protection

Solid state transient over-voltage protection device manufactured by Krone Inc., part no. 6659 2 060-03.

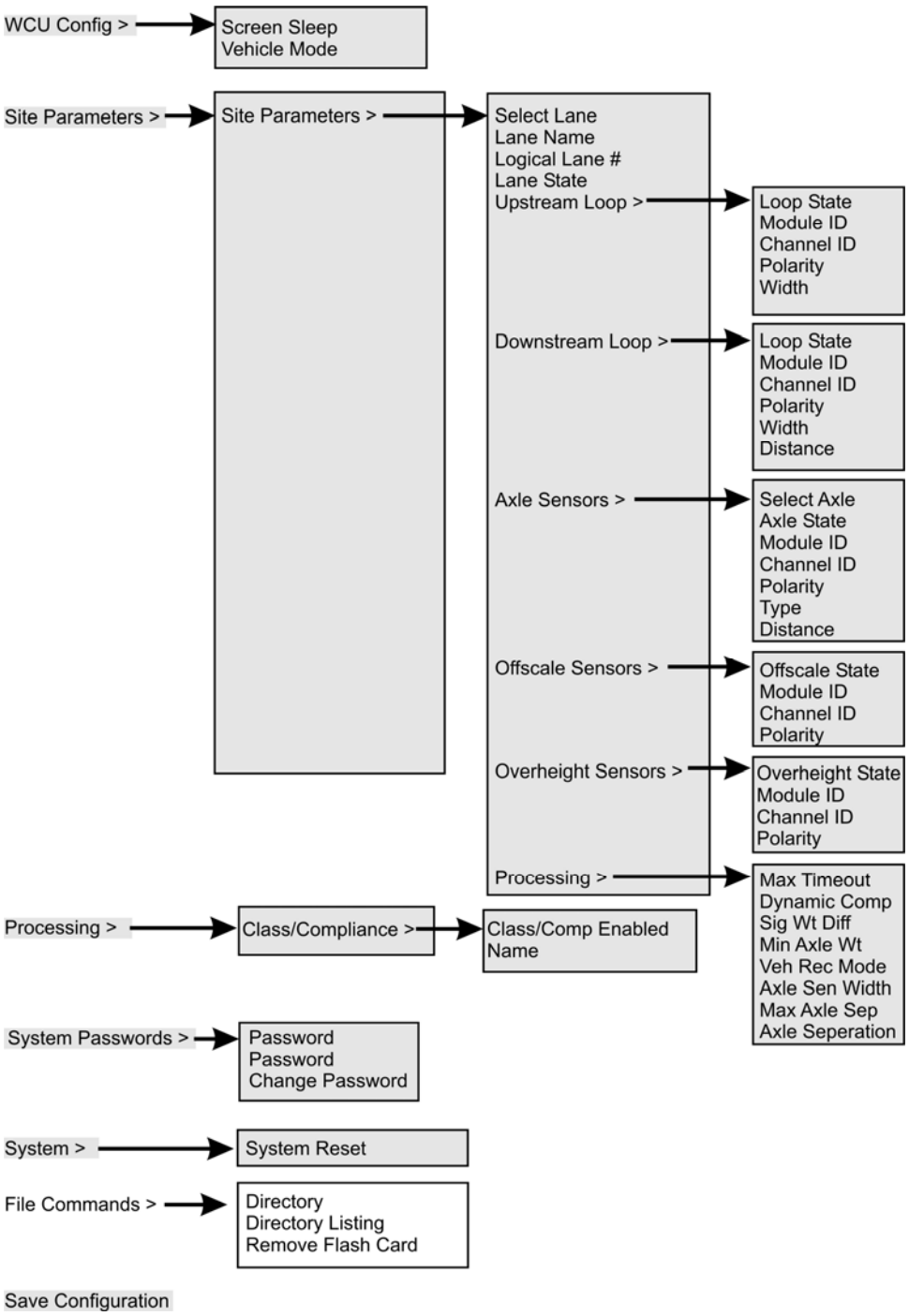
Package	Modified TO-220	
Pins for peak off-state voltage V_{DRM}-1	Pins(V_{DRM}-1)	1-2, 2-3
Peak off-state voltage	V_{DRM}-1 (V)	270
Switching voltage	V_S @ V_{DRM}-1 (V)	350
Pins for peak off-state voltage V_{DRM}-2	Pins(V_{DRM}-2)	1-3
Peak off-state voltage	V_{DRM}-2 (V)	270
Switching voltage	V_S @ V_{DRM}-2 (V)	350
On-state voltage	V_T Max (V)	8.0000
On-state forward voltage	V_F (V)	0
Leakage current	I_{DRM}	5
Switching current	I_s Max (mA)	800
Holding current	I_H Min (mA)	150
Off State Capacitance	C_O (pF)	0
Peak Pulse Current – 2 x 10Aμs	I_{PP} 2 x 10Aμs	250
Peak Pulse Current – 8 x 20Aμs	I_{PP} 8 x 20Aμs	250
Peak Pulse Current – 10 x 160Aμs	I_{PP} 10 x 160Aμs	150
Peak Pulse Current – 10 x 560Aμs	I_{PP} 10 x 560Aμs	100
Peak Pulse Current – 10 x 1000Aμs	I_{PP} 10 x 1000Aμs	80
Peak Pulse Current – 5 x 310Aμs	I_{PP} 5 x 310Aμs	0
Peak Pulse Current – 5 x 320Aμs	I_{PP} 5 x 320Aμs	0
Peak Pulse Current – 10 x 700Aμs	I_{PP} 10 x 700Aμs	0
Peak one cycle surge current	I_{TSM} 60Hz (A)	30
Current rise rate	*di*/*dt* Max (A/Aμs)	500

A.1.6 APPENDIX E – iSINC DATA COLLECTION MENU TREE

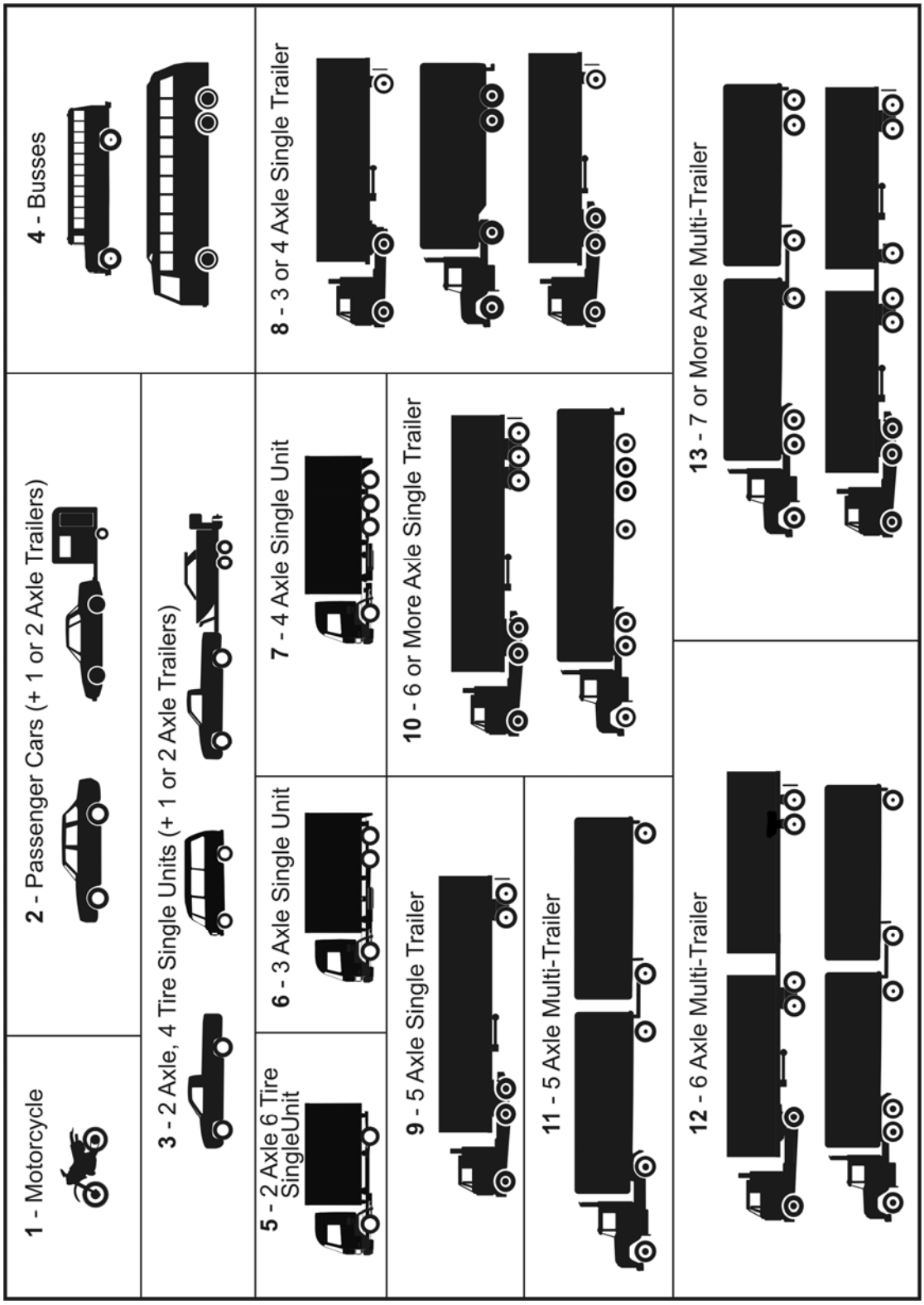
Main Menu:



Menu Options with a gray background are available only to Administrative level users


WCU Config >
Screen Sleep
Vehicle Mode
Site Parameters >
Site Parameters >
Select Lane
Lane Name
Logical Lane #
Lane State
Upstream Loop >
Loop State
Module ID
Channel ID
Polarity
Width
Downstream Loop >
Loop State
Module ID
Channel ID
Polarity
Width
Distance
Axle Sensors >
Select Axle
Axle State
Module ID
Channel ID
Polarity
Type
Distance
Offscale Sensors >
Offscale State
Module ID
Channel ID
Polarity
Overheight Sensors >
Overheight State
Module ID
Channel ID
Polarity
Processing >
Max Timeout
Dynamic Comp
Sig Wt Diff
Min Axle Wt
Veh Rec Mode
Axle Sen Width
Max Axle Sep
Axle Seperation
Processing >
Class/Compliance >
Class/Comp Enabled
Name
System Passwords >
Password
Password
Change Password
System >
System Reset
File Commands >
Directory
Directory Listing
Remove Flash Card
Save Configuration

Appendix F – FHWA Vehicle Classes



5 Kistler Quartz Sensor

5.1 Installation Instructions

KISTLER
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Installation Instructions

Lineas® Sensors for
Weigh-in-Motion
Type 9195E

9195E_002-301e-11.04

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Foreword

We thank you for choosing a Kistler quality product distinguished by technical innovation, precision and long life.

Information in this document is subject to change without notice. Kistler reserves the right to change or improve its products and make changes in the content without obligation to notify any person or organization of such changes or improvements.

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Content

Content

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Total pages: 52

1. Important Notes

1.1 Scope

These instructions apply to the installation of Kistler Type 9195E Lineas sensors and supersede all previous editions. They describe a typical weigh-in-motion (WIM) configuration. In reality each WIM site is different, particularly as far as cabling is concerned. Hence some steps may not apply to your installation or may need to be carried out in a different order. However, please note that the precautions listed in chapter 2 Precautions **must** always be taken for all installations.

The safety data sheets for the Type 1000A1 grouting compound have been produced by our suppliers and are only intended as a recommendation for safe handling of these products.
They shall not be construed as constituting a warranty on the part of Kistler Instrumente AG regarding the properties of these products. The warranty is defined in Kistler's General Terms of Supply.

1.2 Terminology

Row of sensors:
Normally consists of 2 or 4 Lineas sensors.

Sensor cable:
Available in lengths of 40 and 100 m and is permanently connected to the sensor.

Protection tube:
Forms an integral part of the sensor and may be installed directly in the pavement.

Conduit:
The sensor cables must be routed through a conduit or cable duct extending from the edge of the pavement to the roadside electronics cabinet.

Grouting compound:
Kistler Type 1000A1 may only be used for grouting the sensors. A flexible grout must be used for the cables in the pavement.

Flexible grout:
Locally available product that is normally used for grouting induction loops.

2. Precautions

Disregarding these instructions when installing Lineas sensors may incur risks such as the following:

- **Risks to the health of the installation team:** Handling the Kistler Type 1000A1 grouting compound can lead to health risks for the installation team if the instructions are not followed. It is particularly important to comply with the appended safety data sheets for the resin and the hardener of the compound. They describe possible hazards, first aid and necessary personal precautions, and contain other important information and instructions that must always be followed.
- **Accident risks for the installation team:** The regulations and other necessary measures applicable to securing the construction site must be strictly observed. Failure to do so may lead to accidents and other serious consequences.
- **Hazards for road users:** Disregarding these instructions – particularly in relation to the handling and use of the Type 1000A1 grouting compound – may result in individual components or complete sensors becoming detached and causing serious traffic accidents.
- **Damage to the sensor:** The sensor may be damaged and become unusable if not installed properly, particularly if these instructions are not followed.
- **Sensor malfunctions:** Disregarding these instructions may result in the sensor no longer meeting the system specifications.

