



42V PowerNet in Door Application

SAE 2000 World Congress
March 6-9, 2000, Detroit, Michigan, USA
Alfons Graf - Infineon Technologies AG

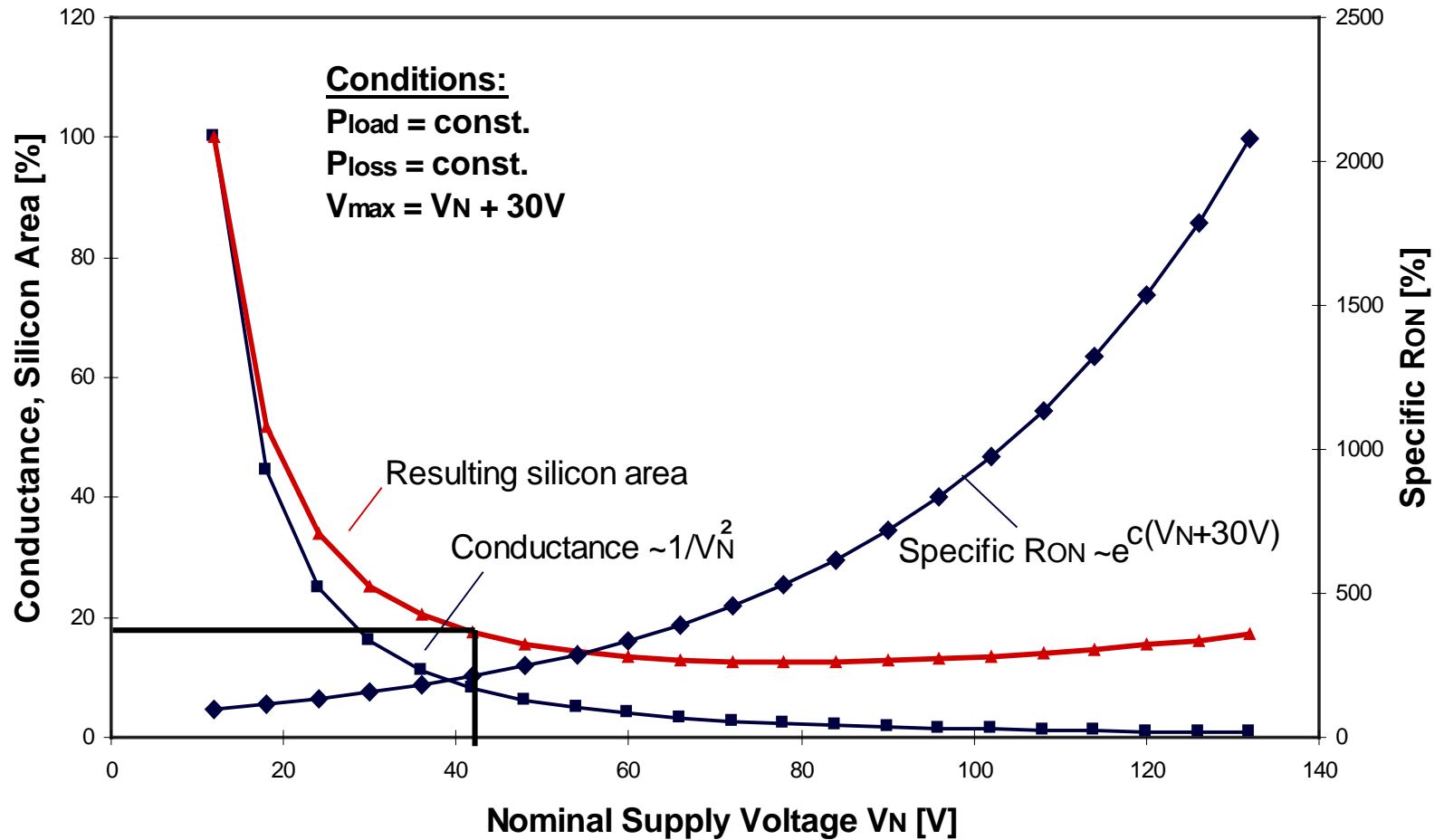
42V PowerNet in Door Application

Introduction

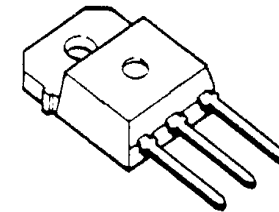
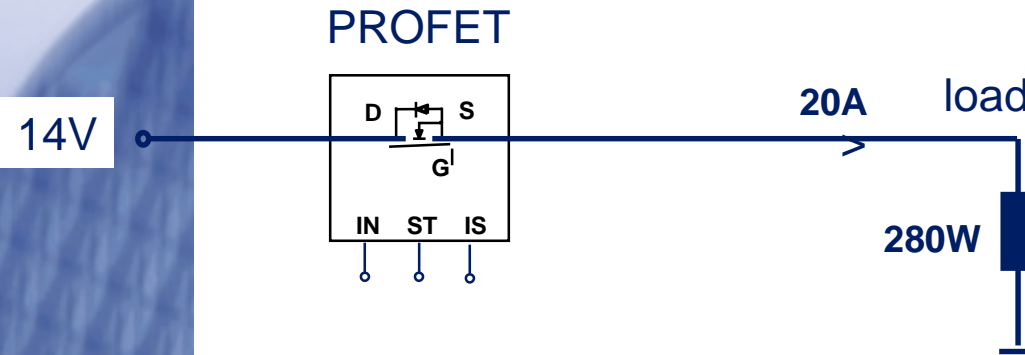
- ✿ 42V and the influence on semiconductors
- ✿ Door module solution today
- ✿ Power window and door lock at 42V
- ✿ Mixed 14V/42V door module
- ✿ Single 42V door module
- ✿ Conclusion



