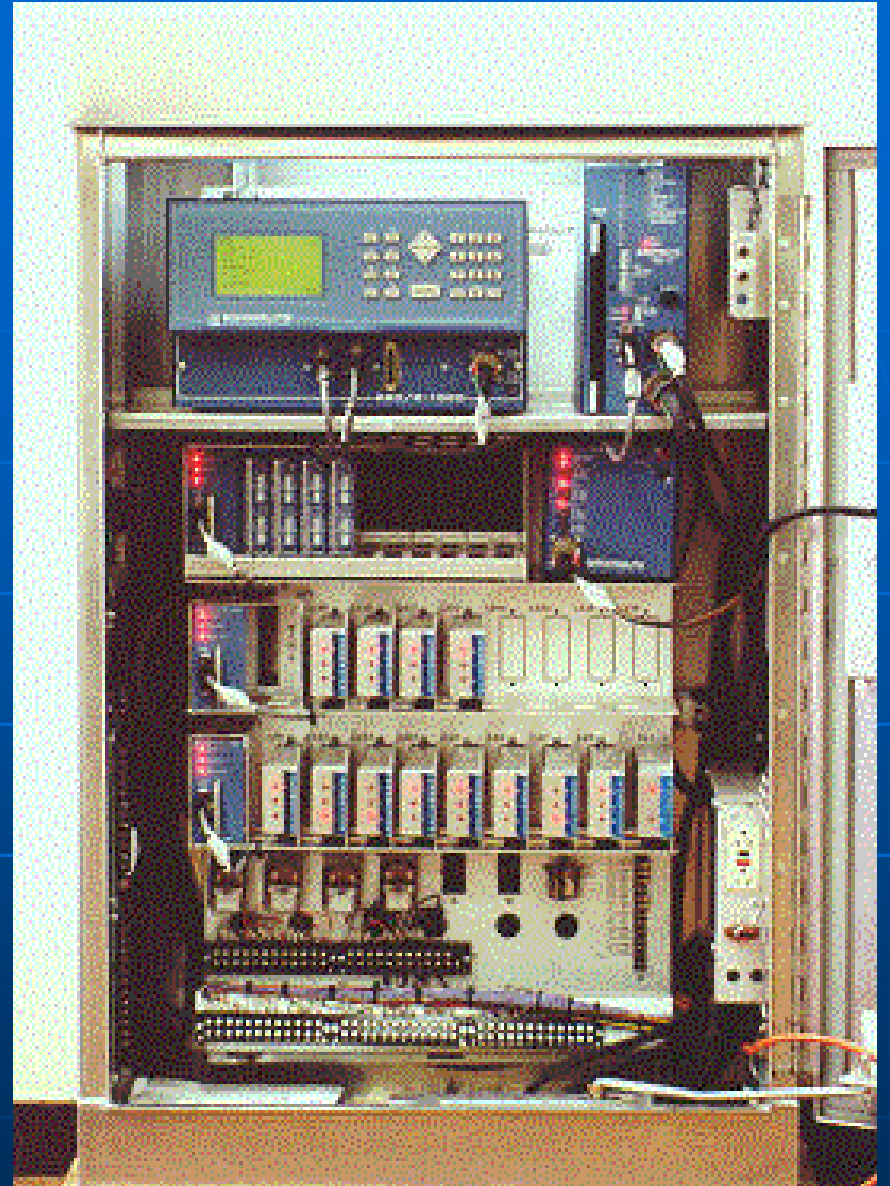


NEMA TS2 Standard & Technology

*Presented by
Mike Shea
Eastern Region Sales Manager*

“The Intelligent Cabinet”



Background of *TS2*

- Developed to overcome limitations of TS1, which was issued in 1976 and reissued in 1983.
- Formally approved by NEMA and IMSA in 1992 as the successor to TS1.
- To coexist with TS1, which was reaffirmed in 1989 and 1994 for another 5 years.
- NEMA TS-2 was updated in 1998 and again in 2003 when NTCIP was added to the standard

