



# Introduction to the Integration of Digital Switching and Modules in Commercial Vehicles

SAE Media Webinar

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Expertise Applied | Answers Delivered

# Agenda

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- Introduction to 'Digital Switching and Controls'
- System Migration – **Why?**
- How to choose your new HMI system
  - CAN-based switching modules
  - LIN-based switching modules
- How to choose your new Control system
  - Non-critical load controllers
  - Other embedded ECUs
- Software integration
- Market-leading developments

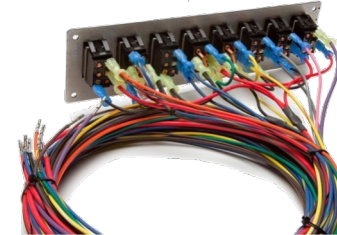
# Introduction

- There are two types of products that will be covered in this webinar which will both be relevant to noncritical cab-based load control applications:
  - Digital Switching Product – A physical interface that provides intelligence and diagnostics when loads are controlled
  - Control Product – A nonphysical interface capable of directly controlling loads through complex logic that interfaces with other ECUs and HMI products
- These products typically communicate through the Controller Area Network (CAN bus system) which is like the nervous system inside a vehicle and enables the communication of information
  - There are different types of communication languages for different applications



# System Migration – Why?

- Commercial Vehicle architectures are trending towards 'Digital' technology in their informational systems for the below reasons:
  - Space and weight of cable harnesses
  - Increased system intelligence
  - Decreased points of communication failure
  - Increased HMI endurance
  - Greater application flexibility
  - Can be more responsive upon load activation



Digital Switching

Emech\* Switching

# How To Choose Your New HMI System

- Major factors to consider:
  - Environment
  - Content Volume & Variety
  - Vehicle Volume
  - Cost
  - Aesthetics
  - Communication Protocol



# CAN-Based Switching Modules

- All tested to minimum IP67 for rugged applications
- Encapsulate different switching aesthetics and types:
  - Rocker
  - Pushbutton
- Covers different size requirements
- Can come with additional features aside from switching:
  - Rotary encoder
    - Rotary Only
    - Rotary and Pushbutton
    - Rotary, Pushbutton and Joystick
  - Relay control
    - VM6 only



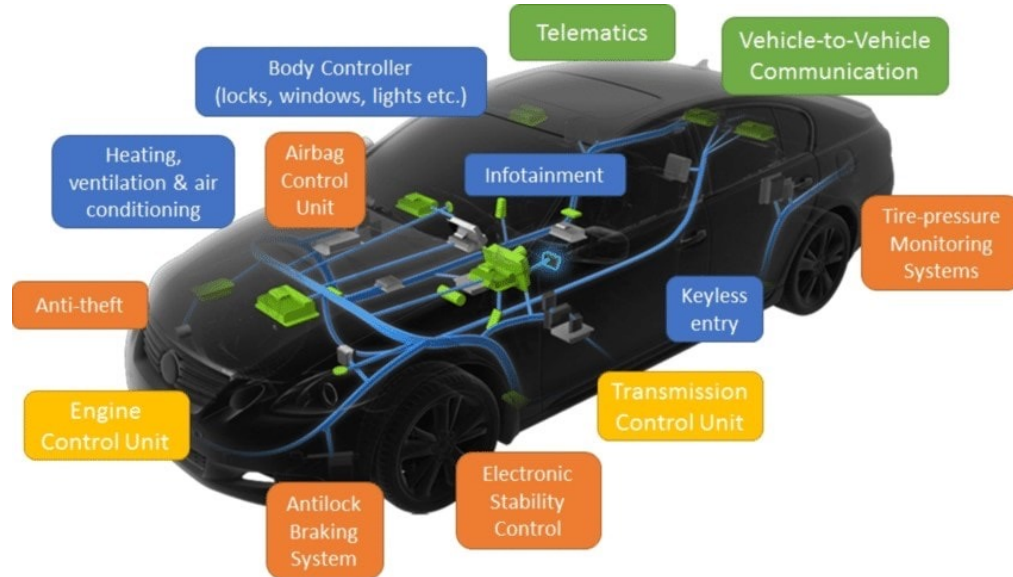
# LIN-Based Switching Modules

- More cost effective for high switch content applications
- Aesthetic is desirable for Truck market
- Benefits engineers searching for their first Digital Switching system
- Master → Slave based software architecture
- Rheostat and locking switches also available



# Choosing a New Control System (Part 1)

- When should you use a controller?
  - Application specific
  - Computational data needs
  - Gatewaying
  - New development need
  - Logical based application
  - Intelligence to system
- Types of controllers
  - By IEEE definition standard, there are 5 types of ECUS in industry production: Powertrain, Vehicle Safety, Comfort, Infotainment and Telematics.
    - Powertrain
      - Motor controller/ Engine ECU
      - Powertrain Module
    - Vehicle Safety
      - Vehicle Supervisory Controller
      - ASIL Integration and compliant units
    - Comfort
      - Body Control Modules
      - Seat Controllers