2.1 General

- The requirements to be met in planning a WIM station are explained in Doc. No. 002-300 Planning of a WIM Station. To ensure optimal operation of the WIM system, installation should only be considered on roads that meet COST 323 Class I (excellent) requirements.
- Careful selection of the most suitable location is crucial, as the accuracy of the system is heavily dependant on the quality of the pavement. Please therefore refer to the requirements of the COST 323 draft standard specification (http://wim.zag.si) and ASTM 1318-02 standard (http://www.astm.org). Rutting, bumps and pavement cracks will impair system performance. Straight sections of roads with uniform vehicle speed distributions and flat pavement are the most suitable for achieving the best possible results.
- The rutting and pavement deformations at the time of installation must not exceed 4 mm over the entire width of the lane. Pavement bumps in the direction of traffic flow must not exceed 1 to 2 mm over an area extending from 40 cm before to 40 cm after the row of sensors. If these requirements are not met, we recommend renovating the pavement before installation or choosing a different site.

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- It is desirable to keep the distance between the installed sensors and the electronics cabinet to a minimum. This allows the use of sensors with standard length integral cables and reduces the risk of damaging the cables (e.g. during pulling). Planning and preparation of the installation is therefore to be carried out as early as possible. Position the electronics cabinet so that it is safely accessible for personnel at all times.
- For every Lineas installation a WIM-Lineas warranty protocol must be completed and sent to Kistler or your supplier within 2 weeks of installing the system.
- Do not install Lineas sensors within 72 hours of a new pavement being laid.
- Do not install the sensors under unfavorable weather conditions (cold, humid – see chapter 4.8). Take account of the local weather forecast.
- The grouting compound has a shelf life of one year when correctly stored. The use by date is specified on the container.
- Some documentation is available at www.kistler.com (Vehicles/Road&Traffic/WIM).

2.2 Authorization and Responsibility for Installation

Installation may only be carried out by persons who have successfully completed a Kistler training course and hold a valid Kistler certificate authorizing them to install the relevant Lineas sensors.
These installation instructions must be strictly followed. Please contact your supplier or Kistler immediately if in doubt.
The person certified by Kistler is responsible for installation and especially for deciding whether or not it is to proceed, and for re-opening the lane.

Kistler will accept no liability under warranty if these instructions are not followed.

2.3 Installation Precautions

- It is absolutely essential to ensure the slots in the pavement and the sensors are completely dry and clean before being grouted.
- Allow sufficient time to heat the slots and grouting compound to the required temperature.
- The grout must be completely cured and the surface of the sensors ground flat before the lane may be re-opened to traffic.

- Grout viscosity and curing time are heavily temperature dependent. If the pavement or air temperature is below +20 °C, use heating equipment to heat and dry the sensor slots along their entire length.
- Overheating of grout, pavement and sensors must be avoided.
- We therefore recommend the use of hot air blowers, infrared or radiant heating equipment. Never use a naked flame for drying and heating.
- We recommend keeping a surplus of grouting compound on hand as a precaution.
- The grouting compound has a shelf life of one year sealed in its original container. Do not store it at temperatures below +10 °C.

2.4 Electrical

Please note that the cables included with the sensor are highly insulated. The sensor insulation resistance must be $\geq 10^{10}$ Ω. It is absolutely essential to maintain this high value. Improper cable handling may impair system performance. Some basic requirements must therefore be met before and during installation:

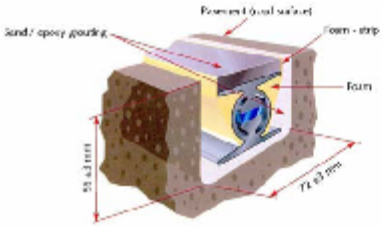
- Lineas sensors come with cables with standard lengths of 40 or 100 m. The location of the electronics cabinet must be chosen accordingly.
- The sensor cables must be laid continuously – i.e. without any intermediate mechanical or solder connection – from the end of the sensor to the electronics cabinet. Use the Kistler Type Z18753 junction box for distances exceeding the standard cable length.
- Cables should be left in the box in which they are supplied for as long as possible. Be careful not to squeeze or damage them once removed. Avoid sharp bends.
- It is important to protect bare cable ends at all times against the ingress or water, damp and dirt. Use the heat-shrink tubing ends supplied as standard.
- The installation resistance of all sensors must be checked immediately after opening the packaging and before grouting.
- Each row of sensors must be connected to the charge amplifier or the electronics cabinet with a ground wire.
- Lay cables and ground wires in conduits to the electronics cabinet and provide rodent protection.

2.5 Safety Data Sheets

The safety data sheets for the resin and hardener of the Kistler Type 1000A1 grouting compound are appended as pages 41 to 52. Make sure all safety precautions are taken and use health and safety equipment at all times.

3. General

3.1 System Description

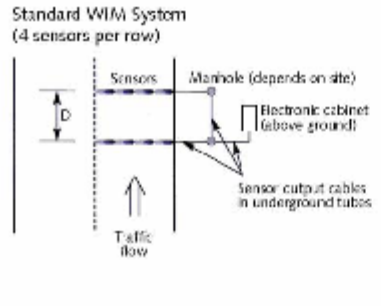


Lineas Type 9195E sensors are installed in saw cut or milled slots in concrete or asphalt paving.

The slot has to be 55 ± 3 mm deep and 72 ± 3 mm wide.

The slots are cut exactly at right angles to the traffic flow. Sensors are available in two lengths: 0,75 m and 1,00 m.

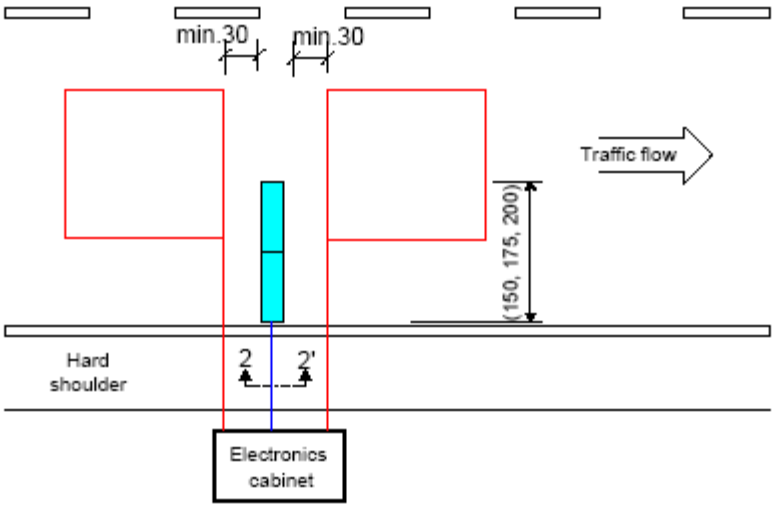
Sensors connected to the same measuring channel must be matched. Please see your delivery documentation for a list of the best matching serial numbers.



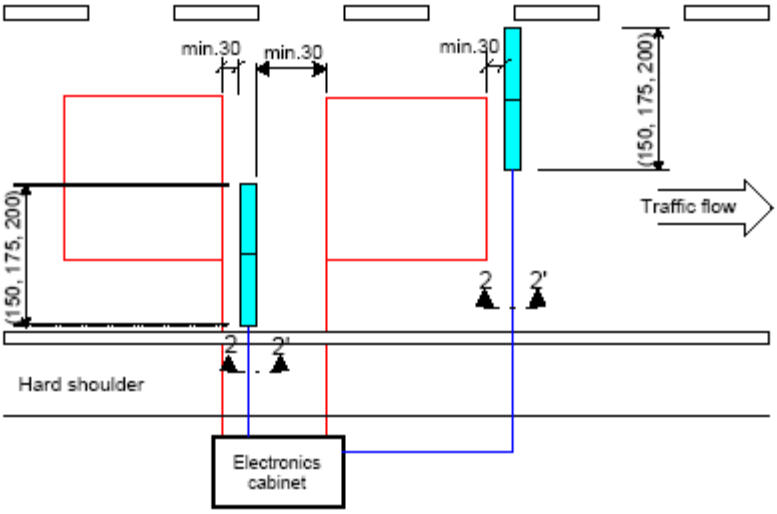
A WIM site usually has two rows of sensors per lane. The spacing D of these rows may be varied. Please see the service manual Planning of a WIM Station (Doc. No. 002-300), which is available in English, for further information.

The sensors are secured in the slots with a special grout (Kistler Type 1000A1) consisting of epoxy resin and quartz sand. The top surface of this grout is troweled off flush with the pavement and, after curing completely, ground flat. The lane can then be re-opened to traffic without risking damage to the sensors. A settling time of at least 72 hours is then required before the sensors may be calibrated.

Statistics WIM



Staggered WIM



All dimensions in cm

Lineas sensor

Induction loops

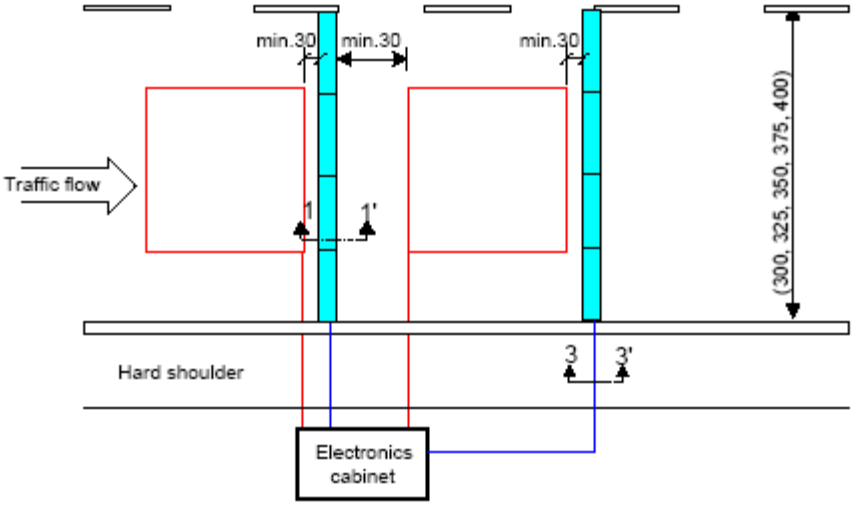
2 2' Cross-section

Sensor cable

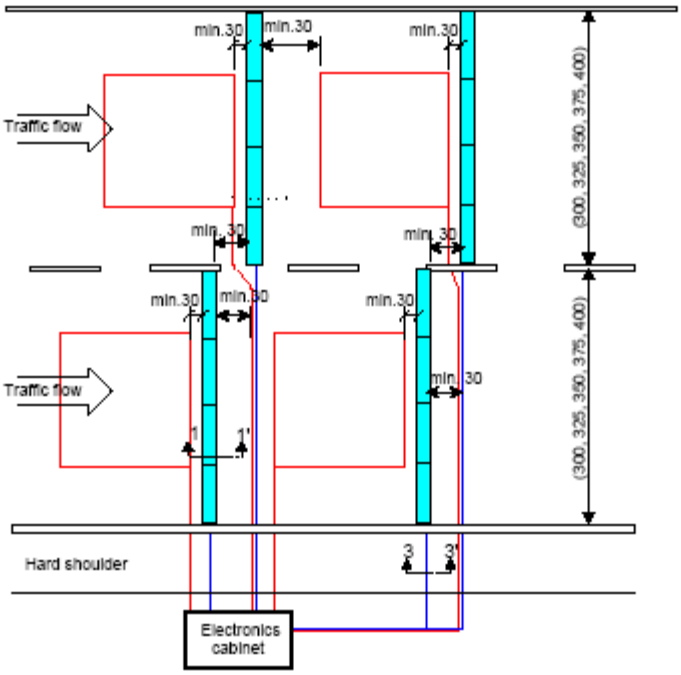
General

KISTLER
measure. analyze. innovate.