Benefits of *TS2* Preview

- Enhanced safety & reduced liability
- Enhanced standardization
- Greater opportunity for multiple sourcing
- Path to expansion & innovation

Enhanced Safety & Reduced Liability

- Simplified cabinet wiring
- Redundant MMU function
- Program verification
- Provision for output monitoring
- Clearance time monitoring
- AC power monitoring
- Detector status monitoring
- Cabinet-level diagnostics
- Provision for detector failure monitoring
- Logging by controller
- Enhanced user interface

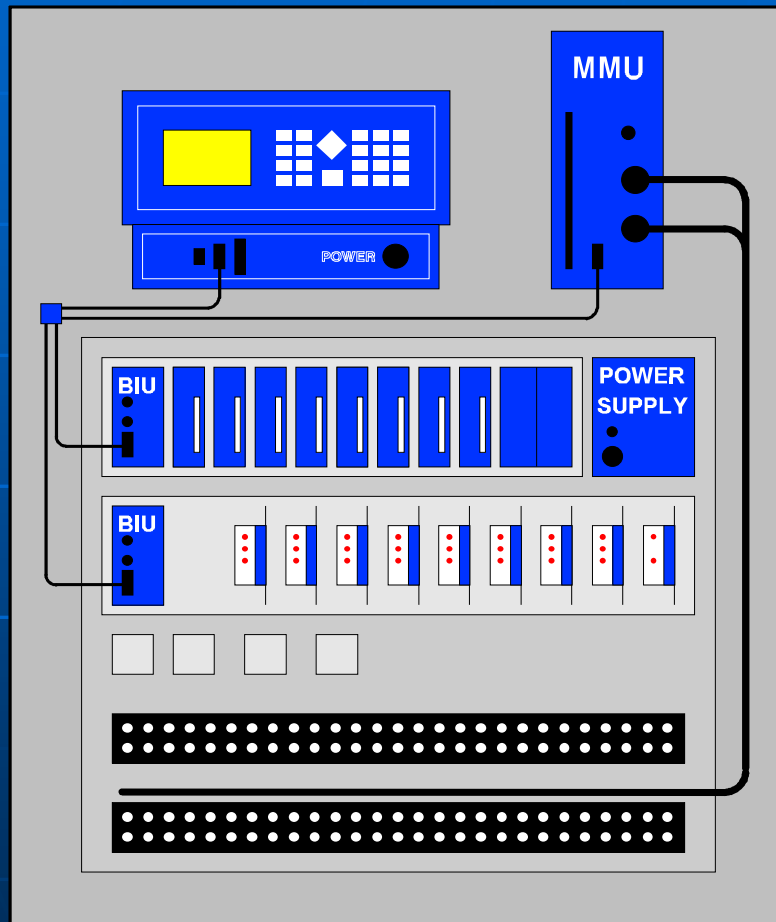
Enhanced Standardization

- TS2 specifies controllers and cabinets more fully than TS1.
- Includes coordination, preemption, time base control, automatic flash & telemetry hardware.
- Specifies all connections inside traffic cabinet.
- Eliminates manufacturer-specific "D" connector.
- Specifies physical layer of system-level communications.
- Specifies cabinet dimensions.