Effects of 42V PowerNet on Silicon

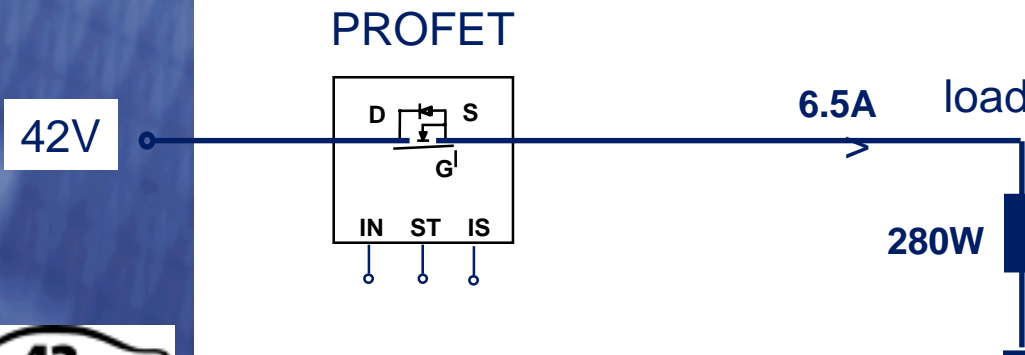


Cost Saving Potential for Power Applications



TO218
 $P_V=1.7W$
 $R_{ON}=2.9m\Omega$

**dramatic cost reduction:
 chip area + package + mounting**

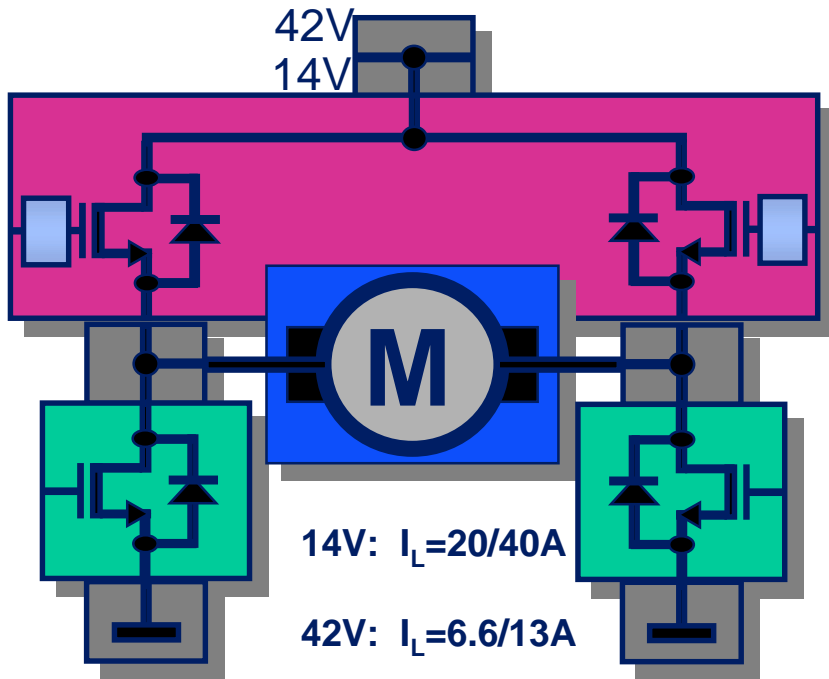
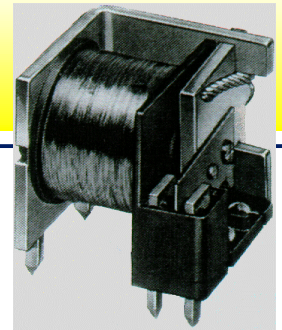


D-PAK
 $P_V=1.1W$
 $R_{ON}=18m\Omega$

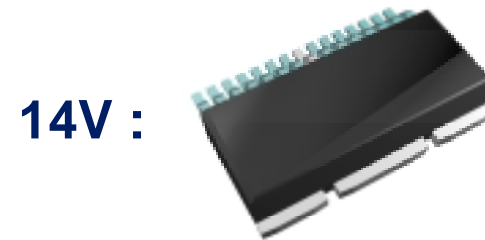
calculation at $T_j=100^\circ C$



Cost Saving Potential for Power Window



TRILITHIC Smart Power Bridges



$P_V : 100\%$
 $R_{ON} = 50m\Omega$

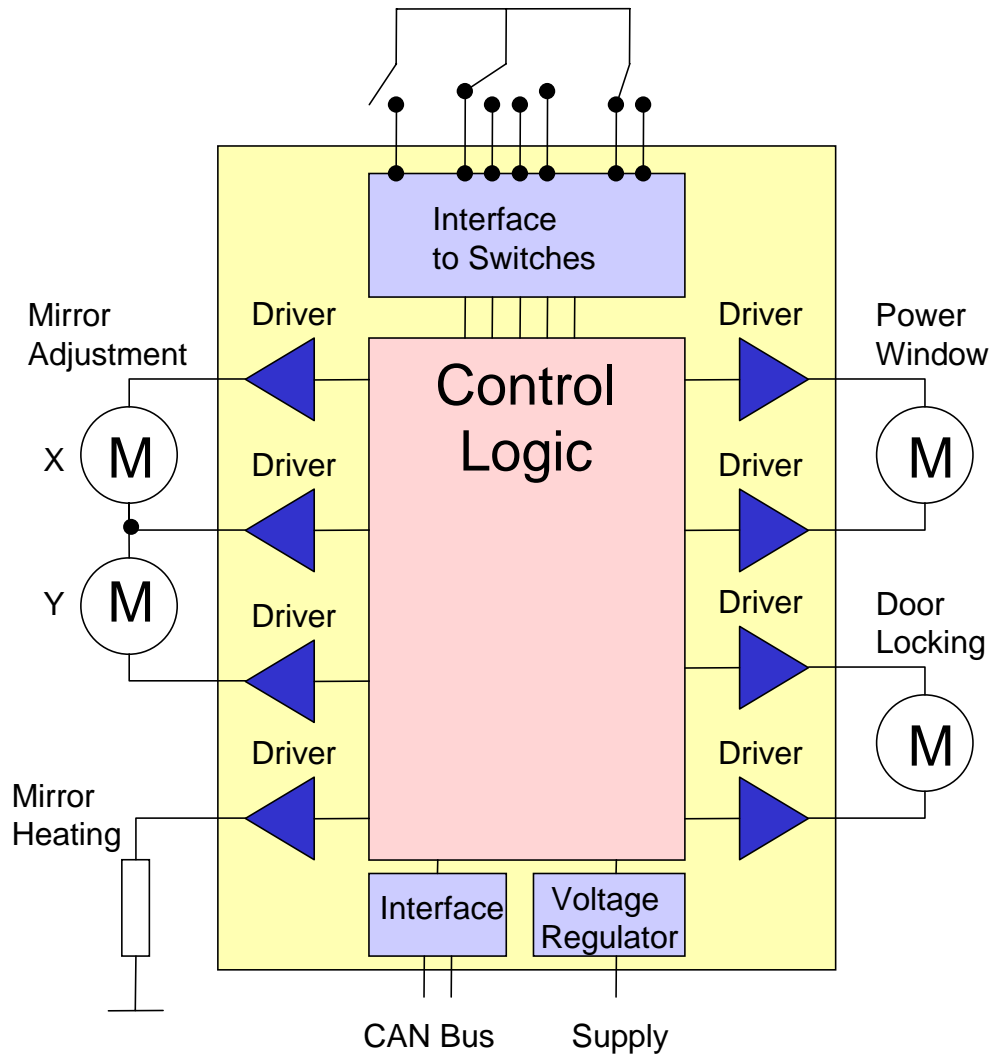
Parameters of Power-Pack:
 $R_{thJ_Air} = 21 K/W$
 $R_{thJ_Case} = 0.5 K/W$



$P_V : 22\%$
 $R_{ON} = 100m\Omega$
Parameters of P-DSO-28:
 $R_{thJ_Air} = 60 K/W$
 $R_{thJ_Pin} = 20 K/W$



Construction of a Today's 14V Door Module



Inputs:

different Switches

Outputs:

H-Bridges (window, lock)

half-Bridges (Mirror)

highside Driver (Heating)

Control:

Microcontroller

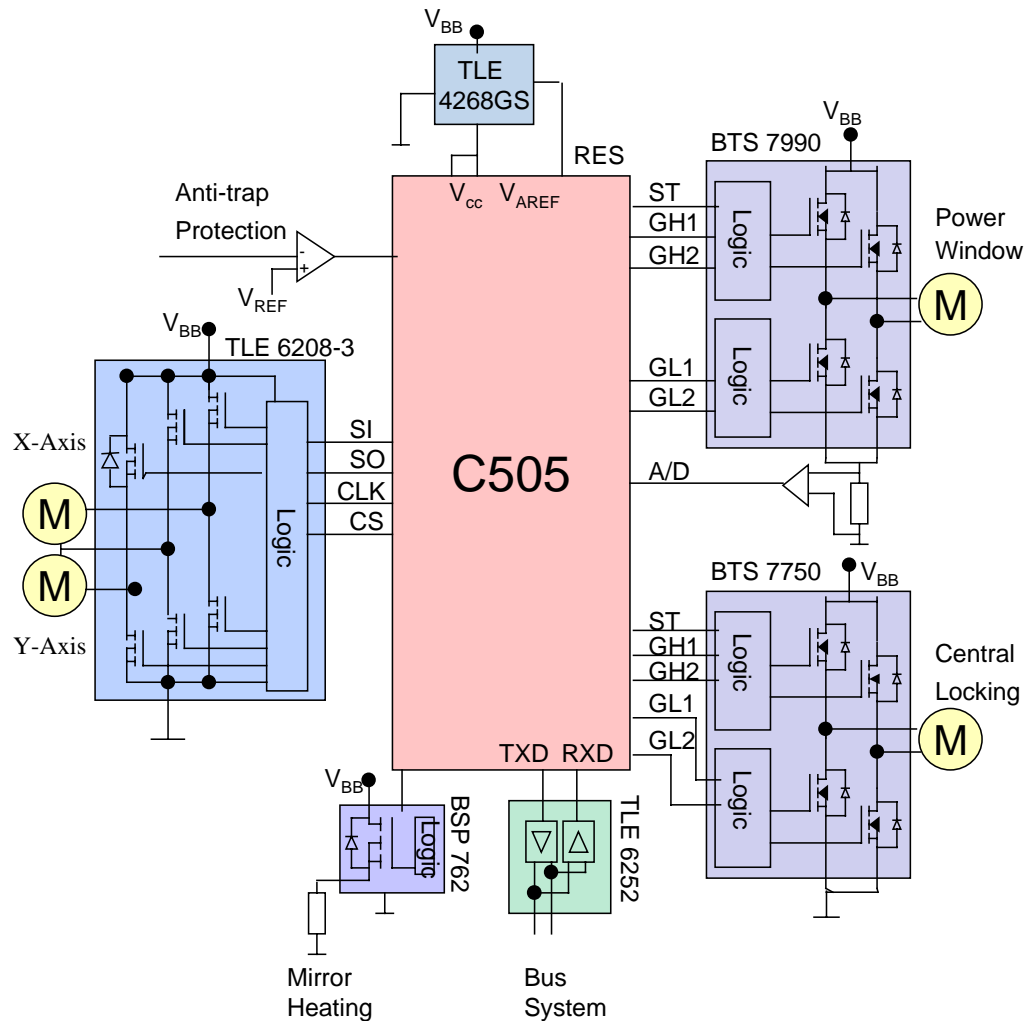
BUS-Interface

Supply:

Voltage Regulator



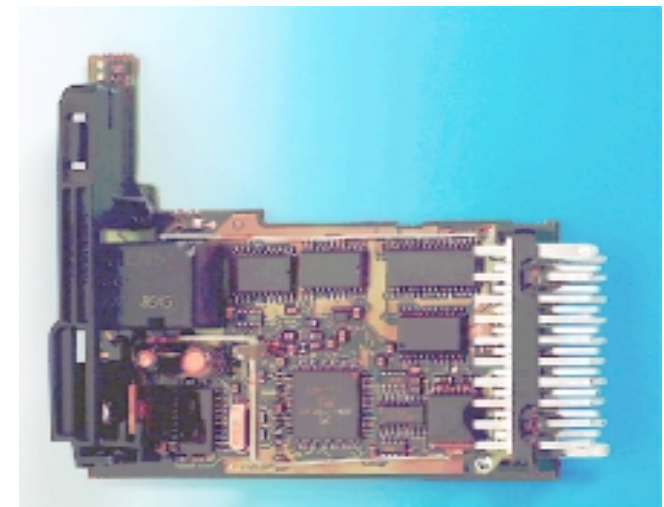
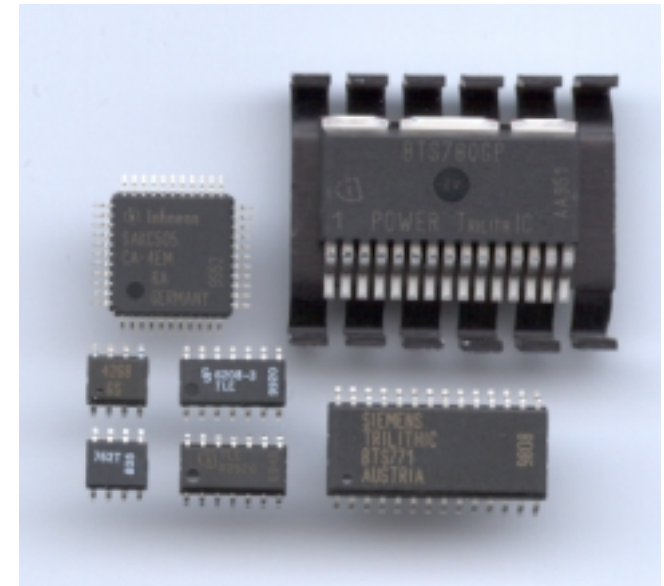
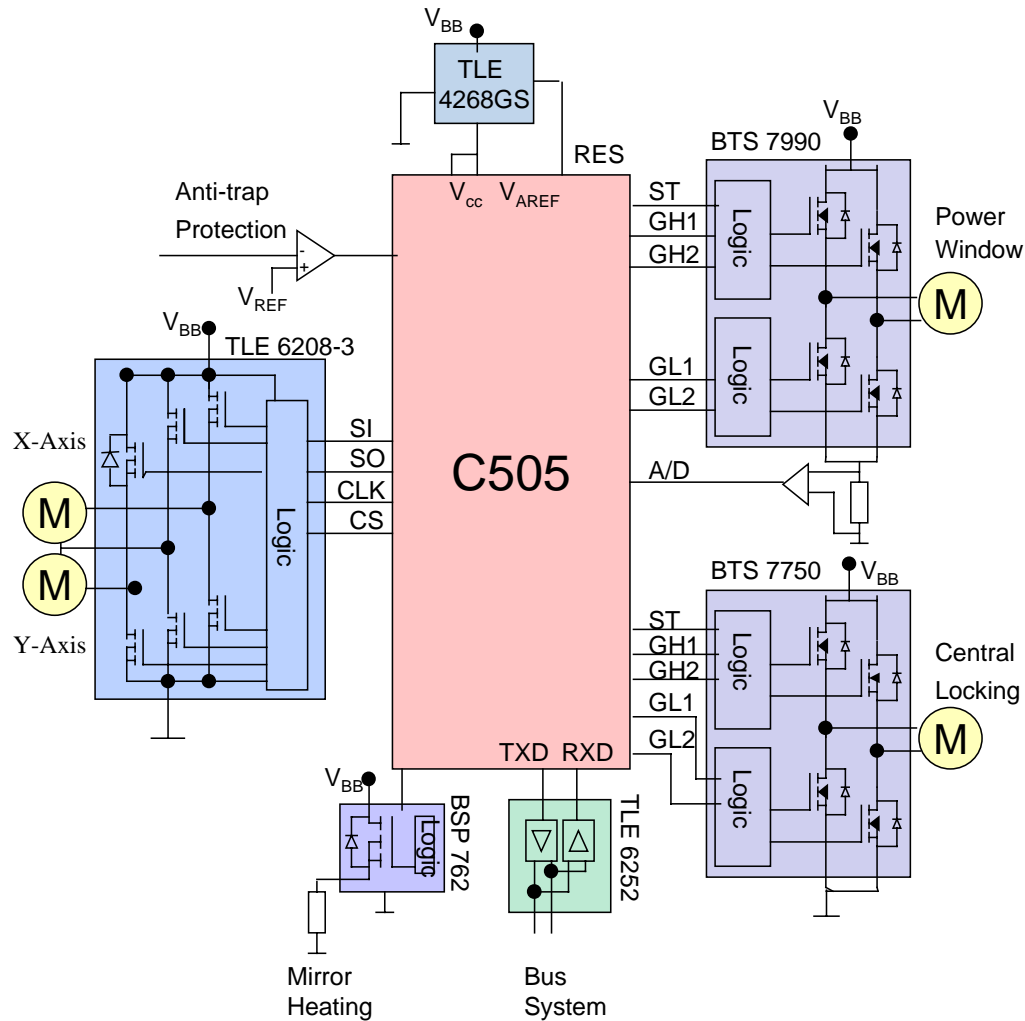
Infineon Products for Today's 14V Door Modules



- Integrated H-bridges for power window and door lock motors.
- Integrated 3 fold half bridges with SPI control for mirror
- Smart power HS-switch for mirror heating
- Bus-driver for CAN
- Intelligent voltage regulator for supply