Standard WIM system on 1 lane



Standard WIM system on 2 lanes



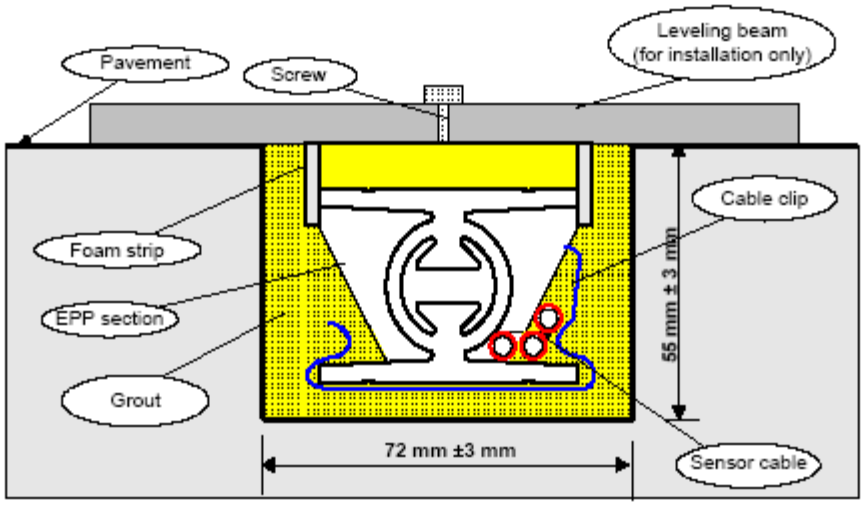
Lineas Sensor
Induction loops
2 2' See cross-section
Sensor cable

All dimensions in cm

9195E_002-301e-11.04 Page 11

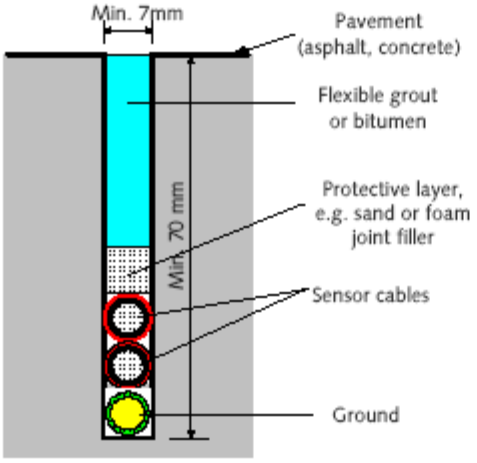
Sensor in Pavement

Section 1-1

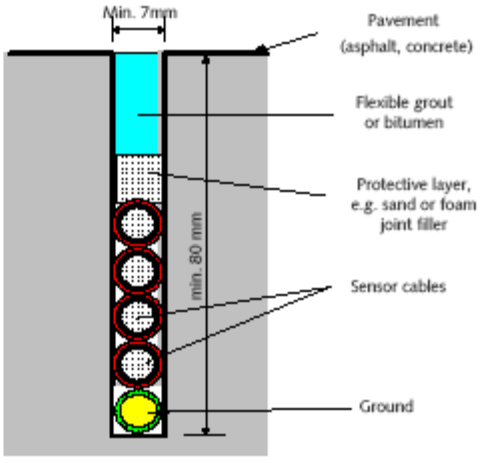


Cable Laying in Pavement

Section 2-2 with 2 sensor cables



Section 3-3 with 4 sensor cables



3.2 Installation in Concrete Pavement

1. Lineas sensors installed in concrete

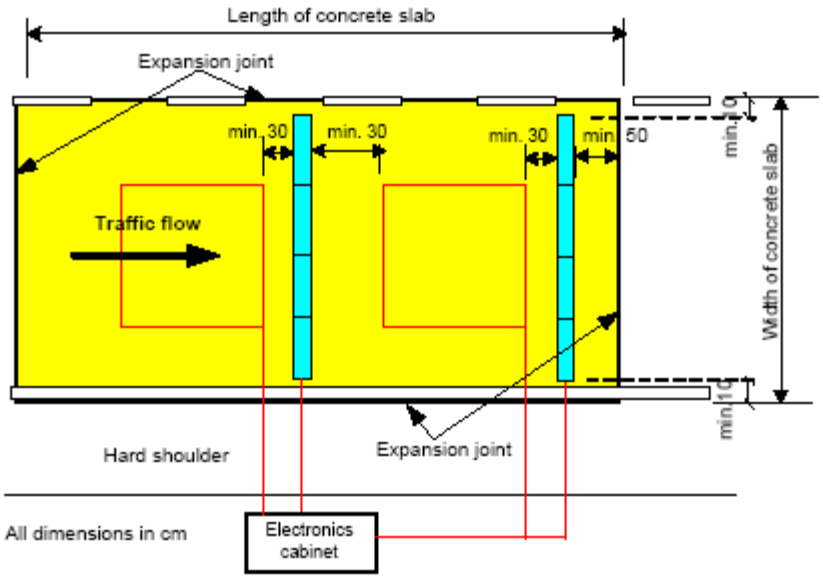
The requirements for installation in a concrete pavement are as follows:

- The cable ducts must be designed to avoid damage to the cables in the vicinity of expansion or other joints, or a change in the type of pavement (from concrete to asphalt). Lay the cables in flexible armored conduits.
- Avoid taking the cables through the concrete; it is preferable to lead them underneath.
- Never cut the steel reinforcement of the concrete. Please consult the design engineers if in doubt.
- The distance between a joint and a Lineas sensor must be at least:
  - Transverse to traffic flow: 100 mm
  - Direction of traffic flow: 500 mm

2. Detail

Never install the sensors in the vicinity of expansion joints. The rows of sensors should be installed in the same concrete slab wherever possible.

WIM sensors in concrete highways



3.3 Other Preporatory Work

To minimize the duration of the roadworks, preparation should include the following:

- Submit applications to authorities
- Check authorities have granted permission
- Check all required materials
- Check that all required tools and equipment are available and in good working order (including heating equipment)
- Prepare warranty protocol
- Take account of local weather conditions

4. Preassembling Sensors in Workshop

The Lineas sensors must be assembled into a row in a clean and dry environment. We recommend that this is done in a workshop, warehouse or laboratory. This will ensure there is sufficient light and clean, flat surfaces, and that work can be performed calmly under quiet conditions.
Preassembly must be completed before heading for site.

4.1 Unpacking Sensors and Laying out in Row

Your delivery documentation includes a list of the matching serial numbers. For each row, matched sensors have been selected according to your site plan. Pre-align the boxes according to the sensor positions. Check their serial numbers agree with the site plan and matching list. Note the serial numbers in the warranty protocol.

4.2 Insulation Check

Measure the insulation resistance of each sensor with a tester (e.g. Kistler Type 5493Y0394). All measurements must be $\geq 10^{\infty}\ \Omega$ (wait several seconds for the reading to stabilize). Carry out a simple operational test by pressing the sensor: the "horizontal bar" should jump off scale.

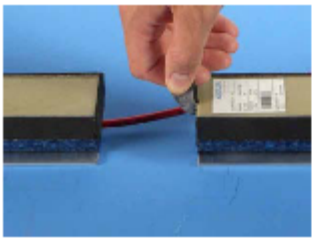
4.3 Cable Handling

The cables have been specially coiled in a figure of 8 to avoid twisting when they are pulled directly (without uncoiling) into the conduits. At the sensor end the first 15 m of cable is provided with a protection tube. Open the outer cable ties and uncoil 4 m of cable to make it easier to assemble the row of sensors.
Replace the coil of cable in the box, ensuring that the BNC connector is in a protected position on top.

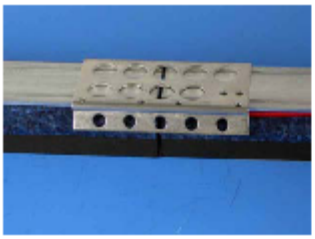
4.4 Cable Marking

Identify each cable with a number tag (e.g. using Scotch code wire marker) about 1 meter from the BNC connector. To ensure the serial numbers and connections to the electronics in the cabinet will remain clear in the future, make absolutely sure you do not forget to enter the numbers on your warranty protocol.

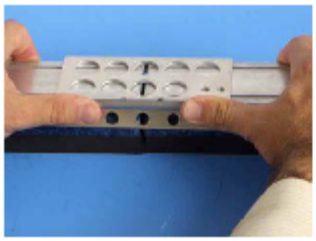
4.5 Assembling Row of Sensors



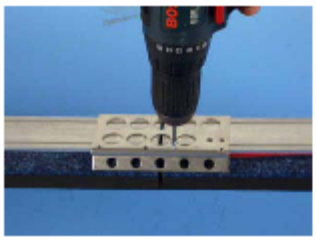
Carefully remove the black strip of foam from the opposite end to the cable entry by pulling it gently upwards, so that only one strip of foam remains between two consecutive sensors.



Place the connection plate in the middle of the joint and make sure the cables are fitted correctly.

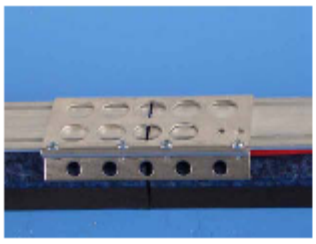


To move the connection plate to it's correct position, firmly press it towards the side with no cables.

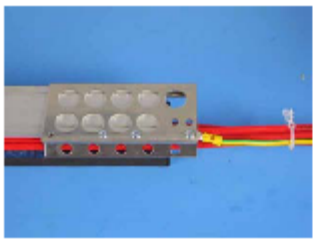


The sensors are connected together to form a row using self-tapping screws in the pre-drilled holes in the connection plates included in the installation kit.

Max. torque: 2,5 Nm



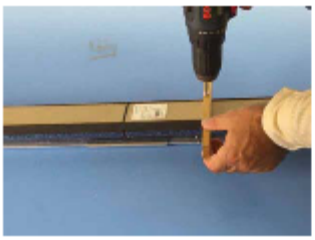
After attaching the connection plate (4 screws, 2 per side) to one sensor with an electric screwdriver (TORX T20), butt the ends of the two sensors together with hand pressure to compress the remaining foam strip and screw the other sensor onto the plate. Assemble the rest of the row in a similar manner.
The row can be checked visually for straightness and lowered into the slot as a single unit later on site.



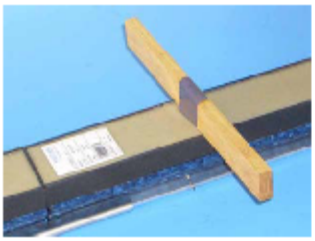
Roll out the ground wire. Cut a length equal to at least the distance between the row of sensors and the electronics cabinet. Connect the ground wire to the end of the connection plate, which should extend about 20 mm beyond the sensor.
The sensor cables can be secured on the connection plate with ties.

4.6 Mounting Leveling Beams

Lay the cables out straight and parallel along the row of sensors and secure with the clips included in the installation kit.

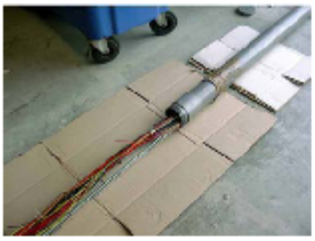


Screw the leveling beams (two per sensor) onto the top surface of each sensor. The leveling beams and matching screws are included in the installation kit.



Cover each screw head with adhesive tape to prevent it getting clogged with grout. This ensures the screws of the leveling beams are easily removed.

4.7 Storage and Transportation of Rows of Sensors



Attach the cables to the row of sensors and thread into a protective pipe.
PE pipes with a minimum diameter of 125 mm (40 m cable) with threaded connections at both ends are suitable for this purpose.
The sensors must be transported carefully.

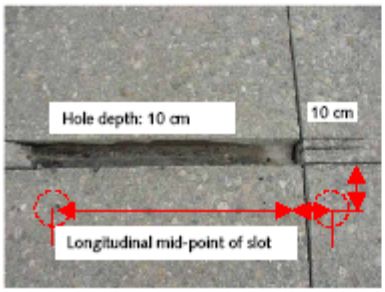
4.8 Preparation for Grouting Sensors

The **pavement** and **air** temperature must be measured and noted on the warranty protocol. The sensors **must not** be installed until the following temperatures are achieved:

a) Pavement

Minimum temperature: +20 °C
Maximum temperature: +50 °C
if heating equipment used

Heating equipment must be used if the temperature requirements are not met.



Measurements when using heating equipment
Drill 10 cm deep holes 10 cm away from the slot in 3 different places (opposite middle and ends of slot). Heat the slot and measure the temperature of the pavement at a depth of 10 cm until the required value of +20 °C is achieved in all holes. Record the measurements (time, temperature and heating settings) and use this data for your installation.

Tests prior to the actual installation are also required if new heating equipment is to be used or installation in a pavement of unknown composition planned.

The **guidelines** for heating slots and installed sensors assume that the slots are clean and bone dry, and the use of heating equipment as explained in chapter 6.3.1.

The data in the following table is only intended as a guide. The actual heating times depend on the site conditions resulting from the weather (temperature, humidity and wind), pavement (temperature, moisture, type and construction) and heating equipment used.

Pavement temperature at start of installation	Minimum time required for heating slot (before sensors installed)	Minimum time required for heating installed sensors
+5 °C to +10 °C	90 minutes	120 minutes
+11 °C to +15 °C	60 minutes	90 minutes
+16 °C to +20 °C	30 minutes	60 minutes

We recommend heating for as long as possible, even after grinding the sensors.

Caution! The pavement must not be damaged through the use of heating equipment.

b) Grout:

The installation team is required to have read and understood the safety data sheets for the grouting compound. They are appended to these instructions.

To ensure even curing, the grouting compound has to achieve the following temperature before being mixed.

Required temperature: +25 ° bis +30 °C

The can with the hardener and the plastic bottle with the resin are taken out of the bucket and heated up to the required temperature separately. This can be done in a workshop or site container, or they can be placed in front of a car heater on full until the required temperature is reached.

If the temperature of the compound is above 30 °C it must be cooled to the required value before being mixed. The pot life of the grouting compound at different temperatures is specified on the technical data sheet.

5. Installation

5.1 Setting Out

Set out as shown on your site plan. Ensure the dimensions are correct and lines parallel.

Measuring pavement surface:

Transverse to traffic flow: The rutting and pavement deformations at the time of installation must not exceed 4 mm over the entire width of the lane.

In direction of traffic flow: Pavement bumps in the direction of traffic flow must not exceed 2 mm over an area extending from 40 cm before to 40 cm after the row of sensors.