Path to Expansion & Innovation

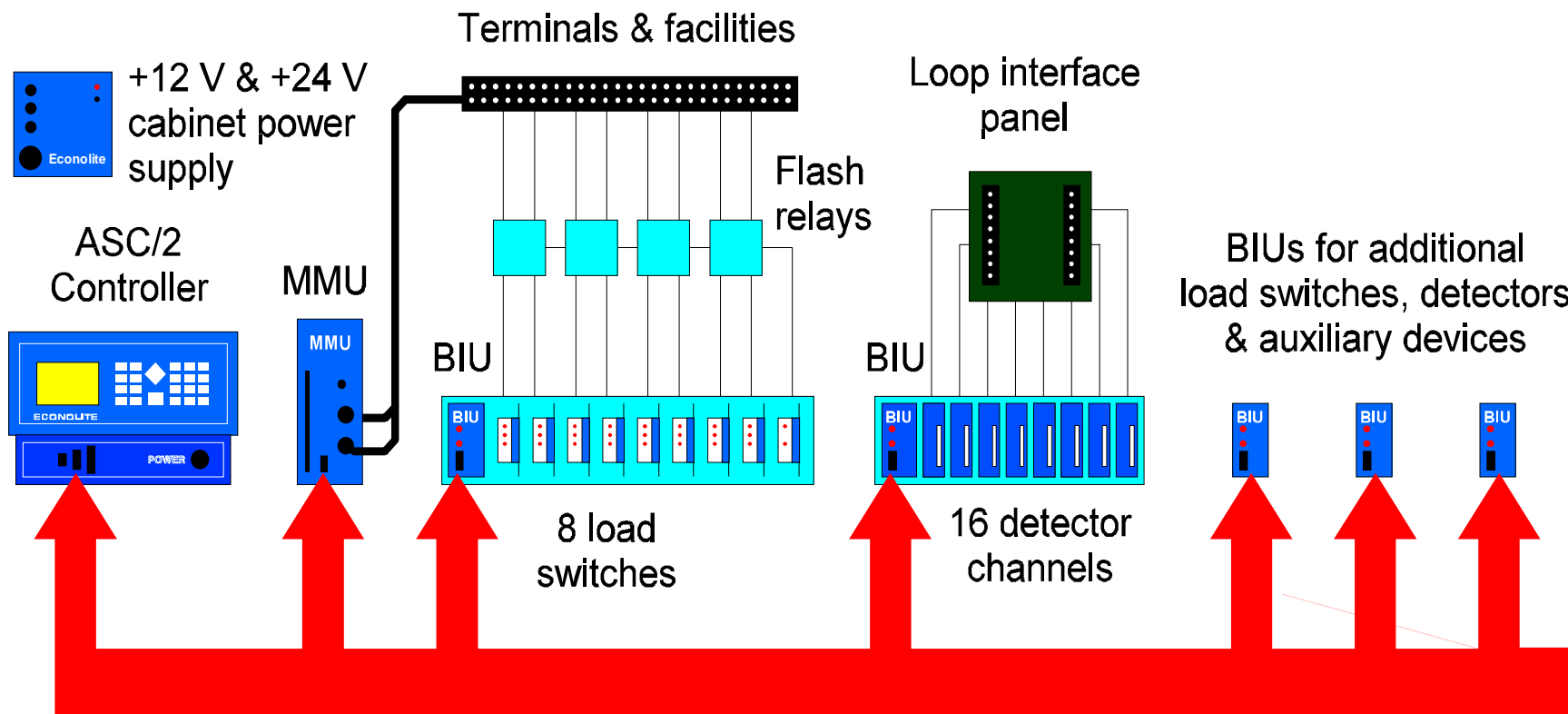
- **Open architecture at cabinet level**
 - Made possible by SDLC bus.
 - Interface to as yet unspecified cabinet devices.
- **Open architecture at system level**
 - Made possible by standardized telemetry port and NTCIP Communications Protocol.
- **“Technology platform” for future ITS applications.**