Infineon Products for Today's 14V Door Modules



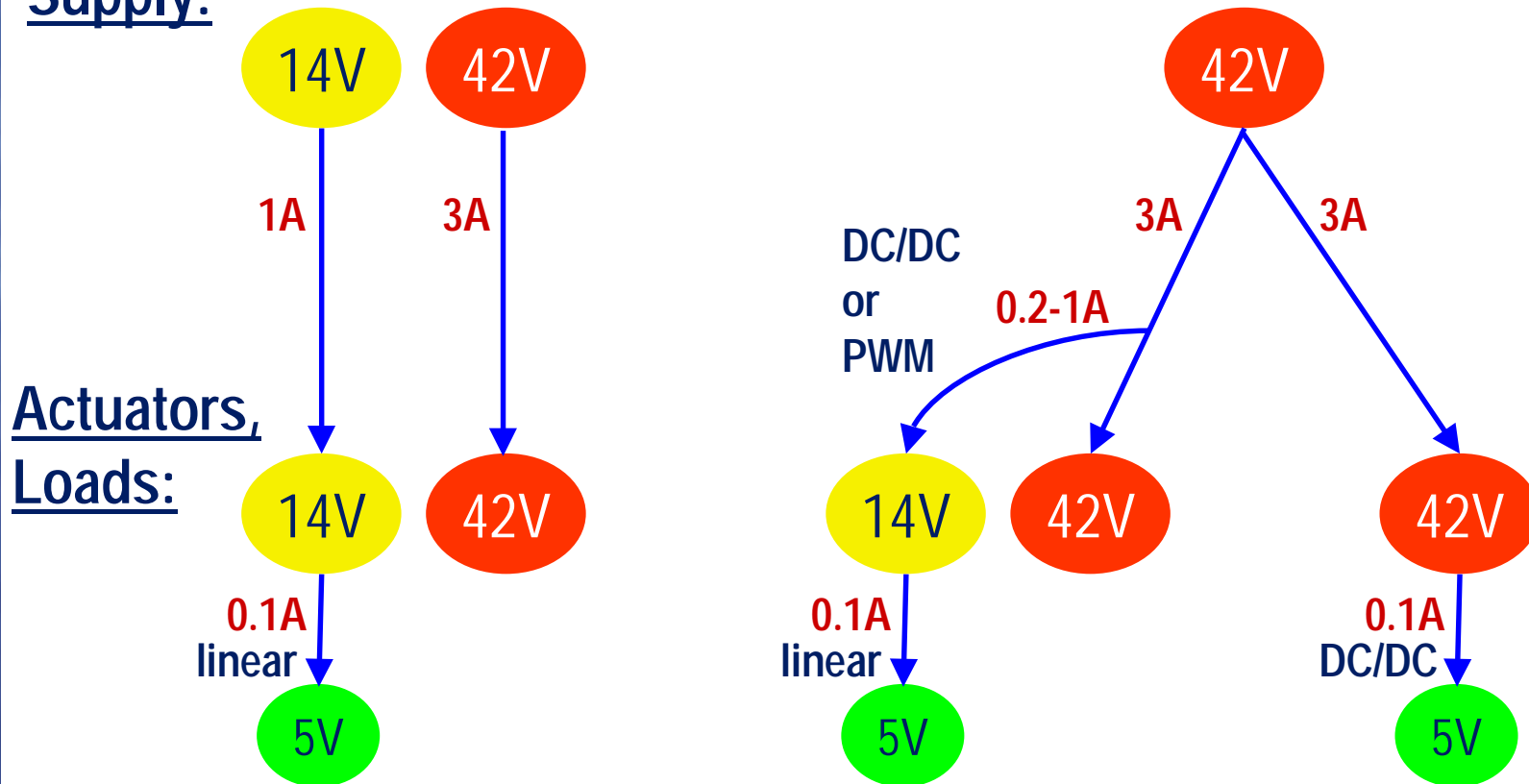
Load Currents for 14V and 42V Door Actuators

	14V	42V	
	I (A) contin. / peak	I (A) contin. / peak	42V- actuator
Mirror heating	1	0.3	yes
Mirror adjust	0.15 / 0.25	0.05 / 0.1	?
Door lock	0.2 / 2	0.1 / 0.7	?
Power window	9 / 35	3 / 11	yes



Alternatives of 42V Door Module System

Supply:



Realization of a mixed 14V/42V-Module with existing Semiconductors and Actuators

	Actuator (V)	Supply (V)
Mirror heating	42	42
Mirror adjust	14	14
Door lock	14 PWM	42
Power window	42	42
Can bus	14	14
Voltage regulator	5	14





Available 42V Semiconductors in different Technologies

Technology	Product-family	Concept	Application	Time Schedule ES / Products
SPT4/90 $V_{Br} > 90V$	Smart Power ICs $V_{AZ} > 80V$		Gasoline Direct Injection $V_{Nom} = 70V / 42V / 24V$ Truck Applications Fast Inductance De-excitation	9/98 TLE customized 9/00 TLE 6387 5V adj., 2A 6/00 TLE 6361 5+3.3+2.5V
S-SMART/80 $V_{Br} > 80V$	Smart Power Switches $V_{AZ} > 65V$		Truck ABS / TRC / VDC $V_{Nom} = 42V / 24V$ High Current Switches	6/98 BSP 365 5 Ω 9/99 BSP 752R 200 m Ω 9/98 BTS 723 2* 95 m Ω 2/00 BTS 6163D 16 m Ω 10/98 BTS 660P 9 m Ω open BTS 560P 4 m Ω
S-FET2/75 $V_{Br} > 75V$	FET / TEMPFET $V_{Br} > 75V$		Starter-Generator $V_{Nom} = 42V / 24V$ High Speed PWM DC / DC Converter	open BTS 282Z-7 8.0 m Ω 11/99 SPP 80N08S2 8.0 m Ω 9/99 SIPC 49S2N08 4.0 m Ω