The sensors must not be installed unless both of these conditions are met. We strongly recommend discontinuing installation and renovating the pavement first, or choosing a different site. Always inform the Project Manager before taking any decision.

5.2 Marking Sensors and Induction Loops on Pavement

Mark the layout of the sensors, induction loops and cable ducts directly onto the pavement.

The sensor slots must be cut 72 mm wide and 55 mm deep.

The slot must be at least 20 mm longer than the fully preassembled row of sensors (including end connection plate).

5.3 Cutting Slot

We strongly recommend using a dry cutting pavement saw with dust extraction system, or preferably producing the slot with a pavement milling machine.

5.4 Cleaning Slot

After cutting the pavement, remove the pieces broken out. Clean any debris from the slot with a suitable vacuum cleaner or blower.

5.5 Inspecting Slot

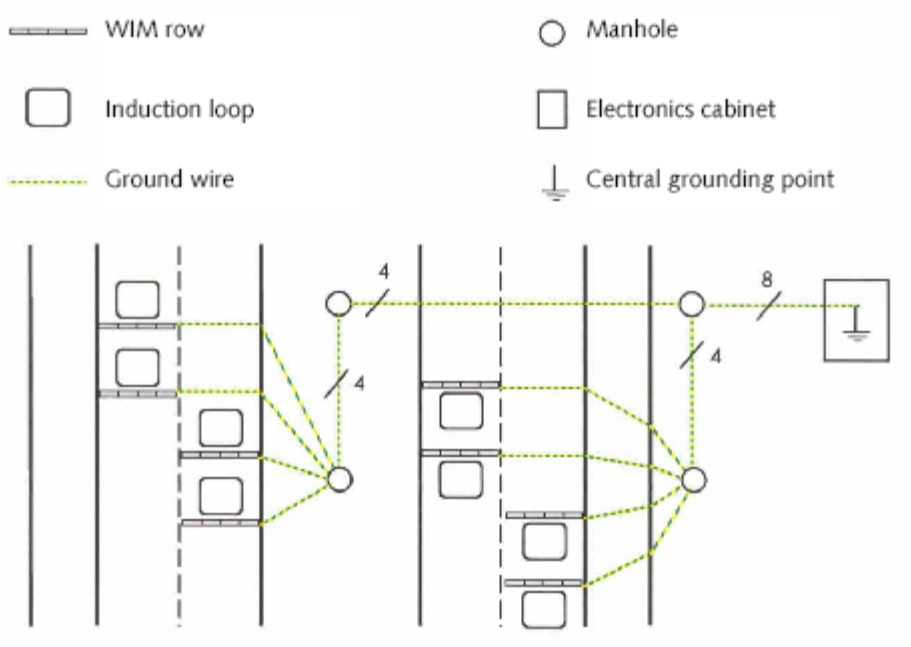
Check the dimensions of the slot with a Type Z16530 gage from Kistler.

Never use a naked flame to dry the slot (use paper towels or fresh cleaning cloths).

The slot must be bone dry.

5.6 Grounding Lineas® Sensors

Each row of sensors has to be grounded. The sensors are grounded centrally in the electronics cabinet rather than locally. A ground wire (min. 6 mm²) must therefore connect each row to the ground point in the electronics cabinet. Ground wire and signal cables have to be laid in parallel. Kistler does not supply the ground wire.



5.7 Insulation Check

Measure the insulation resistance of each sensor, which must be $\geq 10^{10}\,\Omega$. Use a Kistler Type Z18810 quick test adapter if the BNC connector has been cut off.

Carry out an operational test by pressing the sensor and watching the reading of the insulation tester. The "horizontal bar" should move toward the end of the scale.

5.8 Pulling Cables

Handle the highly insulated sensor cables extremely carefully throughout the installation procedure.

! If the BNC connectors have been cut off, each cable end must be sealed with a heat shrink sleeve to prevent ingress of water while pulling the cable through.

Pull half the length of the sleeve (included in the installation kit) over the end of the cable, heat it to about 120°C with a hot air gun and firmly squeeze the other half while still hot.

If the BNC connectors have not been cut off, or are not to be immediately connected to the charge amplifier, protect them against dirt and moisture.

It is absolutely essential to protect the cables at changes in direction when pulling.

For a standard row of sensors (4 sensor cables plus ground wire), a conduit inside diameter of at least 30 mm is recommended if the BNC connectors have been cut off. Otherwise correspondingly larger inside diameters must be chosen. Attach the ground wire and all of the sensor cables of a row to a cable snake. Wrap cables, ground wire and snake with insulation tape to provide strain relief. Carefully pull the group of cables through the conduit.
Protect the end of the conduit to prevent ingress of water and dirt.

5.9 Covering Pavement

Cover the pavement directly adjacent to the slot with a tear-resistant 50 mm wide adhesive tape.

Open or porous pavements: Affix the masking tape parallel to the slot and about 20 mm away. This will enable the grout to fill the cavities of the pavement so its edges are reinforced.

5.10 Final Fitting Check before Grouting

Lower the assembled row of sensors into the pavement slot for a final fitting check. Then remove the assembly and set it down next to the slot ready for embedding.
Ensure the row is straight.

Height check:
The sensors must be flush with or slightly above the level of the paving. Otherwise the leveling beams will have to be shimmed.

5.11 Cleaning Sensors

The light-alloy section to be permanently bonded to the grout must be bone dry and clean. Clean the section with a dry cloth. Clean it with a solvent such as acetone or white spirit if dirty.

5.12 Laying Sensor Cables in Pavement

The sensor cables are laid straight into the slot in the pavement. They must be held in position by a foam joint filler or similar product to prevent them floating during grouting.

5.13 Grouting Precautions

The safety data sheets for the grouting compound have to be read and understood before carrying out grouting. The compound contains dangerous chemicals that could give rise to health risks and damage the environment.
Although the sensors may be installed at air and pavement temperatures below +20°C, the use of heating equipment to pre-heat the pavement and grout components then becomes **absolutely essential**. We recommend the use of heating equipment even at temperatures above 20°C or during windy, humid or wet weather. The heating equipment accelerates the curing of the grout and protects the sensors against moisture.

A 10 kg bucket of Kistler Type 1000A1 grouting compound is generally sufficient for 2 Lineas sensors. It contains the three components:

- Quartz sand
- A plastic bottle with epoxy resin
- A can with epoxy hardener (this is classified as a dangerous material and must therefore be handled with care, wearing safety goggles and gloves)

CAUTION!
The pot life of the mixed grout depends on temperature. You must therefore ensure the sensors are ready for grouting before mixing the compound. Otherwise the grout may heat up in the bucket of its own accord, and start going off before it can be used.

5.14 Grout Preparation: Wear Safety Goggles and Gloves!

IMPORTANT!

- Measure the temperature of the pavement. It must be at least 20°C at a depth of 10 cm.
- Measure the temperature of the sand, hardener and resin. It must be approximately between +25 and 30 °C.
- Ensure the sensors are ready for grouting.

Take the resin and hardener out of the bucket in which they are supplied and pour the sand into another bucket. Pour the resin into the original bucket. (If more than 10 grams of resin remains in the plastic bottle, pour some hardener into it, shake briefly and empty this mixture into the original bucket.)

Pour all of the hardener from the can into the bucket with the resin.

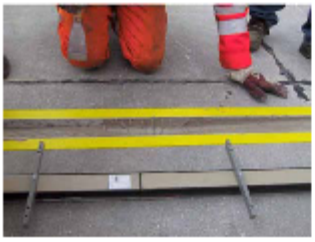
Mix the resin and hardener thoroughly with a heavy-duty mixer.

! Always take particular care to avoid entraining air bubbles in the mixture.

During mixing, pour the sand into the mixture gradually to avoid lumps forming.

Mix thoroughly by moving the mixer up and down until the grout is uniform. This normally takes about 2 or 3 minutes.

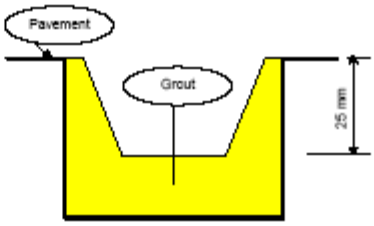
5.15 Pouring Grout into Slot



The slot must be bone dry and free from dust or debris before being grouted.

Fill the entire length of the slot to within 25 mm of the pavement surface.

Sweep a trowel upwards to spread the grout against the sides of the slot up to the top as shown. Level the bottom surface of the channel formed in the grout.



5.16 Lowering Row of Sensors into Slot

Position the row of sensors above the filled slot and press it down slowly into the grout. Continue until the leveling beams come into contact with the surface of the pavement.

Trowel any surplus grout off the sensors and pavement. The grout should be slightly higher than the pavement.

Use weights to position the sensors correctly until the grout has cured.
Ensure the heads of the screws of the leveling beams are protected with adhesive tape so they can be readily removed.

5.17 Curing Time

Remove the leveling beams and masking tape as soon as the grout has cured (which depends on the air and pavement temperature). Maintain the required pavement temperature by heating its surface.

See chapter 6.3.1 for suitable heating equipment.

Heat extremely carefully. **Never use a naked flame.**

5.18 Grinding Surface

Always wear protective clothing, eye protection and breathing protection. Take care not to inhale the dust. Grind the surface of the sensors until perfectly level with the pavement. Only use the diamond grinder to do the rough grinding. Then use the belt sander for finishing.

Diamond grinder (rough grinding)

Belt sander (finishing)

5.19 Checking Surface

Use a gage (aluminum section) at regular intervals during grinding to check whether the surface is flush with the pavement. Rub the gage back and forth over the sensor to reveal high spots as black marks.

It is important to ensure that there are no high or low spots left after grinding, and particularly no ridges at the butt joints between the individual sensors, as they would affect subsequent measurement accuracy.
Clean and clear the site.

5.20 Checking Sensors

Check the insulation resistance of the sensors and perform an operational (jump) test. Note the values in the warranty protocol.

5.21 Electrical Connections to Kistler Charge Amplifier

Connect all sensor cables according to the requirements of your system installation contract. Take particular care of the high-value insulation.

Do not forget to form a spare loop at least 2 m in length before cutting and stripping the cable.

Please refer to the Operating Instructions (002-224) or the Data Sheet (000-310) for further information about the Type 5153A.

5.22 Cable Connection to Charge Amplifier

Kistler Type 5038A2Y43 charge amplifier for two channels.

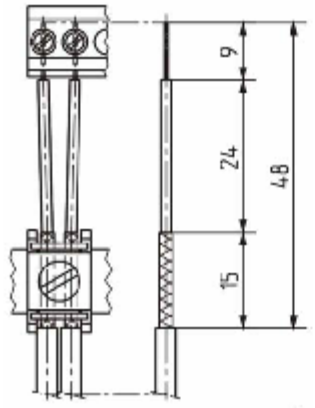
Type 5038A2Y43 charge amplifier

Fit a BNC connector to each signal cable if the connector has been cut off to allow the cable to be pulled through.

1. Push the blue anti-kink sleeve and the ferrule over the cable sheath.
2. Carefully strip the insulation with Kistler's special Type Z17616 tool to expose the cable braid, insulation and central conductor.
3. Position the gold contact pin on the central conductor of the cable, ensuring there are no stray strands that could cause a short circuit.
4. Crimp the pin with the special Huber & Suhner 75Z-0-0-50 crimping tool using the smaller groove of the 75Z-0-0-50 insert.
5. Splay braid slightly.
6. Slide the ferrule over the braid carefully.
7. Crimp the pin with the special Huber & Suhner 75Z-0-0-50 crimping tool, using the large hexagonal opening of the 76Z-0-2-51 insert.
8. Fit the blue anti-kink sleeve.
9. Test the BNC connector for correct insulation resistance.
10. Connect the two BNC connectors of the same pair of sensors to the amplifier with a Kistler Type 1743 BNC-T adapter.

Kistler Charge Amplifier 5153A...
for 9 or 18 channels

Detail A



Type 5153A... charge amplifier

The Type 5153A charge amplifier does not need BNC connectors, as the sensor cables are introduced via PG9 glands.

1. Push the signal cables of the same row of sensors at least 200 mm through a PG9 nut and seal to ensure no strands of wire can fall into the amplifier when the insulation is stripped.
2. Screw the PG9s on loosely to enable cable positioning.
3. **Strip the insulation of the coaxial cables as shown in Detail A.**
   - Remove a 48 mm length of the sheath.
   - Shorten the braid 33 mm, taking care not to nick the insulation of the central conductor.
   - Strip a 9 mm length of the inner Teflon insulation to the diameter (0,55 mm) of the central conductor (7 strands of silver-plated steel wire).
4. Connect the signal cables to the amplifier terminals as shown in Detail A.
5. Adjust cable lengths and screw the PG9s tight.
6. Connect the connectors of the supply and signal cables to the amplifier.
7. Carry out an operating test.
8. Re-fit the amplifier cover with the 4 Allen screws.

Only introduce the sensor cables (without additional sheath) into the amplifier. The additional sheath must remain in the lower part of the electronics cabinet. Ensure no water can get into the amplifier.

5.23 Warranty Protocol

Ensure that all of the required measurements have been performed and entered on the warranty protocol, date and sign it. It must be sent to your distributor or the manufacturer within 14 days of installation, otherwise Kistler will not accept any liability under warranty (see appended pages 38 to 40).