TS2 Type 1: the pure TS2 cabinet

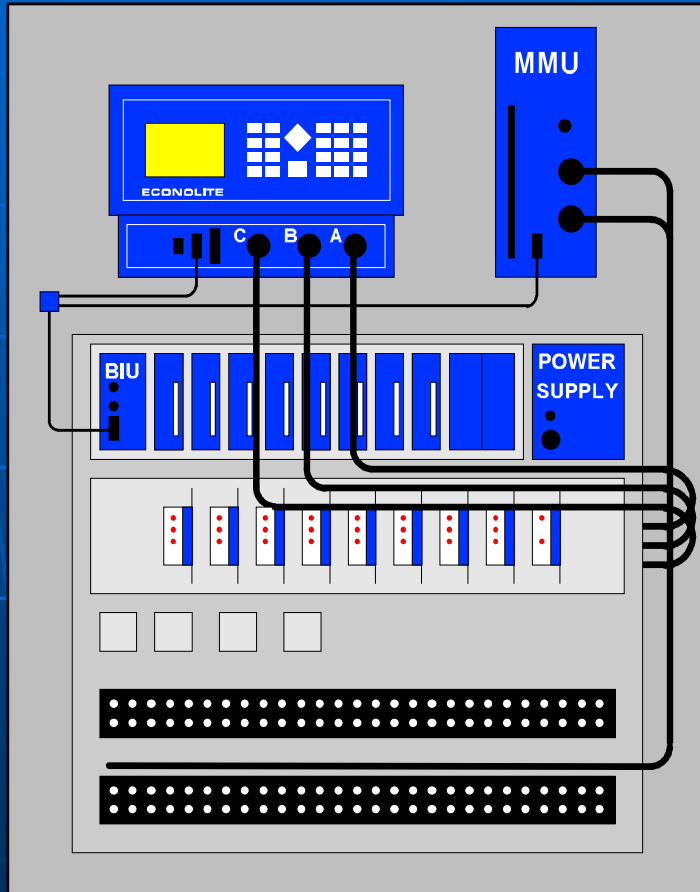


- SDLC serial data bus replaces A, B and C harnesses of TS1.
- Bus serves as data highway for cabinet.
- Load switches and detectors are interfaced to bus via BIUs.
- MMU retains point-to-point wiring to load switch outputs.

TS2 Type 1 Operation

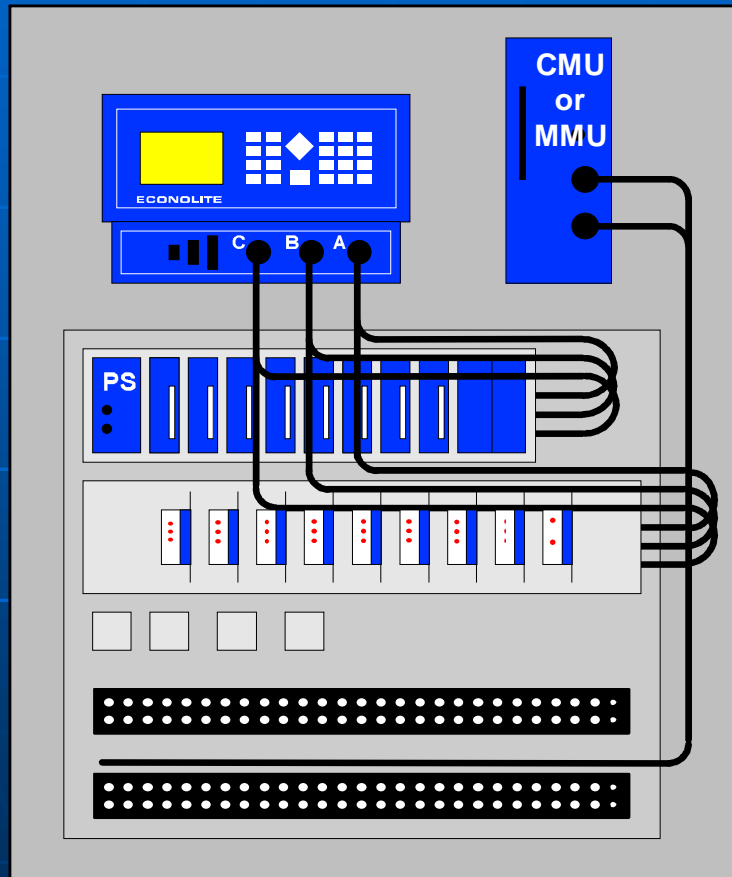


TS2 Type 2: a hybrid TS1/TS2 cabinet



- Controller provides connectors to SDLC bus and to A, B, C harnesses.
- Minimum requirement is that controller and MMU be connected via SDLC bus.
- TS2 Type 2 provides upgrade path to TS1 users.