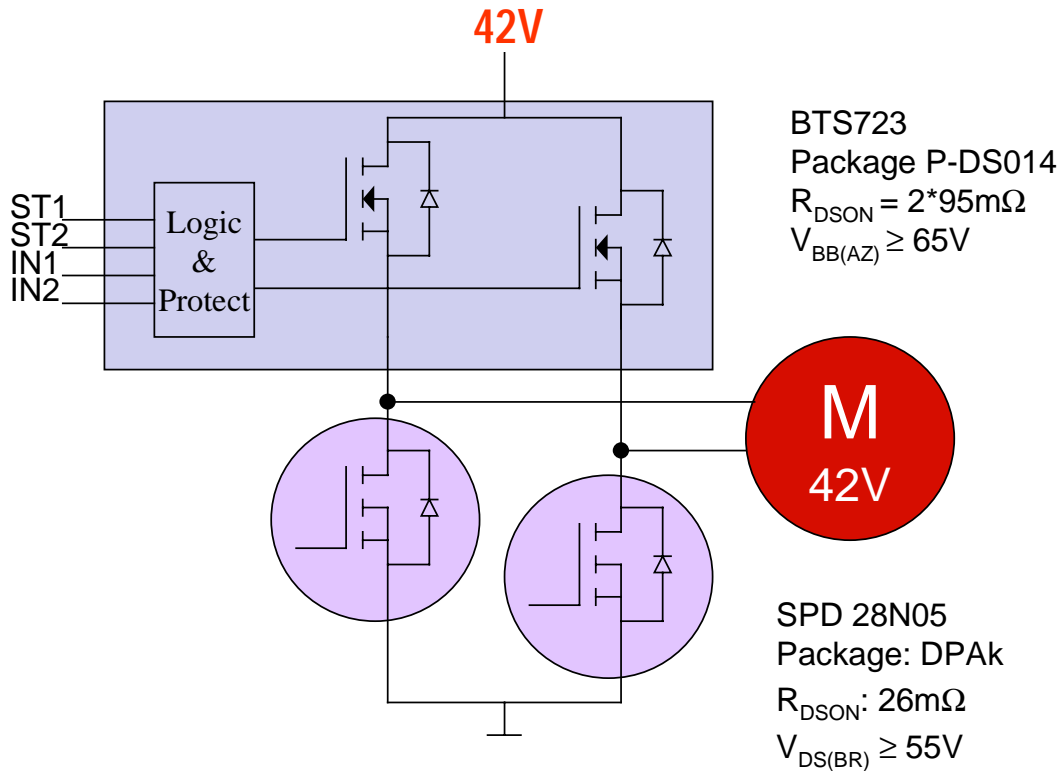


Semiconductors for AUTOMOTIVE SOLUTIONS

A. Graf, AI AP I



Realization of a H-bridge for 42V Power Window with existing Semiconductors



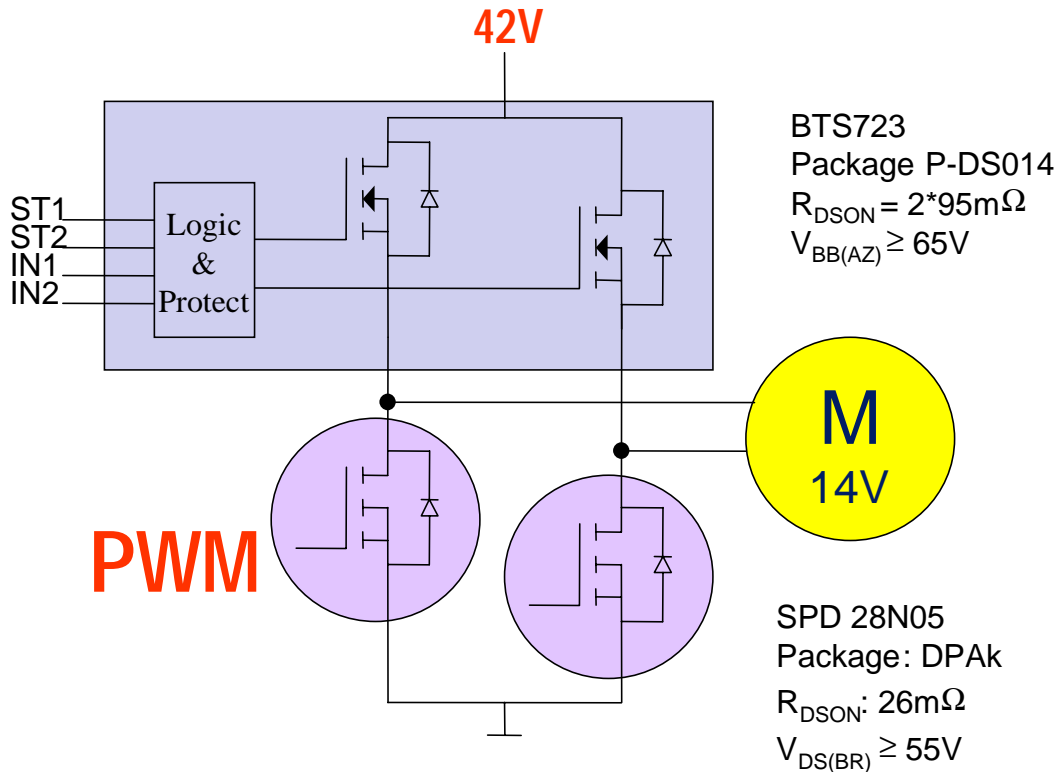
DC Current 3A / 11A

Discrete realization with double highside switch and two standard MOSFETs

Protection against over-temperature, short circuit to GND and short of load



Realization of a H-bridge for 42V PWM Door Lock with existing Semiconductors



PWM Current 0.15A / 2A, >3kHz

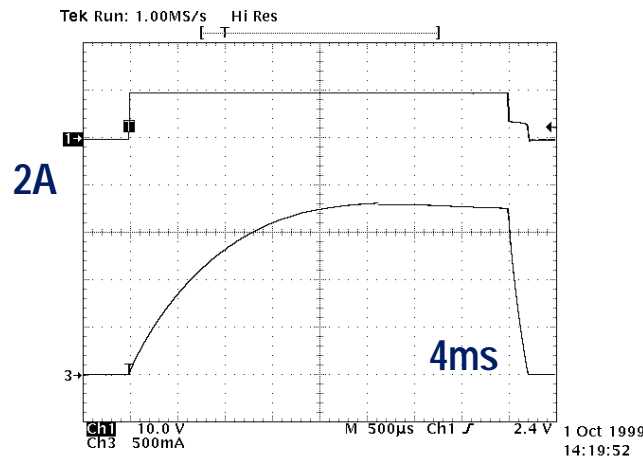
Discrete realization with double highside switch and two standard MOSFETs and PWM Protection against over-temperature, short circuit to GND and short of load



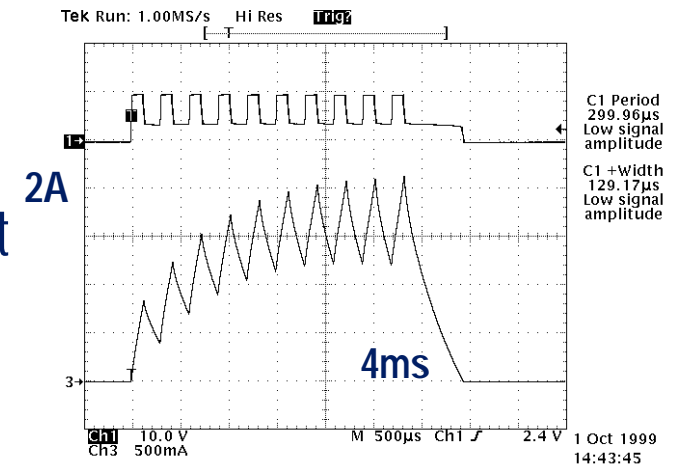
Comparison between the Door Lock Currents at 14V DC and 42V PWM Supply Voltage

14V door lock motor at 14V DC

14V door lock motor at 42V PWM

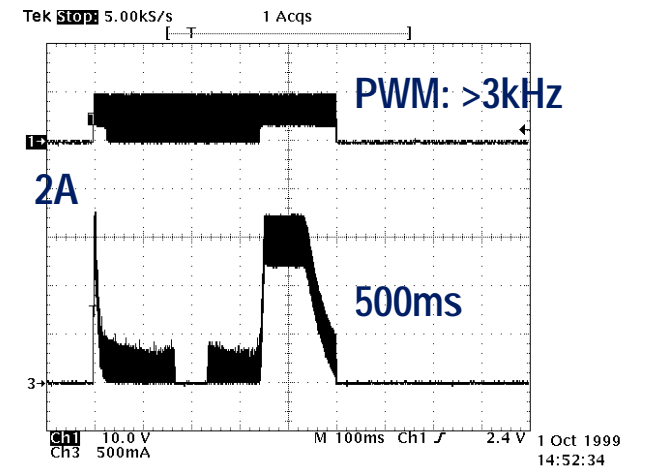
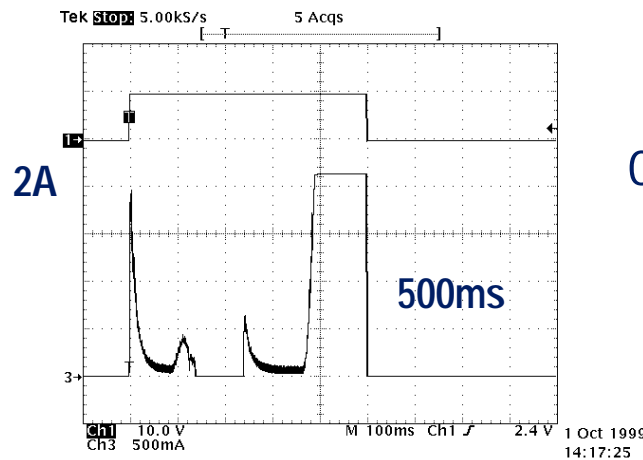