5.24 Calibration

Calibration must **not** be performed with 72 hours of installation. We recommend leaving it for at least 2 weeks.

6. Installation Requirements

See the checklist (Doc. No. 200-369) for a complete description.

6.1 Kistler components

▪ Grouting compound: A 10 kg bucket is generally sufficient for 2 Lineas sensors with some to spare.	Kistler Type 1000A1
▪ Lineas sensors	Kistler Type 9195Exxx
▪ Charge amplifiers	Kistler Type 5038x, 5153x
▪ Cables, accessories and tools	

6.2 Materials and Equipment (Not Supplied by Kistler)

- Flexible conduit for the sensor cables, armored
- Ground wire, one per row of sensors, must be long enough to reach from the row of sensors to the electronics cabinet (at least 6 mm^2), including installation kit.
- Weights (approximately 10 kg, approximately two per sensor) to hold the sensor in the right position when grouting.
- Cable snake
- Cable marking kit (e.g. Scotch code)
- Cable binder
- Tear-resistant masking tape, 50 mm wide.
- Chalk or spray paint and string for marking slots
- Insulation tape, 20 mm wide
- Plastic rubbish bags
- Gloves
- Eye protection
- Breathing protection
- Knee protectors
- Kistler warranty protocol (www.kistler.com)

6.3 Tools and Machinery (Not Supplied by Kistler)

- Generator or extension cables
- Compressor
- Lighting for nighttime installation
- Dry cutting pavement saw or pavement milling machine
- Pneumatic hammer and air lance
- Industrial mixer (electric drill with mixing attachment)
- Heating equipment
- Concrete grinder
  (e.g. Bosch GBR14CA with 2608600261 diamond wheel)
- Belt sander (e.g. Bosch GBS100AE)
- Electric screwdriver with TORX T20 blades
- Industrial vacuum cleaner
- Kistler Type 5493Y0394 insulation tester and quick test adapter as necessary
- Crimping tool, multi cable stripper, tool for fitting anti-kink sleeve
- Multimeter for voltage, current, capacitance and resistance
- Hot air gun (min. 120 °C)
- Thermometer for monitoring air and pavement temperature
- Hammer and chisel
- Kistler Type Z16530 slot gage
- Set of trowels
- Carpet knives/cutters
- Tape measure, square and rod (1 m)
- 400 mm long aluminum angle section for checking whether sensor flush with pavement during grinding
- Set of Allen keys

Kistler Type 5493Y0394
insulation tester

Kistler Type Z16530
slot gage

Kistler Type Z18810
quick test adapter

Needed for BNC connections

Huber& Suhner 75 Z-0-0-50,
2254 47 54 crimping tool
76 Z-0-2-51, 2254 47 56
insert for crimping tool

Kistler Type Z17616
multi cable stripper

Huber & Suhner
74 Z-0-2-1, 2254 31 00
tool for fitting anti-kink sleeve

6.3.1 Examples of Useful Heating Equipment

Other systems, such as infrared or radiant heating equipment, may also be suitable.

Heater components:
Air heater unit (1)
Flexible ducting for connecting to heater (2)
Swept tee with connection for heating channel (3)
Heating channel sections (4)

Installed heater with four x 1,2m long heating channel sections.

Small heater

Capacity:	15 kW
Air flow rate:	300 m³/hour
LPG consumption:	1,2 kg/hour

Larger heater

Capacity:	15-30 kW
Air flow rate:	750 m³/hour
LPG consumption:	1,2-2,8 kg/hour

Heating channel sections

Dimensions:	20 x 20 cm (height x width)
Material:	Galvanized iron

Flexible ducting

Dimensions:	25 cm diameter
Material:	Galvanized iron

Maximum permissible air temperature in heating channel: +80 °C

7. Maintenance

The lane must be closed for the duration of the maintenance. Record the current condition on the maintenance record (Doc. No. 900-556) and illustrate your description with photographs.

IMPORTANT! Ensure that all necessary approvals have been obtained and take safety precautions at all times. Always wear the stipulated health and safety equipment.

The Lineas sensors must not be overlaid by pavement or milled. **Never** re-use sensors that have been removed.

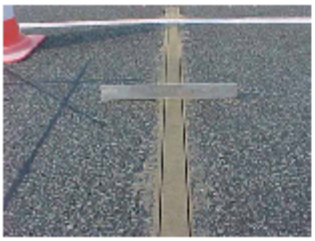
7.1 Visual Inspection

Check the pavement for cracks, rutting and other deformations at least every 6 months.
Note any changes in the pavement or anything else that could be relevant to the Lineas sensor installation.

7.2 Acoustic check

Tires passing over the sensors should not make any unusual noises.

7.3 Checking Pavement Deformation



The sensors have to be re-ground if they become more than ½ mm protruded of the pavement.

Test 1
Lay a 40 cm long straight edge on the sensor (sensor should be in the middle).

If it clicks when pressed down repeatedly at one end or the other, grinding is required.

Test 2
Lay a 2 to 4 meter long rule or straight metal section on the pavement in the area extending from 40 cm before to 40 cm after the row of sensors, and measure the rutting and pavement deformations with a tapered or straight rule.

Record the results. Mark the higher points and perform test 1.

7.4 Re-Grinding Sensors

See chapter 5.18 and 5.19.
Since the thickness of the wearing layer is 10 mm, the sensors may only be ground down by a total of less than 10 mm.

7.5 Calibration Check

We recommend re-checking the calibration factors after re-grinding some areas.

7.6 Repairs

Use a flexible bituminous sealing compound to repair cracks in the grouting and the pavement in the vicinity of the sensors. The pavement must be flat in the vicinity of the sensors.

WIM – Lineas® Warranty Protocol

WIM Site

Country _____

Place _____

Road from ... to ...

Road No. & km _____

Driving Direction

System Operator _____

System Supplier _____

Road Working Company _____

Weather

Date of Installation _____

WIM Application

- ☐ Statistics
- ☐ Overload protection
- ☐ Pre-selection
- ☐ Road Research
- ☐ Bridge Protection
- ☐ Weight Enforcement
- ☐ Toll Roads
- ☐

Company Stamp _____

Responsible of Lineas® Installation

Full Name

Company _____

Certified by Kistler No.

Date & Signature _____

This warranty protocol must be returned to your local Kistler representative within 2 weeks after date of installation!

Installation Data

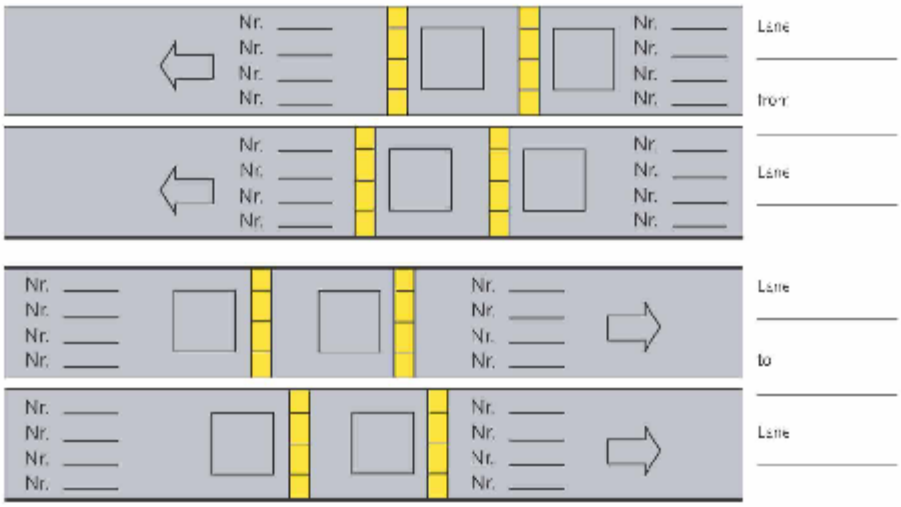
	Temperature at Start of Grouting		Time	
	Air	Pavement	End of Grouting	Lane Opening
Lane 1				
Lane 2				
Lane 3				
Lane 4				

Use of heating equipment? ☐ Yes ☐ No

Insulation Resistance Tester

Manufacturer _____

Type & Serial No. _____



Date & Signature _____

Measurements

	Sensor No. *)	Serial No.	Channel	Insulation Resistance (Ω) Before the installation	Insulation Resistance (Ω) After the installation	Function Check **)	Comment
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 32							

*) according to system supplier (fill in below)

**) changes of sensor resistance by jumping or sensor identification by cable markings

5.2 Kistler Epoxy MSDS

Maintenance

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GROUTING COMPOUND 1000A1

Technical data sheet

Grouting Compound for KISTLER Lineas WIM Sensors

PRODUCT
KISTLER GROUTING COMPOUND 1000A1 is a pourable high grade, solvent free, 3-component epoxy resin composition.

APPLICATION FIELDS
Grouting of LINEAS WIM sensors and cable duct tubes in road pavements based on bituminous materials, asphalt or concrete.

FEATURES AND BENEFITS
- Read-to-use packs for on-site applications.
- Very good workability.
- Excellent flow properties.
- Rapid, shrink-free curing and early strength.
- Good adhesion on concrete, metals, asphalt, and bituminous compositions.
- High mechanical properties.
- Good chemical resistance.
- Takes up and transfers tensile, compressive and shear loads.
- Waterproof.
- Cures in damp or wet surroundings.

PACKAGING

Working pack (A+B+C)		10,0 kg
(All components in a 10 litre pail)		
Component A	Resin	1,9 kg
Component B	Hardener	0,6 kg
Component C	Filler	7,5 kg

TECHNICAL DATA

Density	at 25°C		g/cm³	≈1,9
Pot life	at °C	10	20	40
Minutes		80	35	8
Minimal curing temperature				8°C

MECHANICAL PROPERTIES
After 7 days at 23°C

Compressive strength	>80	N/mm²
Flexural strength	>35	N/mm²
Modulus of elasticity	≈13 000	N/mm²
Adhesive strength		
- On concrete	>4	N/mm²
- On steel	>10	N/mm²

GLASS TRANSITION POINT
(DSC) 50°C

COMPRESSIVE STRENGTH DEVELOPMENT
At different temperatures

Curing time at	10°C	20°C	30°C	
2 hours	--	50	70	N/mm²
6 hours	--	70	80	N/mm²
8 hours	--	80	80	N/mm²
12 hours	20	80	80	N/mm²
1 day	50	80	80	N/mm²
2 days	70	80	80	N/mm²
7 days	80	80	80	N/mm²

CHEMICAL RESISTANCE at 23°C
GROUTING COMPOUND 1000A1 is resistant to
- Potable-, sea- and wastewater
- Diluted acids and alkalis
- Grease, fuel and mineral oils

TEMPERATURE RESISTANCE
At constant temperatures above 70 °C the mechanical properties of the product may decrease.

9195E_002-301e-11.04 Page 41

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Lineas® Sensors for Weigh-in-Motion Type 9195E

APPLICATION DATA

PREPARATORY WORK

- The substrate must be sound, dry, clean and free from dust, oil or grease.
- All loose material and debris must be removed by shot blasting or vacuum cleaner before grouting.
- If the sensor installation has to be berformed at air or pavement temperatires below +20 °C, the pavement slot and the grout components must be warmed up carefully. We suggest to use heating equipment also at temperatures of over 20 °C, specially on windy or humid weather conditions. Heating equipment promotes curing and protects from humidity.
- Cover the pavement surface adjacent to the slot with a reinforced adhesive tape where spilling has to be avoided.

MIXING

1. Take the resin and the hardener can out of the bucket and pour the quartz sand into an other bucket.
2. Pour the resin (component A) into the original bucket. If more than about 10 grams remains in the plastic container, pour some hardener into it and shake it for a short time.
3. Pour this and hardener can (component B) into the bucket .
4. Stir the resin with the hardener very well with a heavy-duty mixer which acts bottom-up to avoid air bubble entrapping. To avoid spilling, start slowly at the bottom and increase mixer speed gradually.
5. While stirring, pour the quartz sand into the mixture gradually to avoid clotting.
6. Mix thoroughly with an up- and downward movement over the whole bucket area, until the grout is homogenous. This typically takes 2 - 3 minutes.

APPLICATION

The well mixed grout must be cast at once and without interruption. To ensure good adhesion to the slot cuts, spread the grout onto the cut edges using a trowel or spatule, so that the side surfaces are "painted" all the way up to the top edges.
Ensure evacuation of entrapped air from voids.

CONSUMPTION

A bucket of 10 kgs is sufficient for 2 Lineas sensors.

CLEANING OF TOOLS

Tools must be cleaned immediately after use with solvents as acetone or toluene, or cleaning paste. (If not available, denatured alcohol is a less efficient compromise.)

STORAGE

Shelf life min. 1 year unopened in original packaging.
Do not store at temperatures below 10 °C or in direct sunlight.

SAFETY PRECAUTIONS

Keep resin and hardener away from eyes, mouth and skin. Do not inhale vapours. The uncured mixture can cause irritation of the skin. The best protection is to wear rubber or plastics gloves. In case of contamination wipe away resin or hardener immediately from the skin using paper towels and then wash with soap and water or hand cleansing cream. Under no circumstances remove resin or hardener from the skin with solvents. Empty resin and hardener cans must be disposed as dangerous good. Under no circumstances should they be used to store food or drinks, not even if they have been cleaned.