Downward compatibility with TS1

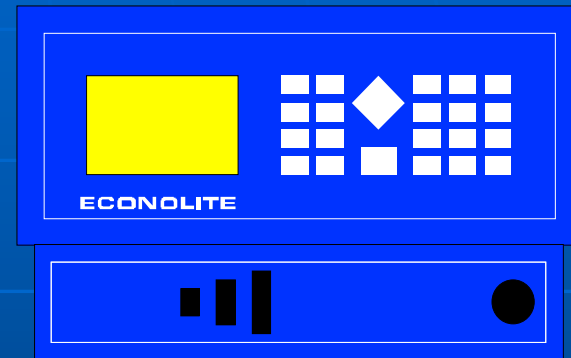


- TS2 Type 2 controller offers TS1 operating mode.
- TS2 MMU offers TS1 CMU operating mode.
- TS2 detectors, load switches, flash relay and flasher will operate in TS1 cabinet.

TS2 cabinet components: Two types of *TS2* controllers

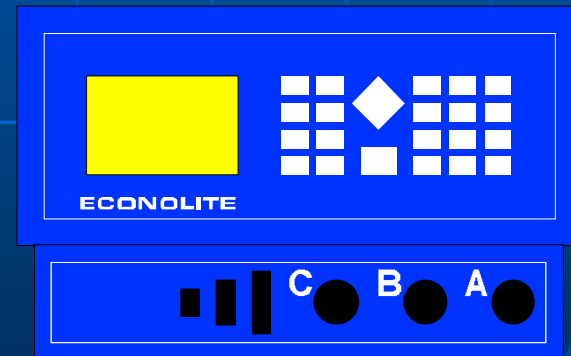
- **TS2 Type 1**

- “Pure” TS2 controller.
SDLC bus only.



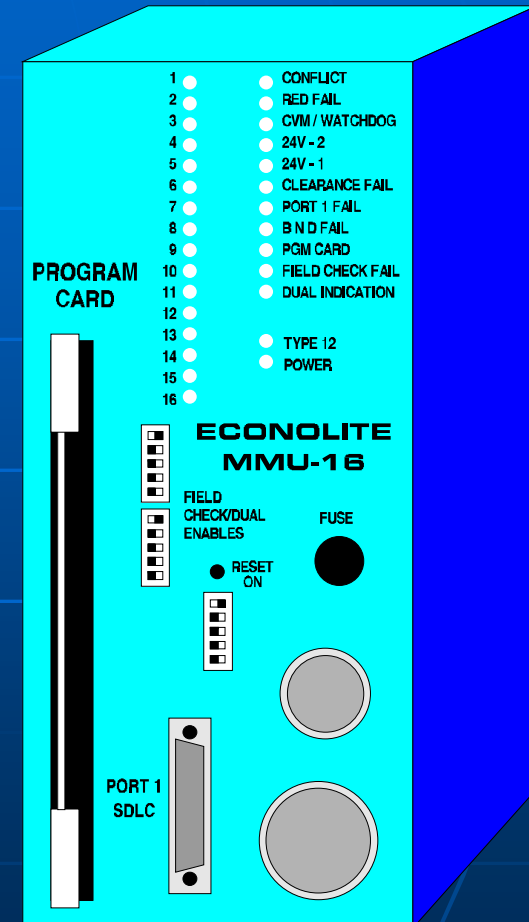
- **TS2 Type 2**

- Hybrid TS1/TS2.
- SDLC bus plus A, B, C connectors.