inrush current

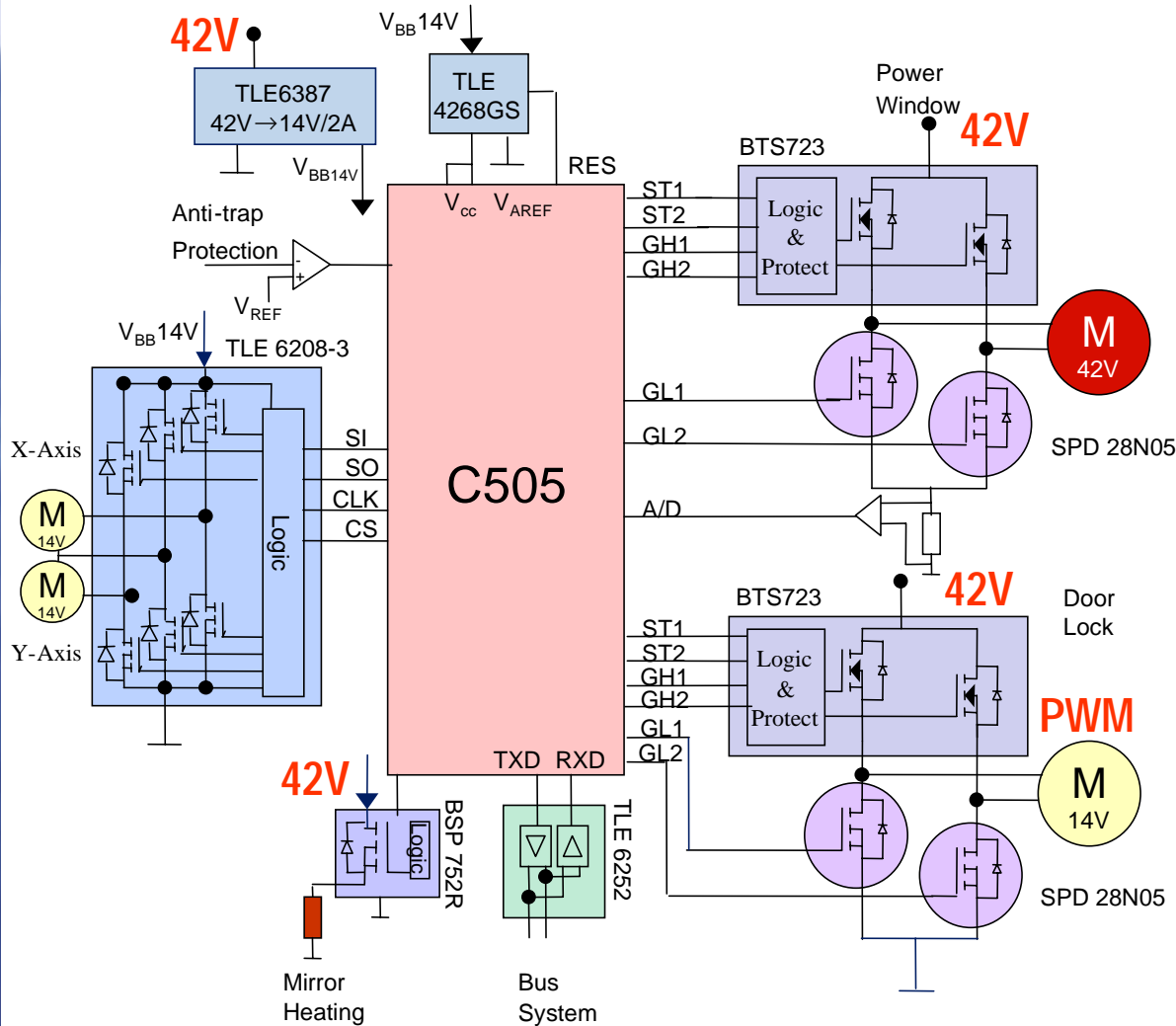


complete locking

cycle



Realization of a mixed 14V/42V-Module with existing Semiconductors and Actuators



Only power window and mirror heating is realized as a 42V actuator

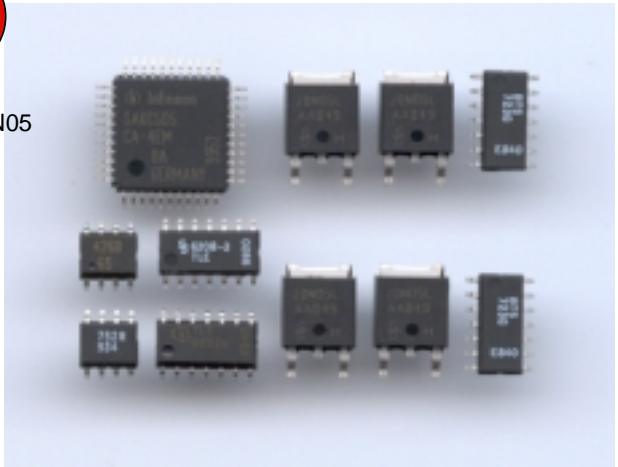
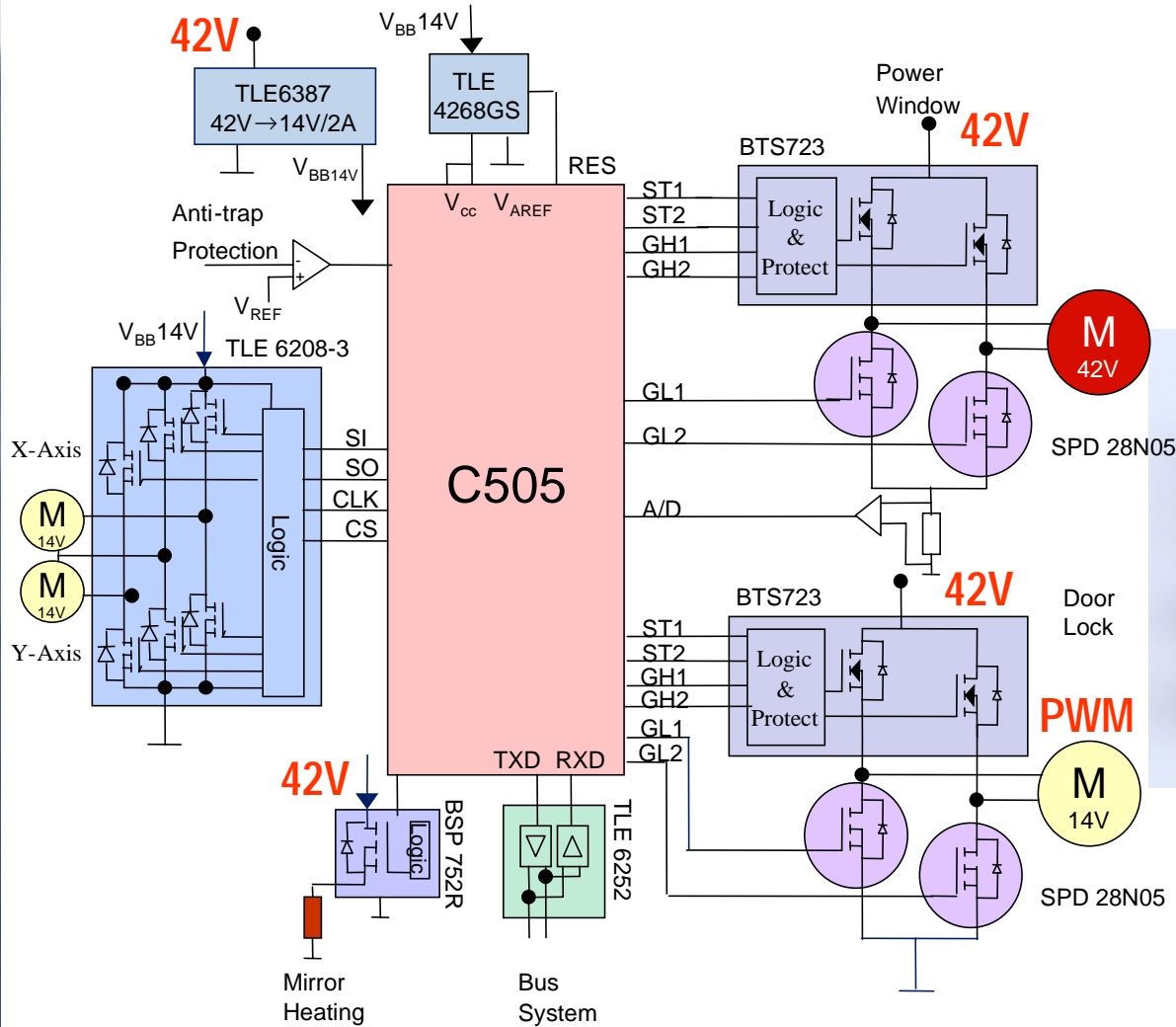
The 14V door lock motor is driven with PWM on 42V supply

All other loads are still driven with 14V

No cooling!