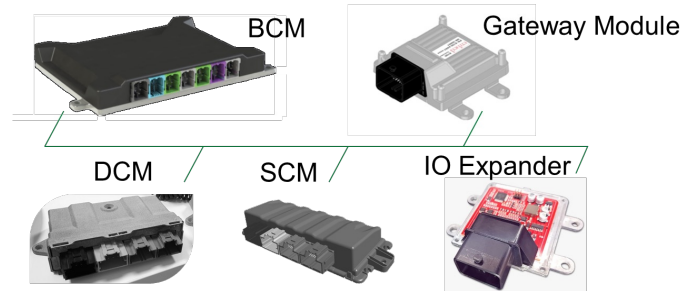
# Choosing a New Control System (Part 2)

- Criteria for choosing a controller
  - What do you need to achieve? - Application Specific?
    - Take information from Digital switches and process to create an application?
    - Connect two ECUs together?
    - Control LIN Latches on a system and relay diagnostic states to other controllers?
    - Process data and create a decision.
  
- What do you need to achieve? - Control Peripherals
  - Communication based
  - IO based
  - Safety Critical
  - Rapid Prototyping
  - Cost Down
  
- What are the limitations?
  - Current draw
  - Inputs/Outputs
  - Diagnostic capabilities? Needs DM1 instead of UDS for example
  - Cost

Number Pins	112 Pin	112 Pin	32 Pin	48 Pin
Function	Engine / Powertrain	Engine / Powertrain	Remote IO	General Purpose/ Gateway / HVAC
Series	ECM5554-112	SECM112	E100	E400
Microcontroller	Freescale MPC5553 or 5554	Freescale MPC564xA plus auxilliary MC9S12G	NXP S12P	Freescale MPC5646
Clock Frequency	80MHz	80MHz		
Internal Flash	2M	2M prod / 4M dev	128k	3M
External Flash			6K	64K
EEPROM	32k (serial)	4k EEPROM	4k serial	
Internal SDRAM	64k	128k prod / 196k dev		256k
External SDRAM	512k (dev't version only)			
Supply Voltage	8-16v	8-32v	6-16v	6-26v
Emergency Stop	1	1		
Switch Inputs		3		
Frequency Inputs	Up to 4 Hall type (PU)	Up to 6	4	
Crank position Input Type	2 engine speed. (SW config Hall or VR)	2 engine speed. (SW config Hall or VR)	-	-
Analogy Input (10 bit)	33	up to 33	4	up to16
Knock Inputs	2 (DSP)	2 (DSP)		
O <sub>2</sub> Sensor Inputs	4 differential	2 HEGO (Bosch wide-range)2 differential EGO (opt) 2 single-wire EGO	-	-
High Current drivers (10A)				
Medium Current Drivers (3A)	4 low side (w/HEGO diagnostics)	5 low side (1 wih current sense)	2 ( 3 Amp)	2 (3A max,PWM) current & voltage feedback

# Non-Critical Load Controllers

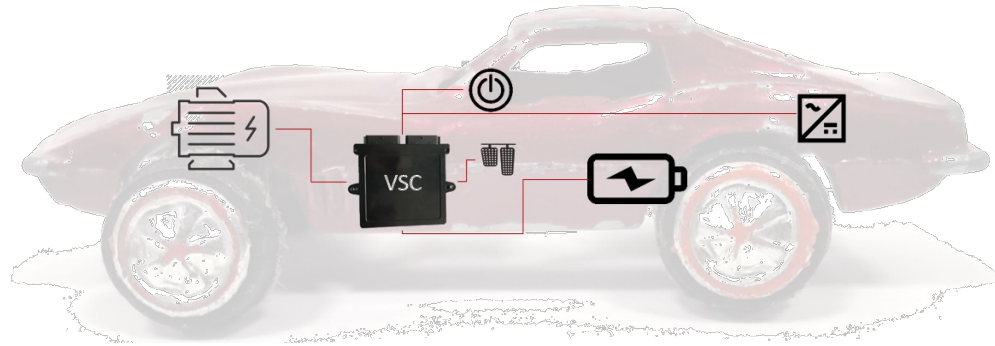
- What is a non-critical load controller?
  - These controllers are part of our control product line which can control loads which are capable of intelligence, diagnostics and feedback.
- Gateway controllers
  - Embed Gateway : 2 CAN gateway
  - Embed E400: 4 CAN/4 Lin Gateway
- High Load controllers
  - Body Control Module: Full body Light control (External and Internal), Door locking, Auxiliaries (Wipers, Horn ...etc.)
  - Door Control Module: Full door control, door lights, window control, electro chromatic glass and latch control.
  - Seat Control Module: Full Seat Control, full steering column control, seat ventilation and footwell lighting.
  - LIN Master Module: Control multiple LIN Loads and inputs to allow switching.