Malfunction Management Unit (MMU)

- Required in any TS2 cabinet.
- Downward compatible with TS1.
- "Type 16" mode:
 - 16 channels: 8 vehicle, 4 ped, 4 O/L.
 - Three 120 VAC inputs per channel: Green/Walk, Yellow, Red/Don't Walk.
- "Type 12" mode:
 - 12 channels: 8 vehicle, 4 O/L.
 - Four 120 VAC inputs per channel: Green, Yellow, Walk, Red.



Malfunction Management Unit (MMU)

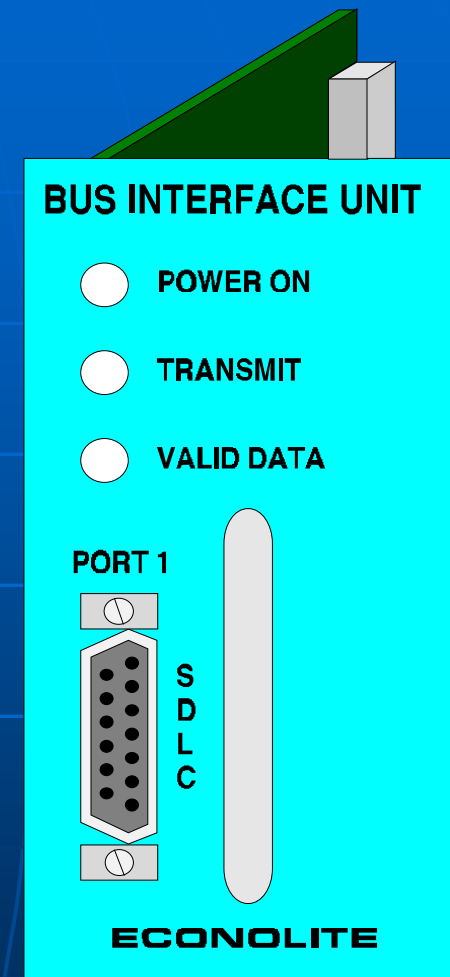


Reno A&E



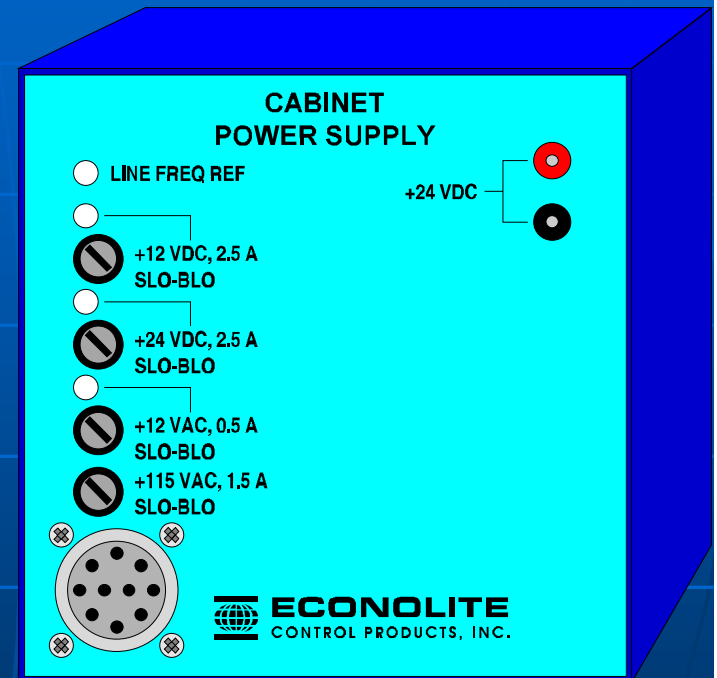
Bus Interface Unit (BIU)

- Interfaces detector racks & terminals & facilities to SDLC bus in Type 1 mode.
- 15-pin D connector on front panel to SDLC bus.
- 64-pin DIN connector to backplane.
 - I/O includes:
 - 8 inputs
 - 4 opto-isolated inputs
 - 24 re-mappable input/outputs
 - 15 outputs
 - 4 address select inputs