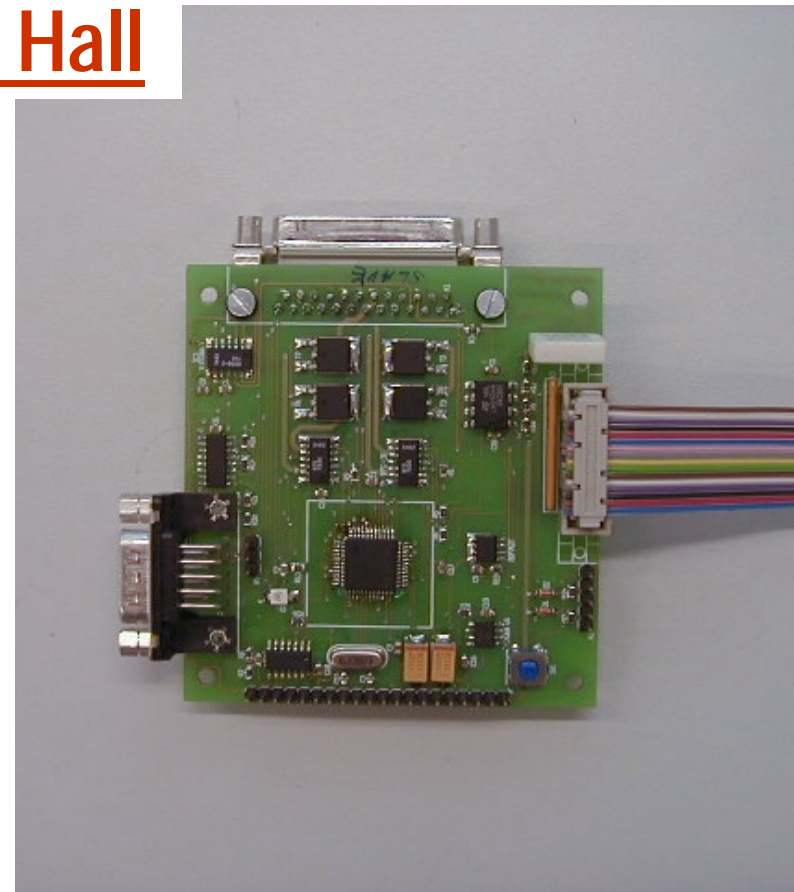


Realization of a mixed 14V/42V-Module with existing Semiconductors and Actuators



Realization of a mixed 14V/42V-Module with existing Semiconductors and Actuators

See demonstration setup at [booth #7400, Michigan Hall](#)



Realization of a mixed 14V/42V-Module with existing Semiconductors and Actuators

	Actuator (V)	Supply (V)
Mirror heating	42	42
Mirror adjust	14	14
Door lock	14 PWM	42
Power window	42	42
Can bus	14	14
Voltage regulator	5	14



Realization of a 42V-Module with mixed 14V/42V Actuators

	Actuator (V)	Supply (V)
Mirror heating	42	42
Mirror adjust	14 PWM	42
Door lock	14 PWM	42
Power window	42	42
Can bus	14 ZD	42
Voltage regulator	5 DC/DC	42

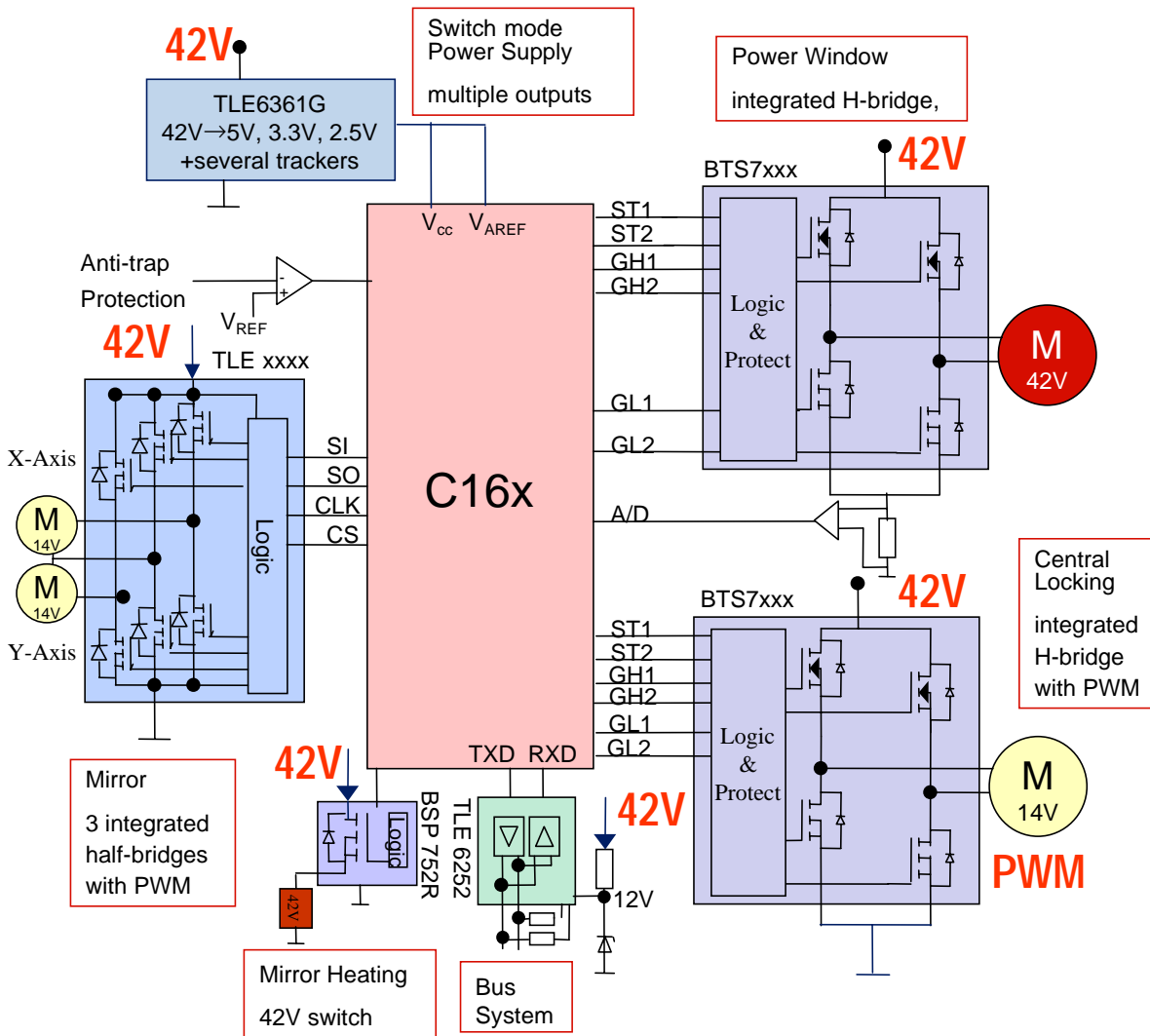


Realization of a 42V-Module with 42V Actuators

	Actuator (V)	Supply (V)
Mirror heating	42	42
Mirror adjust	42	42
Door lock	42	42
Power window	42	42
Can bus	14 DC/DC	42
Voltage regulator	5 DC/DC	42