The information given in this publication is based on the present state of our knowledge but any conclusions and recommendations are made without liability on our part.
For Lineas WIM sensors the Kistler Installation Instructions 002-301e must be followed.

---

22 May 2003 F/Ca

Maintenance

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SAFETY DATA SHEET

GROUTING COMPOUND 1000A1 RESIN

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

Chemical characterization Formulated epoxy resin

Supplier INTECSER AG
Augsterstrasse 52
CH-4133 Pratteln
Switzerland

Emergency telephone number Tel (+41) 0 61 / 811 46 60 Fax (+41) 061 / 811 46 66

2. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous components 80-100% bisphenol A/F-epoxy resins, mw <700
CAS 40216-08-8 Xi, N R-36/38-43-51/53

3. HAZARDS IDENTIFICATION

Irritating to eyes and skin. May cause sensitization by skin contact. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

4. FIRST AID MEASURES

General advice Take off immediately all contaminated clothing.

Inhalation Move to fresh air in case of accidental inhalation of fumes from overheating or combustion.

Skin contact Wash off immediately with soap and plenty of water. If skin irritation persists, call a physician.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

Ingestion Immediately give plenty of water (if possible charcoal slurry). Do not induce vomiting without medical advice. If a person vomits when lying on his back, place him in the recovery position. Obtain medical attention.

9195E_002-301e-11.04 Page 43

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media Water spray. Carbon dioxide (CO_2). Carbon dioxide blanket. Foam. Dry powder.

Extinguishing media which must not be used for safety reasons
High volume water jet.

Specific hazards Burning produces irritant fumes.

Special protective equipment for firefighters
In case of fire, wear a self contained breathing apparatus.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions Ensure adequate ventilation. Remove all sources of ignition.

Environmental precautions Prevent product from entering drains. Do not allow material to contaminate ground water system.

Methods for cleaning up Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Clean with detergents. Avoid solvents.

7. HANDLING AND STORAGE

Handling Provide sufficient air exchange and/or exhaust in work rooms.

Storage Keep out of reach of children. Keep containers dry and tightly closed to avoid moisture absorption and contamination. Do not freeze. Store in original container.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures to reduce exposure
Avoid contact with skin, eyes and clothing. Handle in accordance with good industrial hygiene and safety practice.

Personal protection equipment

Respiratory protection No special protective equipment required.

Hand protection Latex gloves.

Eye protection Goggles.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form	Liquid.	
Colour	Clear.	
Odour	Mild.	
Physical and chemical properties		
	Boiling point/range	>200 °C.
	Decomposition temperature	>200 °C.
	Flash point	>135 °C.
	Density	1.6-1,8 g/ml. (25°C)
	Water solubility	<0.5 %.
	Vapour pressure	<1 Pa.

10. STABILITY AND REACTIVITY

Stability	Stable at normal conditions.
Conditions to avoid	Exothermic reaction with strong acids. Do not expose to temperatures above 50 °C.
Materials to avoid	Incompatible with strong acids and oxidizing agents.
Hazardous decomposition products	Carbon monoxide. Carbon oxides. Combustion produces caustic fumes.

11. TOXICOLOGICAL INFORMATION

Acute toxicity	LD50/oral/rat = >5000 mg/kg.
Local effects	Negligible.
Long term toxicity	Chronic intensive skin contact may cause dermatitis.
Sensitization	Causes sensitization on guinea-pigs.

12. ECOLOGICAL INFORMATION

Ecotoxicity	No data available.
Mobility	No data available.
Persistence / degradability	No data available.
Bioaccumulation	No data available.

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products
Can be landfilled or incinerated, when in compliance with local regulations.

Contaminated packaging Offer rinsed packaging material to local recycling facilities.

14. TRANSPORT INFORMATION

Proper shipping name Environmentally hazardous substance, liquid, n.o.s.

UN-No 3082

ADR/RID Class 9. Packing group III. ADR/RID-Labels 9.
TREM-CARD 9. Classification code: M6 Kemler code 90.
Additional information: BISPHENOL A/F EPOXY RESIN.

IMO Class 9. Packaging group III. IMO-Labels 9
EmS: F-A / S-F.
Additional information: (BISPHENOL A/F EPOXY RESIN).

ICAO Class 9. Packaging group III. ICAO-Labels 9.
Additional information: (BISPHENOL A/F EPOXY RESIN).
Packing instruction (passenger aircraft): 914, No Limit.
Packing instruction (cargo aircraft): 914, No Limit.

15. REGULATORY INFORMATION

Regulatory Information Bisphenol A/F epoxy resin

Symbol(s)
Xi - Irritant.
N - Dangerous for the environment.

R-phrase(s)

R36/38:	Irritating to eyes and skin.
R43:	May cause sensitization by skin contact.
R51/53:	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

S-phrase(s)

S28:	After contact with skin, wash immediately with plenty of soap and water.
S37/39:	Wear suitable gloves and eye/face protection.
S61:	Avoid release to the environment. Refer to special instructions/Safety data sheets.

16. OTHER INFORMATION

Recommended use	For the building industry
Further information	R36/38: Irritating to eyes and skin. R43: May cause sensitization by skin contact. R51/53: Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
Disclaimer	The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release. And is not to be considered a warranty or quality specification.
Revision Date	05.03.2003
Number	Version 2

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Lineas® Sensors for Weigh-in-Motion Type 9195E

SAFETY DATA SHEET

GROUTING COMPOUND 1000A1 HARDENER

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

Chemical characterization	Modified aliphatic polyamine
Supplier	INTECSER AG Augsterstrasse 52 CH-4133 Pratteln Switzerland
Emergency telephone number	Tel (+41) 0 61 / 811 46 60 Fax (+41) 061 / 811 46 66

2. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous components	80-92%	trimethylhexamethylenediamine CAS 25620-58-0 EC-No. 247-134-8 C R-22-34-43-52/53

3. HAZARDS IDENTIFICATION

Harmful if swallowed. Causes burns. May cause sensitization by skin contact. Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

4. FIRST AID MEASURES

Inhalation	Move to fresh air in case of accidental inhalation of fumes from overheating or combustion.
Skin contact	Wash off immediately with soap and plenty of water.
Eye contact	Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Ingestion	Immediately give plenty of water (if possible charcoal slurry). Do not induce vomiting without medical advice. If a person vomits when lying on his back, place him in the recovery position. Obtain medical attention.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media Water spray. Carbon dioxide (CO2). Foam. Dry powder.

Extinguishing media which must not be used for safety reasons
High volume water jet.

Specific hazards Burning produces irritant fumes.

Special protective equipment for firefighters
In case of fire, wear a self contained breathing apparatus.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions Use personal protective equipment. Remove all sources of ignition.

Environmental precautions Prevent product from entering drains. Avoid subsoil penetration. Do not allow material to contaminate ground water system.

Methods for cleaning up Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).

7. HANDLING AND STORAGE

Handling Provide sufficient air exchange and/or exhaust in work rooms. Avoid formation of aerosol. Handle and open container with care.

Storage Keep out of reach of children. Store at room temperature in the original container.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Personal protection equipment

Respiratory protection In case of insufficient ventilation wear suitable respiratory equipment.

Hand protection Latex gloves. Before removing gloves clean them with soap and water.

Eye protection Goggles.

Skin and body protection Protective suit. Safety shoes.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form	Liquid.
Colour	Light yellow.
Odour	Amine-like.

Physical and chemical properties

pH	ca. 11
Boiling point/range	>200 °C.
Decomposition temperature	>200 °C.
Flash point	114 °C. (DIN 51758)
Water solubility:	partly soluble.
Vapour pressure	<100 Pa.
Viscosity	15-20 mPa.s. (25°C)
Density	0.9-0.95 g/ml. (25°C)

10. STABILITY AND REACTIVITY

Stability	Stable up to approximately 200 °C.
Conditions to avoid	Do not expose to temperatures above 50 °C.
Materials to avoid	Incompatible with acids. Incompatible with oxidizing agents.
Hazardous decomposition products	Thermal decomposition can lead to release of irritating gases and vapours.

11. TOXICOLOGICAL INFORMATION

Acute toxicity	LD50/oral/rat = 850 mg/kg.
Local effects	The product causes burns of eyes, skin and mucous membranes.
Long term toxicity	Repeated contact may cause allergic reactions with very susceptible persons.
Sensitization	Causes sensitization.

12. ECOLOGICAL INFORMATION

Ecotoxicity	May change pH of waters.
Bioaccumulation	Aquatic toxicity is unlikely due to low solubility.

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products
Can be incinerated, when in compliance with local regulations.

Contaminated packaging Empty containers should be taken for local recycling, recovery or waste disposal.

14. TRANSPORT INFORMATION

Proper shipping name	TRIMETHYLHEXAMETHYLENEDIAMINES SOLUTION		
UN-No	2327		
ADR/RID	Class 8. ADR/RID-Labels 8. TREM-CARD 8.	Packing group III.	Kemler code 80. Classification code: C7
IMO	Class 8. IMO-Labels 8.	Packaging group III.	EmS: F-A / S-B
ICAO	Class 8. Packing instruction (passenger aircraft): 818, 5 L. Packing instruction (cargo aircraft): 820, 60 L. ICAO-Labels 8.	Packaging group III.	

15. REGULATORY INFORMATION

Regulatory Information	Trimethylhexamethylenediamine	
Symbol(s)	C - Corrosive.	
R-phrase(s)	R22:	Harmful if swallowed.
	R34:	Causes burns.
	R43:	May cause sensitization by skin contact.
	R52/53:	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S-phrase(s)	S26:	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
	S36/37/39:	Wear suitable protective clothing, gloves and eye/face protection.
	S45:	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
	S61:	Avoid release to the environment. Refer to special instructions/Safety data sheets.

16. OTHER INFORMATION

Further information	R22: Harmful if swallowed. R34: Causes burns. R43: May cause sensitization by skin contact. R52/53: Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
Revision Date	05.03.2003
Number	Version 2

6 Modem

SIXNET®

331 Ushers Road, P.O. Box 767, Clifton Park, NY 12065 USA
+1 (518) 877-5173 Fax +1 (518) 877-8346
e-mail: modemsales@sixnetio.com www.industrialmodem.com

Make Your Job Easier

Rugged Industrial Telephone Modems

General Purpose Industrial Modem

Select a VT-MODEM-1 when...
...you need a telephone modem rated for tough industrial environments that will work on the hottest and coldest days.

- Rated for -30° to +70°C operation
- Tough enough for Class I, Div. 2 (Zone 2) hazardous locations
- DIN Rail or flat panel mounting
- DC powered - No more bulky AC adapters
- Five year guaranteed availability for OEMs

THIS INDUSTRIAL MODEM IS AS RELIABLE AS THE PLC YOU CONNECT IT TO.

PLC Self-Dialing Industrial Modem

Select a VT-MODEM-2 when...
...you need all the features of the General Purpose Modem plus dial out based upon an alarm contact or PLC coil output.

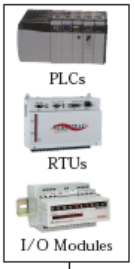
- Dial upon alarm using a PLC coil output
- Works with all brands and models of PLCs
- Auto-answers for two-way operation
- Report low tank level with a level switch
- UL508 (PLC enclosure), CSA and CE rated

ANY PLC WILL CONNECT TO THIS RUGGED INDUSTRIAL MODEM

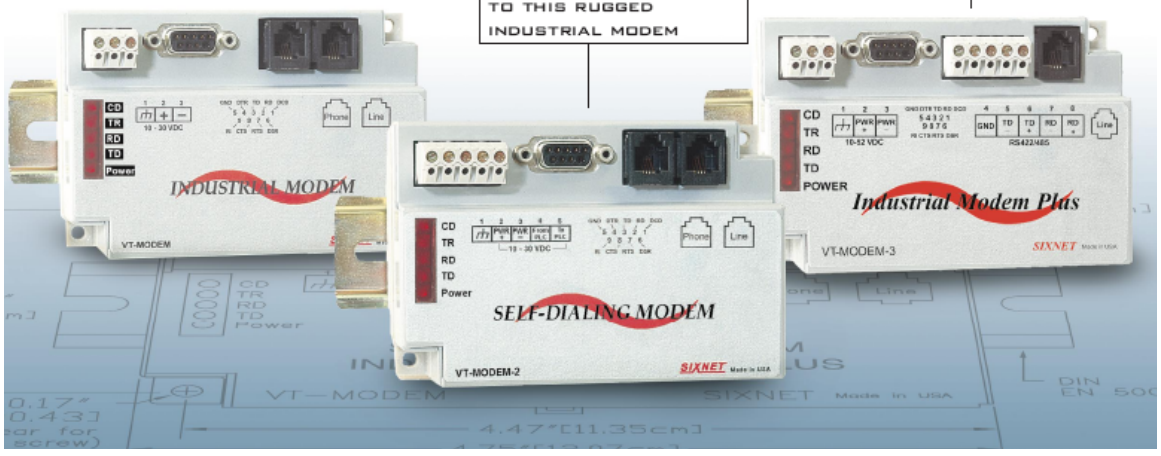
RS422/RS485 Industrial Modem Plus

Select a VT-MODEM-3 when...
...you need all the features of the General Purpose Modem plus an RS422 / RS485 port or the ability to run up to 52 VDC power.