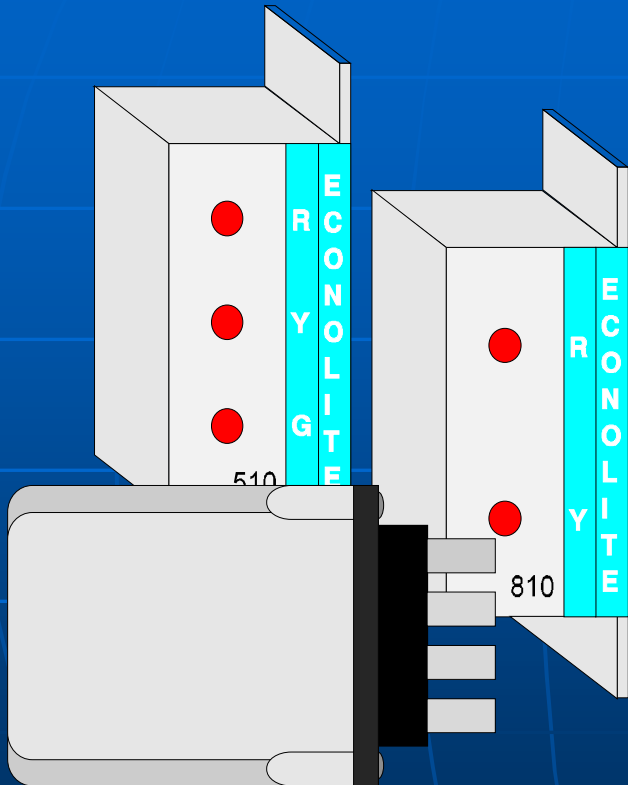


TS2 Cabinet Power Supply

- One required per TS2 cabinet with a BIU.
- Four outputs:
 - 24 VDC to drive load switches & BIUs.
 - 12 VDC to drive TS2 detectors.
 - 12 VAC for isolated inputs.
 - 60 Hz timing reference for BIUs.
- Fuses for AC power input & power outputs.



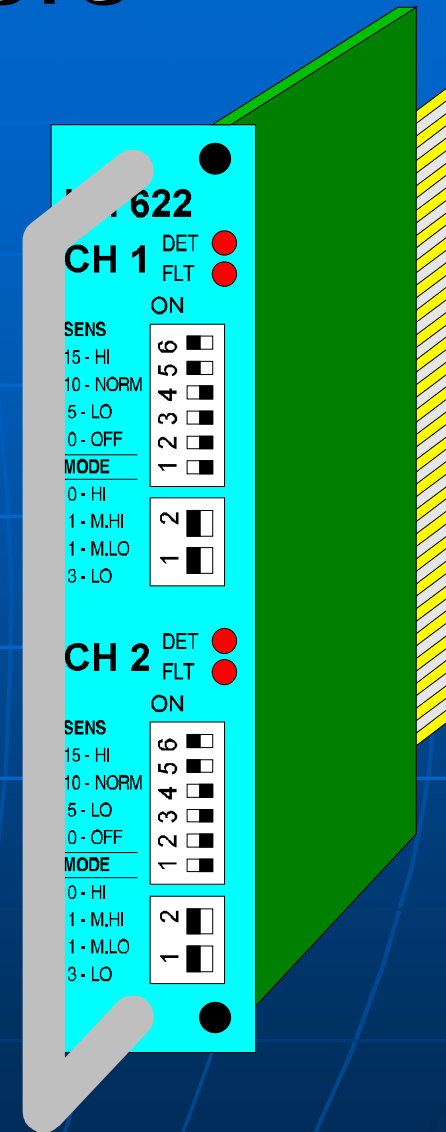
Load Switches, Flasher & Flash Transfer Relays



- Downward compatible with TS1.
- TS2 load switch has peak leakage of 10 mA, compared to 20 mA for TS1.
- TS2 flasher & flash transfer relay operate at 89 VAC, compared to 95 VAC for TS1.
- TS2 specifies flash transfer relays both mechanically and electrically.