# Other Embedded ECUs

- HVAC – Heating, Ventilation, and Air Conditioning
- BMS – Battery Management System
- ACM – Accessory Control Module
- DDM – Driver Drowsiness Module

These controllers are more customised to the system than noncritical load controllers.



# Software Integration – Digital Switching

- **Current State:**

- Network Type, Source Address Configuration & Interface Specification

## 9. NETWORK TYPE

J J1939 (250K BAUD Rate)      K J1939 (500K BAUD Rate)

## 10. SOURCE ADDRESS

The Source Address is a unique number (**000-248**) assigned to each node on a CAN network, and is determined based on the specific CAN architecture of each customer application.

## Resources

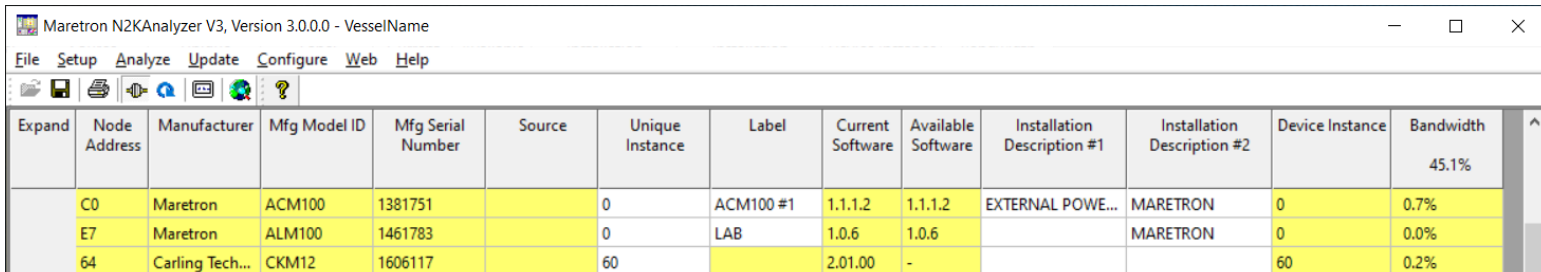
### Switches - Digital Switching

 [CKP-Series Datasheet \[pdf\]](#)

 [CKP-Series Interface Specification \[pdf\]](#)

- **Future State:**

- Configuration Tool



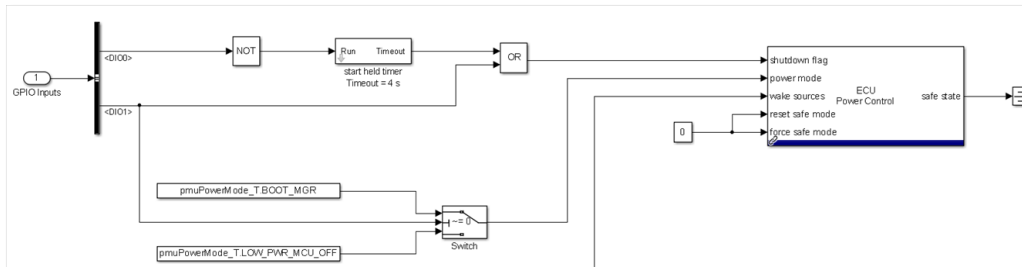
Maretron N2KAnalyzer V3, Version 3.0.0.0 - VesselName

File Setup Analyze Update Configure Web Help

Expand	Node Address	Manufacturer	Mfg Model ID	Mfg Serial Number	Source	Unique Instance	Label	Current Software	Available Software	Installation Description #1	Installation Description #2	Device Instance	Bandwidth
	C0	Maretron	ACM100	1381751		0	ACM100 #1	1.1.1.2	1.1.1.2	EXTERNAL POWE...	MARETRON	0	0.7%
	E7	Maretron	ALM100	1461783		0	LAB	1.0.6	1.0.6		MARETRON	0	0.0%
	64	Carling Tech...	CKM12	1606117		60		2.01.00	-			60	0.2%

# Software Integration – Controllers

- What level of software integration is need?
  - A lot of digital switches come with their own diagnostics; the controller must be able to respond and process these diagnostics.
    - DM1s
    - UDS
    - XCP
    - LIN Schedule responses
  - The applications themselves are specifically created through a tool called Matlab Simulink with something called a ‘blockset’
    - Using this ‘blockset’ it allows all functions of the controller to be accessed through its interface and controlled for their logic
    - These are used to create and generate the ‘flashable’ file for the controller.



# Market-Leading Developments

- Ability to provide a complete Digital Switching System
- Collaboration with Engineers on architectural functionality with our market experience
- Ability to rapidly prototype proof of concept designs



## Case Study:

- Engineering team problems:
  - Minimal interaction changes from end user but leverage benefits of Digital Switching
  - Lack of software knowledge and experience
- Solutions offered:
  - Switches that could be hard wired, fully LIN or hybrid depending on control function
  - Switches were aesthetically similar to previous generation design
  - Controller created to handle all LIN software integration