- Connects to existing multi-drop devices
- RS422 / RS485 port uses 2 or 4 wire connections
- Has a standard RS232 port as well
- Connects directly to industrial I/O



THE RS485 PORT CAN CONNECT TO MULTIPLE DEVICES



INDUSTRIAL MODEMS MAKE YOUR JOB EASIER

SIXNET Industrial Telephone Modems

ELIMINATE THE DIFFICULTIES OFTEN ENCOUNTERED WITH INSTALLING OFFICE-GRADE MODEMS IN INDUSTRIAL SETTINGS. THESE RUGGEDIZED MODEMS CONNECT TO ANY PLC, RTU OR OTHER INDUSTRIAL EQUIPMENT AND PROVIDE THE IMPORTANT FEATURES YOU HAVE BEEN LOOKING FOR.

- *Reduce Design Time*
- *Simplify Installation*
- *Increase Reliability*

Why an Industrial Telephone Modem?

SIXNET industrial telephone modems are designed for industrial environments. Their rugged packaging and protected circuitry keep them working under conditions that may cause cheap office-grade modems to fail. Industrial applications are demanding - it gets hot, it gets cold - the power browns out or spikes wildly - and you need a reliable industrial modem that can keep on going.

Industrial modems survive heat & cold

SIXNET industrial modems work reliably through the dead of winter to those hot summer days. Unlike ordinary modems that are intended only for use in air conditioned offices, SIXNET industrial modems are designed for those places that you don't want to be - over the temperature range of -30º to 70ºC.

PC Software compatibility guaranteed

SIXNET industrial modems contain an industrial version of the same modem chip-set found in PC internal modems. They support the full set of modem (AT) commands, protocols and operating features, and are 100% Windows software ready.

Forget the Velcro and makeshift brackets

SIXNET industrial modems can be DIN rail or direct panel mounted. Their compact footprint fits easily into equipment-filled enclosures.

Lose those bulky power transformers

SIXNET industrial modems run directly on the DC power that you already have in your control cabinet. Get rid of those cumbersome AC outlet transformers. No AC power means fewer safety issues. If you ship your equipment internationally, you can forget about the headaches caused by different line voltages and incompatible power plugs.

Stop redesigning your OEM products

Have you ever qualified a system only to find that the modem you used is no longer available? SIXNET guarantees availability of these modems for a minimum of five years. Design your system just once!

A simple solution for global business

Forget about the troubles of supplying different modems for each country. SIXNET industrial modems are compliant with telephone systems around the world. Simplify the logistics of your worldwide business and improve your bottom line.

System Integrators increase profits

System Integrators are putting SIXNET industrial modems in every PLC cabinet they design or service. Now, you can make program changes and get your customer's systems running without leaving your office. Your customers will be delighted with your quick service and you will love the cost savings of not having to make a site visit.

SIXNET

331 Ushers Road, P.O. Box 767, Clifton Park, NY 12065 USA
+1 (518) 877-5173 Fax +1 (518) 877-8346
e-mail: modemsales@sixnetio.com www.industrialmodem.com

Industrial Modem Selection Guide

Industrial Feature Designed to Make Your Job Easier	SIXNET MODEM-1 General	SIXNET MODEM-2 Self-Dialing	SIXNET MODEM-3 RS485 Port	Office-grade External Modems
DIN Rail or flat panel mounting	Yes	Yes	Yes	No
UL508 (electrical control enclosure) rated	Yes	Yes	Yes	No
CE rated for European and International use	Yes	Yes	Yes	?
Compliant with International phone systems	Yes	Yes	Yes	?
RS232 port	Yes	Yes	Yes	Yes
RS485 port for 2 wire or 4 wire operation	No	No	Yes	No
Auto-answer for unattended remote locations	Yes	Yes	Yes	Yes
Auto-dials from a simple contact closure	No	Yes	No	No
Dials upon an alarm in any PLC	No	Yes	No	No
Powered directly from 12 or 24 VDC source	Yes	Yes	Yes	No
Powered directly from 48 VDC source	No	No	Yes	No
Does not need a cumbersome wall-mount Transformer	Yes	Yes	Yes	No
Rated for tough industrial environments	Yes	Yes	Yes	No
Operates outdoors without requiring a heater	Yes	Yes	Yes	No
Will survive the heat in your control cabinet	Yes	Yes	Yes	No
Includes internal surge protection	Yes	Yes	Yes	No
Rated for Class I, Div. 2 (zone 2) hazardous locations	Yes	Yes	Yes	No
Auto-select or fixed rate up to 33.6K bits/sec	Yes	Yes	Yes	Yes
Replaces old 1200, 2400 or 9600 baud modems	Yes	Yes	Yes	?
100% Windows software compatible	Yes	Yes	Yes	Yes
100% compatible with the modem in your PC	Yes	Yes	Yes	Yes
Supplied with RS232 cable to make setup easier	Yes	Yes	Yes	No
Long-term support for OEMs and end users	Yes	Yes	Yes	No
Protected by an extended industrial warranty	Yes	Yes	Yes	No
Designed to make your job easier	Yes	Yes	Yes	No

Ordering Information

Modem Type	US Part Number*	Price	EC Part Number*	Price	World-Wide Part Number*	Price
General Purpose	VT-MODEM-1US	$340	VT-MODEM-1EC	$340	VT-MODEM-1WW	$360
PLC Self-Dialing	VT-MODEM-2US	$450	VT-MODEM-2EC	$450	VT-MODEM-2WW	$470
RS422 / RS485	VT-MODEM-3US	$410	VT-MODEM-3EC	$410	VT-MODEM-3WW	$430
Extended Warranty	Extend the warranty period from 12 months to 3 years				VT-CARE-36	$35
All modems include a RS232 modem cable (DB9) and complete Windows software CD, at no extra cost.						

* Location Codes
US For use in U.S., Canada, Mexico, Central and South America
EC For use in Europe, Asia, Africa, Australia and New Zealand
WW For world-wide use. OEMs install and test it here — use it there.

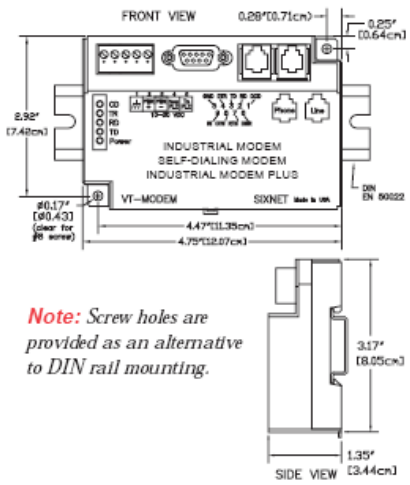
** All prices given are in U.S. Dollars

SIXNET

331 Ushers Road, P.O. Box 767, Clifton Park, NY 12065 USA
+1 (518) 877-5173 Fax +1 (518) 877-8346
e-mail: modemsales@sixnetio.com www.industrialmodem.com

VT-MODEM Performance Specifications	
Telephone Line	
Max. data rate	33.6 kbps (V.34)
Compatibility	V.34, V.32 bis, V.32, V.22, V.22A/B, V.23, V.21, Bell 212A and 103
Data compression	V.42 bis MNP 5
Error correction	V.42 MNP 2-4
Max. fax rate	14.4 kbps
Fax capabilities	Group 3 (V.33, V.17, V.29, V.27 ter, V.21)
Ringer equivalent	0.3
Line / Auxiliary jack	RJ11
RS232 Port	
Max. RS232 Rate	115.2 kbps (Kilobaud)
RS232 (DB9 female)	TD, RD, CTS, RTS, CD, DTR, DSR, RI, GND
Command Set	All standard AT and S register commands, incl. Class 1 & 2 Fax
Status LEDs	
CD (Carrier detect) TR (Terminal Ready)	Carrier detected on the phone line Host connected and ready
RD (Receive Data)	Data is coming from the serial port
TD (Transmit Data)	Data being sent out the serial port
Power	On when power is present
General Characteristics	
Input power	10-30 VDC (VT-MODEM-1 & -2)
Input power	10-52 VDC (VT-MODEM-3)
Input current	65 mA @ 24 VDC
Operating Temp.	-30° to 70°C (-40° to 85°C storage)
Humidity	5% to 95% RH (non-condensing)
Flammability	UL 94V-0 materials
Telecom Certification	FCC part 68, Industry Canada CS03-8, CTR21 (98/482/EC); ACA TS 001-1997; ACA TS 002-1997
Electrical Safety	UL 508, CSA C22.2/14; EN61010-1 (IEC1010), IEC 950: 1991, AS/NZS3260-1993 CE
EMI emissions	FCC part15, ICES-003, Class A; EN55022; AS/NZS3548-1995 CE
EMC immunity	EN50082-1 (IEC801-2, 3, 4) CE
Surge withstand	IEEE-472 (ANSI C37.90)
Vibration	IEC68-2-6
Hazardous locations	UL 1604, CSA C22.2/213-M1987, (Class I, Div 2, Groups A, B, C, D) Cenelec EN50021 (EEx nA II T4)
Mounting	DIN rail or panel mount
PLC Discrete I/O Interface (VT-MODEM-2 Only)	
"Trigger" Input	Connects to PLC output. Starts auto-dialing when TRUE.
Voltage range	9 to 30 VDC (6.5 mA at 24 VDC)
Max OFF voltage	5 VDC
"On-line" Output	Output is ON as long as a connection exists (carrier detect).
Output type	Sourcing — switches supply power
Max. output current	100 mA
RS422 / RS485 Port (VT-MODEM-3 Only)	
RS422 mode	Supports 4 wire full duplex
RS485 modes	2 or 4 wire party-line operation
Signal rate	Standard rates up to 115.2 kbps
RS422/485 distance	Up to 0.5 miles

Mounting Dimensions



Note: Screw holes are provided as an alternative to DIN rail mounting.

Complete documentation

is provided on the SIXNET CD or may be downloaded from www.industrialmodem.com. Includes applications help for many common situations.

Contact your SIXNET Applications Engineer today!

For instant availability and the latest product information check out
www.industrialmodem.com

05-15-00 Final Modem Brochure_r04.qxd

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7 Pull Box

1-800-GRAYBAR

Contact Us

Products are continually being added. For assistance, contact your local Graybar representati

Item Details

Category	Enclosures, Underground - Boxes
Mfg Name	Strongwell-Quazite
Mfg Part Num	PG1730BA24
Graybar ID	94070839
Description	Enclosure, Box, Underground, 17 X 30 in, Stackable Box with Open Bottom, Precast Polymer Concrete
Application	Splice Box, Pull Box, Equipment Enclosure
Approvals	UL
Brand or Series	Quarzite, PG Series
Dimensions	19-1/4 X 32-1/4 X 24 D Inch
Features	Straight Sides for Easy Adjustment of Box to Grade, Lightweight, High Strength, Corrosion Resistant
Load Rating	Tier 22, 22568 Lbs Design, 33852 Lbs Test
Material	Precast Polymer Concrete
Nominal Size	17 X 30 Inch
Type	Stackable Box with Open Bottom
Weight	122 Lbs

Return

8 3M Loop Sealant

8.1 3M Loop Sealant MSDS

3M Canada Company
1840 Oxford Street East, Post Office Box 5757
London, Ontario N6A 4T1
Medical Emergency Telephone: (519) 451-2500, Ext. 2222
Transportation Emergency Telephone (CANUTEC): (613) 996-6666

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Material Safety Data Sheet

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Document id : 09-2062-9 Issue date : 22/03/2005
Version : 1.00 Supersedes date : ---

Prepared by: Environmental Health and Safety Services
Department, 3M Canada Company
Telephone: (519) 452-2161, Fax: (519) 452-6015, Web Site: www.3M.ca

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1 Product Identification

Tradename:
3M DETECTOR LOOP SEALANT BLACK 5000
Product ID:
78-8110-9503-9 78-8016-9813-1 78-8110-9504-7
Intended Use of Product:
Sealant
Division:
FOOD SERVICES TRADE DEPARTMENT

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2 Composition/Information on Ingredients

Ingredient Name	CAS Number	Percentage
URETHANE PREPOLYMER	9057-91-4	25 - 35
TALC	14807-96-6	20 - 30
POLYSTYRENE	9003-53-6	15 - 25
1-METHOXY-2-PROPYL ACETATE	108-65-6	15 - 25
DIMETHYL SILOXANE, REACTION PRODUCT WITH SILICA	67762-90-7	1 - 5
2-METHOXY-1-PROPYL ACETATE	70657-70-4	0.5 - 1.0
TOLUENE 2,4-DIISOCYANATE	584-84-9	0.1 - 0.5

CARBON BLACK	1333-86-4	0.1 - 0.5
TOLUENE 2,6-DIISOCYANATE	91-08-7	0.1 - 0.2

1-METHOXY-2-PROPANOL	107-98-2	0.1 - 0.2

NOTE:
Each percentage is expressed as the ratio of the weight of the ingredient to the weight of the controlled product.