TS2 Loop Detectors

- Rack mounted version only, 2 & 4 channel.
- Each detector rack is interfaced to SDLC bus via a BIU.
- 16 detector channels per rack, BIU addressing for up to 4 racks.
- Can be powered by 10.8 - 28.8 V, compared to 24 ± 2.5 V for TS1.
- 24 V open collector outputs allow use in TS1 cabinets.
- Powerful TS2 diagnostic features.





National Electrical Manufacturers Association

What does The Future Hold?

TS2 Standard Maintenance

- Standard Maintenance Task Group – Chair: Scott Evans
- This task group will be charged with updating the current TS2 standard.
 - Including harmonization of TS2 with the NTCIP Global and ASC object standards
 - adding requirements for support of the following:
 - flashing yellow arrow protected permissive left turn signal
 - LED signal interface requirements (such as a new load switch for handling the low loads of LED signals)
 - functional standards for the physical interface of video based vehicle detection equipment (such as card size, pin out, power, etc.)
 - providing functional standards for the physical interface of preemption hardware (again such as card size, pin outs, power, etc.),
 - improving the environmental and transient requirements
 - and possibly adding something regarding UPS/BBS systems.

NEMA Field Master

- Field Master Task Group – Chair: Eric Raamot
- This group has the task of developing a standard for a field master that provides the functions needed to support the NTCIP FM objects (1210).
- The hardware portion of this standard will draw on the ATC controller standard.
 - ATC Engine board
 - Field Master specific host module. The host module requirements will be covered in the NEMA field master standard.
- This task group has had one initial meeting at which the basic features needed for a field master were outlined.

Next Generation Cabinet

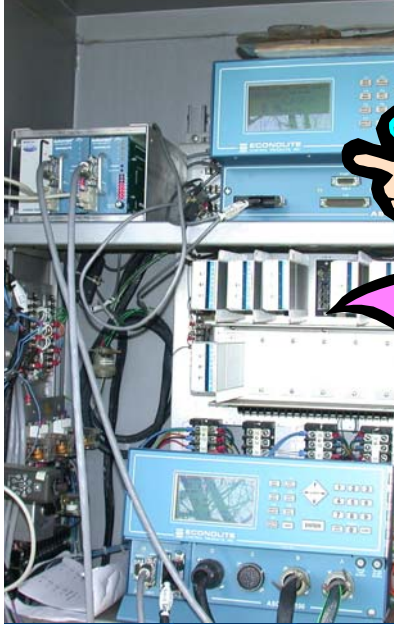
- Next Generation Cabinet Task Group – Chair: Peter Ragsdale
- This task group will be charged with developing a next generation cabinet standard that goes beyond TS2 and the ITS Cabinet.
- This standard is not meant to compete with the ITS Cabinet per se. The efforts of this task group are to be coordinated with the ITS Cabinet effort.
- If the funding for the ITS Cabinet effort ends, this task group can pick up and complete/enhance what was started by the ITS Cabinet effort.

Advanced Signal Controller

- Advanced Signal Controller Task Group –
Chair: Ray Derr
- This task group will be charged with developing a functional standard for the ATC controller (the ATC controller standard only covers hardware).
 - The functionality for this standard will be based on TS2 and NTCIP 1202.
- It is anticipated that additional functionality beyond TS2 will probably end up in this standard once the effort gets well underway.

NEMA – ITE Forum

- NEMA is working with ITE to sponsor an open forum to discuss the new standards efforts during the upcoming ITE Technical Conference to be held in San Antonio, TX in March. The forum is tentatively scheduled for the afternoon of March 22nd which is at the end of the ITE meeting.



We installed *TS-2*
years ago!"