3 Hazards Identification

Critical Hazards:
Combustible liquid and vapour.
Moderate Eye Irritation: Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision.
Allergic Skin
Reaction (non-photo induced): Signs/symptoms may include redness, swelling, blistering, and itching.
Allergic Respiratory Reaction:
Signs/symptoms can include difficulty breathing, wheezing, cough, and tightness of chest.
WARNING: Contains a chemical which can
cause cancer. (584-84-9) (NTP anticipated human carcinogen, IARC possible human carcinogen 2B, Calif. Proposition 65)
WARNING:
Contains a chemical which can cause cancer (1333-86-4) (IARC possible human carcinogen 2B)
WARNING: Contains a chemical which
can cause cancer. (91-08-7) (NTP anticipated human carcinogen, IARC possible human carcinogen 2B)
TALC (14807-96-6) has been shown to cause fibrosis of the lungs.
See Sections 7 and 11 for further information.

4 First Aid Measures

Instructions for Eye Contact:
Immediately flush eyes with large amounts of water for at least 15 minutes. Get immediate medical attention.
Instructions for Skin Contact:
Immediately flush skin with large amounts of water. Remove contaminated clothing. If irritation persists, call a physician. Wash contaminated clothing before reuse.
Instructions for Inhalation:
Remove person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, get immediate medical attention.
Instructions for Ingestion:
Drink two glasses of water. Call a physician.

3M DETECTOR LOOP SEALANT BLACK 5000 Page 3 of 10

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5 Fire Fighting Measures

Flash point:	Approximately42.8 C
Lower Explosive Limit (%):	1 %
Upper Explosive Limit (%):	7 %
Autoignition temperature:	Not Available

Suitable Extinguishing Media:
Water spray; Carbon Dioxide; Dry chemical; Foam;

Exposure Hazards during Fire:
No data available.

Combustion Products from Fire:
Carbon monoxide and carbon dioxide; Oxides of nitrogen; Hydrogen Cyanide; Aldehydes; Isocyanates;

Fire Fighting Procedures:
Wear full protective clothing, including helmet, self-contained, positive pressure or pressure demand breathing apparatus, bunker coat and pants, bands around arms, waist and legs, face mask, and protective covering for exposed areas of the head.

NFPA: Health	3
NFPA: Fire	2
NFPA: Reactivity	1
NFPA: Unusual Reaction Hazard	reacts with water

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6 Accidental Release Measures

Personal Precautions:
Refer to other sections of this MSDS for information regarding physical and health hazards, respiratory protection, ventilation, and personal protective equipment.

Spill Response:
Ventilate the area with fresh air. Remove all ignition sources such as flames, smoking materials, and electrical spark sources. Use only non-sparking tools. Evacuate unprotected and untrained personnel from hazard area. The spill should be cleaned up by qualified personnel. Collect as much of the spilled material as possible using non-sparking tools. Clean up residue with an appropriate organic solvent. Read and follow safety precautions on the solvent label and MSDS. Place in an approved metal container. Seal the container. Avoid contact with water.

Methods for Disposal:
Incinerate in a permitted hazardous waste incinerator.

3M DETECTOR LOOP SEALANT BLACK 5000 Page 4 of 10

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7 Handling and Storage

Storage Requirements:
Store in a cool place. Avoid contact with water.

Incompatible Materials:

Store out of direct sunlight. Keep away from aluminum and zinc.
Store away from acids; Amines; Alcohols; Water;
Ventilation:
Keep container in well-ventilated area.
Fire Prevention:
No smoking while handling this material.
Explosion Prevention:
Keep away from heat, sparks, open flame, pilot lights and other sources of ignition. Prevent all sources of ignition. Combustible liquid and vapour.
Use Instructions:
Contents may be under pressure, open carefully. Keep container tightly closed. Do not pierce or burn container, even after use.

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8 Exposure Controls/Personal Protection

Personal Protection

Eye Protection:
The following should be worn alone or in combination, as appropriate, to prevent eye contact: Safety glasses with side shields
Hand Protection:
The following glove material(s) are recommended: butyl rubber;
Skin Protection:
Avoid skin contact.
Respiratory Protection:
Avoid breathing of vapours. Select one of the following approved respirators based on airborne concentration of contaminants and in accordance with regulations: half-mask organic vapour respirator;

When applying 3M Brand Detector Loop Sealant 5000 outdoors where air movement is unrestricted, there is little risk of user overexposure and, therefore, no need to use a respirator. Always follow product directions.
Ingestion (Prevention):
Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water.
Recommended Ventilation:

3M DETECTOR LOOP SEALANT BLACK 5000 Page 5 of 10

Use with adequate dilution ventilation. If exhaust ventilation is not adequate, use appropriate respiratory protection.

Ingredient Exposure Data

URETHANE PREPOLYMER (9057-91-4)
Specific Ingredient Data: Not Available.
LD50 (rat, oral)
: No data available.
LC50 (rat, inhalation/4 hours)
: No data available.

```
      Exposure Limits
   : No data available.
  TALC (14807-96-6)
      LD50 (rat, oral)
   : No data available.
      LC50 (rat, inhalation/4 hours)
   : No data available.
   Exposure Limits: ACGIH: TWA 2 mg/m3  (Respirable) (Table A4)
   CMRG: TWA 0.5 mg/m3  as respirable dust (specific form)
  POLYSTYRENE (9003-53-6)
      LD50 (rat, oral)
   : No data available.
      LC50 (rat, inhalation/4 hours)
   : No data available.
      Exposure Limits
   : No data available.
  1-METHOXY-2-PROPYL ACETATE (108-65-6)
   LD50 (rat, oral): 8532 mg/kg
      LC50 (rat, inhalation/4 hours)
   : No data available.
   Exposure Limits: AIHA: TWA 100 ppm
   AIHA: TWA 541 mg/m3
   CMRG: TWA 100 ppm
  DIMETHYL SILOXANE, REACTION PRODUCT WITH SILICA (67762-90-7)
   Specific Ingredient Data: LD50 (rat, dermal): >16 ml/kg
   LD50 (rat, oral): >64 g/kg
   LD50 (dermal, rabbit): >16 g/kg
   LC50 (rat, inhalation/4 hours): 315 -708 mg/m3
   Exposure Limits: CMRG: CEIL 5 mg/m3
  2-METHOXY-1-PROPYL ACETATE (70657-70-4)
   Specific Ingredient Data: No data available.
      LD50 (rat, oral)
   : No data available.
      LC50 (rat, inhalation/4 hours)
   : No data available.
      Exposure Limits
```

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   : No data available.
  TOLUENE 2,4-DIISOCYANATE (584-84-9)
   LD50 (rat, oral): 5800 mg/kg
   LC50 (rat, inhalation/4 hours): 14 ppm
   Exposure Limits: ACGIH: TWA 0.005 ppm  (Table A4)
   ACGIH: TWA 0.036 mg/m3  (Table A4)
   ACGIH: STEL 0.02 ppm  (Table A4)
   ACGIH: STEL 0.14 mg/m3  (Table A4)
  CARBON BLACK (1333-86-4)
   LD50 (rat, oral): >15400 mg/kg
   LC50 (rat, inhalation/4 hours):  6750 mg/m3
   Exposure Limits: ACGIH: TWA 3.5 mg/m3  (Table A4)
   CMRG: TWA 0.5 mg/m3
  TOLUENE 2,6-DIISOCYANATE (91-08-7)
      LD50 (rat, oral)
   : No data available.
      LC50 (rat, inhalation/4 hours)
   : No data available.
```

Exposure Limits: 3M: TWA 0.005 ppm Category: FREE ISOCYANATES
3M: STEL 0.02 ppm Category: FREE ISOCYANATES
1-METHOXY-2-PROPANOL (107-98-2)
LD50 (rat, oral): 6600 mg/kg
LD50 (dermal, rabbit): 13 g/kg
LC50 (rat, inhalation/4 hours): 15,000 ppm
Exposure Limits: ACGIH: TWA 150 ppm
ACGIH: TWA 553 mg/m3
ACGIH: STEL 100 ppm
ACGIH: STEL 369 mg/m3

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9 Physical and Chemical Properties

Physical form,Color,Odour:	Caulk; Black; mild odour;
Odour Threshold:	No data available.
pH:	Not applicable
Boiling point/boiling range:	156.1 C
Melting point/melting range:	Not Available
Vapour pressure:	2 mmHg
Water Solubility:	Nil
Specific gravity:	1.22 Water=1
Vapour density:	4.60 Air=1
Volatile organic compounds:	248 gms/liter
Evaporation rate:	0.21 BuOAc=1
Viscosity:	25000 centipoise
Percent Volatile:	20 %

3M DETECTOR LOOP SEALANT BLACK 5000 Page 7 of 10

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10 Stability and Reactivity

Conditions to Avoid:
Store out of direct sunlight.
Materials to Avoid:
Keep away from aluminum and zinc. Store away from acids; Amines; Alcohols; Water;
Hazardous Decomposition:
Carbon monoxide and carbon dioxide; Oxides of nitrogen; Hydrogen Cyanide; Aldehydes; Isocyanates;
Stability and Reactivity:
Stable. Hazardous polymerization will not occur.

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11 Toxicological Information

Effects from Eye Contact:
Moderate Eye Irritation: Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision.
Effects from Skin Contact:
Allergic Skin Reaction (non-photo induced): Signs/symptoms may include redness, swelling, blistering, and itching.
Mild Skin
Irritation (after prolonged or repeated contact): signs/symptoms can include redness, swelling, and itching.

Effects from Inhalation:
Allergic Respiratory Reaction: Signs/symptoms can include difficulty breathing, wheezing, cough, and tightness of chest.

Nervous System Effects: signs/symptoms can include emotional changes, lack of coordination, tremors and sensory loss.
Upper
Respiratory Tract Irritation: Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain.
Prolonged or repeated exposure may cause:
Kidney Effects: signs/symptoms can include reduced urine volume, blood in urine and back pain.
Liver Effects:
signs/symptoms can include yellow skin(jaundice) and tenderness of upper abdomen.

Effects from Ingestion:
Ingestion is not a likely route of exposure to this product.
Gastrointestinal Irritation: Signs/symptoms may include abdominal pain, nausea, diarrhea and vomiting.
Central Nervous System
Depression: signs/symptoms can include headache, dizziness,

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drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue, blurred vision, slurred speech, giddiness, tremors and convulsions.

Sensitization Information:
Allergic Skin Reaction (non-photo induced): Signs/symptoms may include redness, swelling, blistering, and itching.
Allergic
Respiratory Reaction: Signs/symptoms can include difficulty breathing, wheezing, cough, and tightness of chest.

Carcinogenicity:
WARNING: Contains a chemical which can cause cancer. (584-84-9) (NTP anticipated human carcinogen, IARC possible human carcinogen 2B, Calif. Proposition 65)
WARNING: Contains a chemical which can cause cancer (1333-86-4) (IARC possible human carcinogen 2B)

WARNING: Contains a chemical which can cause cancer. (91-08-7) (NTP anticipated human carcinogen, IARC possible human carcinogen 2B)

Mutagenicity:
No data available.

Reproductive Effects:
WHILE THE FOLLOWING EFFECTS ARE ASSOCIATED WITH ONE OR MORE OF THE INDIVIDUAL INGREDIENTS IN THIS PRODUCT AND ARE REQUIRED TO BE INCLUDED ON THE MSDS BY THE U.S. OSHA HAZARD COMMUNICATION STANDARD. THEY ARE NOT EXPECTED EFFECTS DURING FORESEEABLE USE OF THIS PRODUCT.

2-METHOXY-1-PROPYL ACETATE (70657-70-4) is a potential reproductive hazard causing vertebral anomalies, skeletal defects, cleft palate, heart effects and kidney effects via inhalation exposure in laboratory animal studies.

Component Based Information:
TALC (14807-96-6) has been shown to cause fibrosis of the lungs.
Product Based Information:
No data available.

12 Ecological Information

Environmental Data:
Ecotoxicity Data:
No data available.
Ecofate Data:
Other Effects and Information:
Since regulations vary, consult applicable regulations or authorities before disposal.

13 Disposal Considerations

Product as Sold:
No data available.
Product Packaging:
No data available.
Special Instructions:
Since regulations vary, consult applicable regulations or authorities before disposal.

14 Transportation Information

Transportation of Dangerous Goods

TDG Classification:	Non-Regulated: TDGR Section 1.33 Regulated by Air and Ocean Limited Quantity;
Proper Shipping Name:	RESIN SOLUTION
Class/Division:	3
UN Number:	UN1866
Packing Group:	III

International Dangerous Goods Classification

15 Regulatory Information

WHMIS Classification: B3, D2A, D2B
NOTE:
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.
Product Certifications:
The product on this MSDS, or all its components, is included on the

following countries' chemical inventories, as noted:
DSL - Domestic Substances List (Canada)
TSCA - Toxic Substances Control Act (USA)
EINECS -
European Inventory of Existing Commercial Chemical Substances
AICS - Australian Inventory of Chemical Substances

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16 Other Information

Reason for Reissue:
MSDS initial issue

The information in this Material Safety Data Sheet (MSDS) is believed to be correct as of the date issued. 3M MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR COURSE OF PERFORMANCE OR USAGE OF TRADE. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's method of use or application. Given the variety of factors that can affect the use and application of a 3M product, some of which are uniquely within the user's knowledge and control, it is essential that the user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for user's method of use or application.