42V Door Module with mixed 14V/42V Actuators and new designed 42V Semiconductors



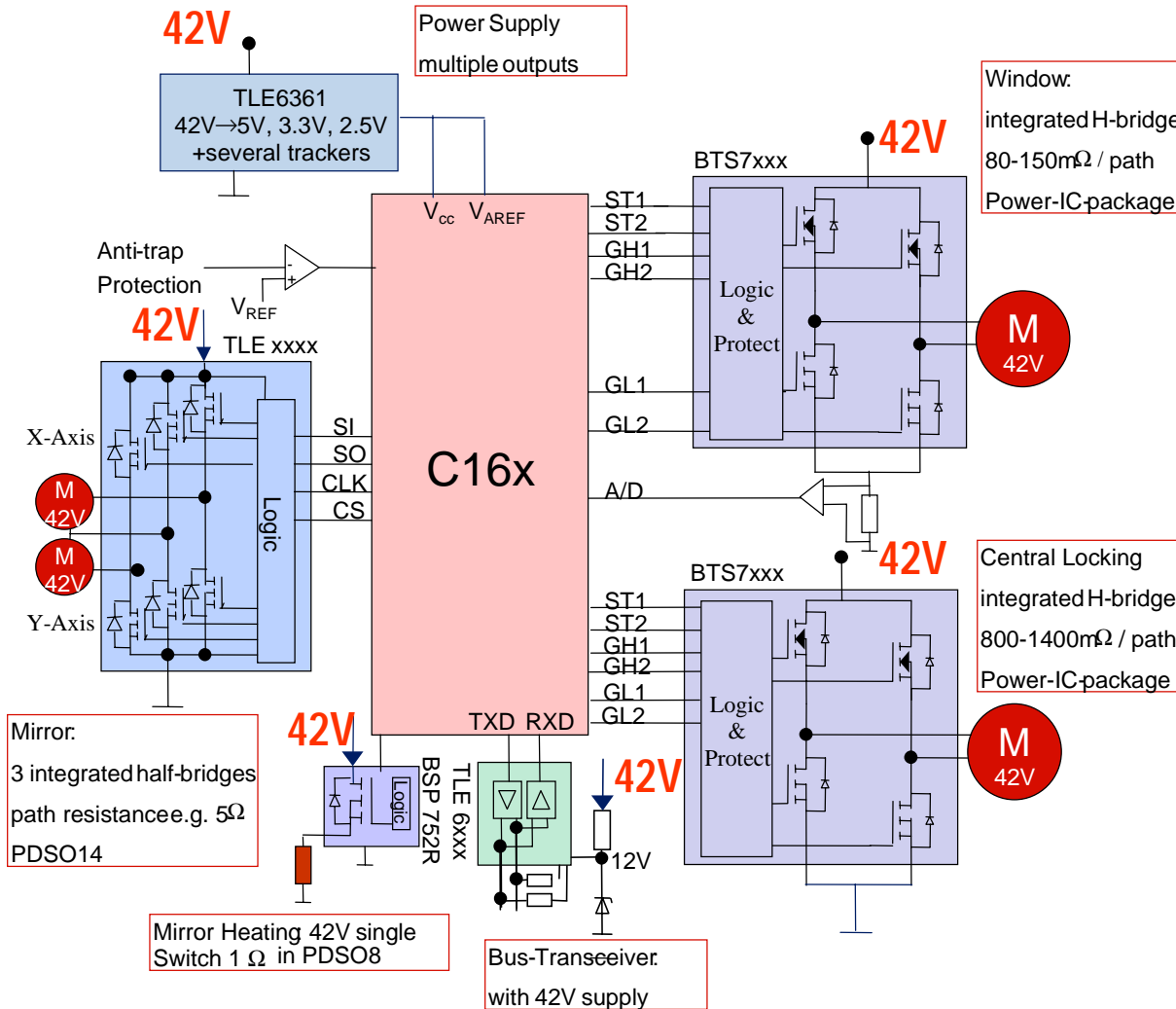
Only the power window and mirror heating is realized as 42V load

All other loads are 14V loads, but driven with PWM at 42V supply

Logic supply with a step down converter



42V Door Module exclusively with 42V Actuators and new designed 42V Semiconductors



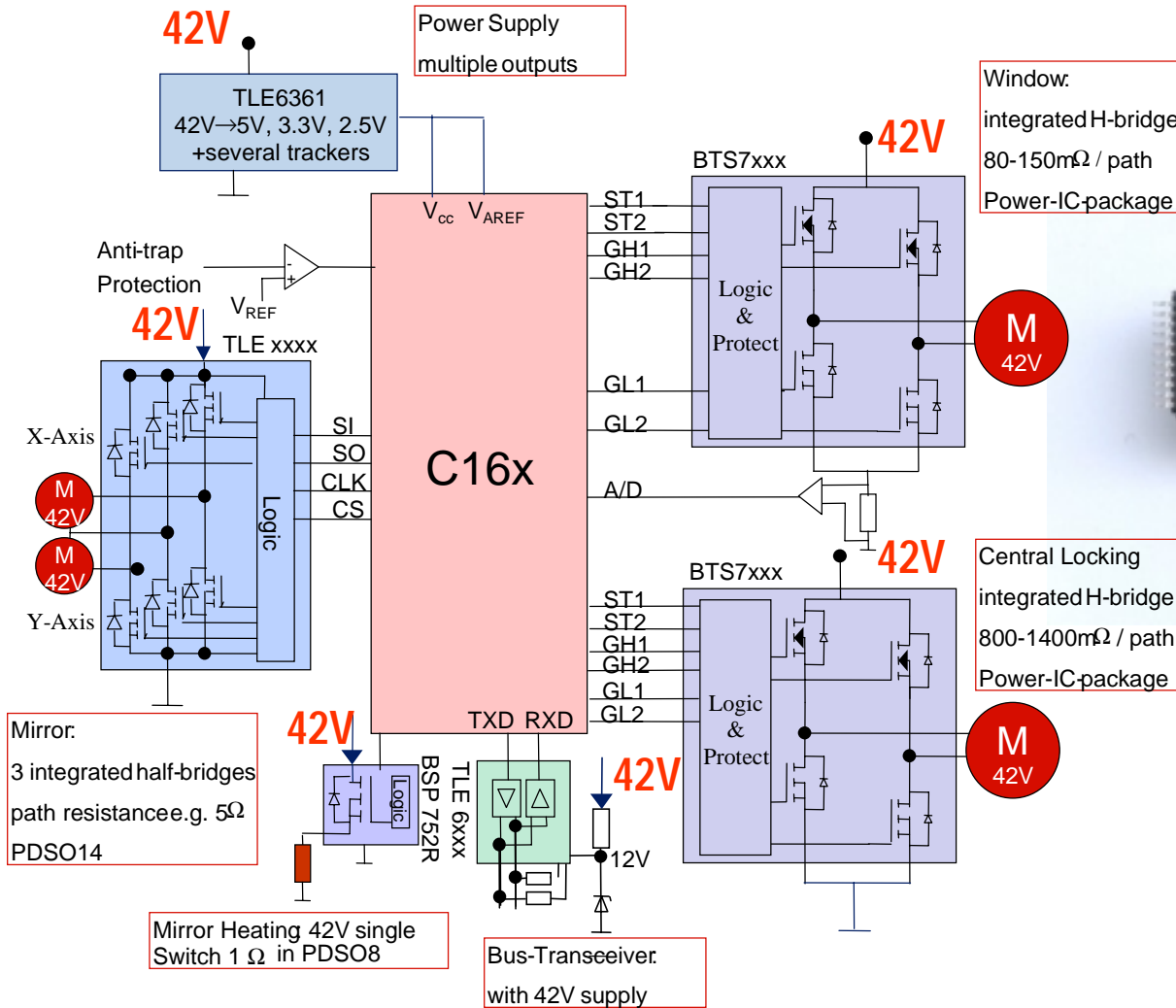
All loads are designed for 42V

All semiconductors are optimized for this operation

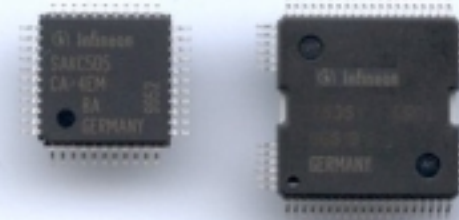
Chip integration shows cost savings



Door Module exclusively with 42V Actuators and optimized 42V Semiconductors (Vision)



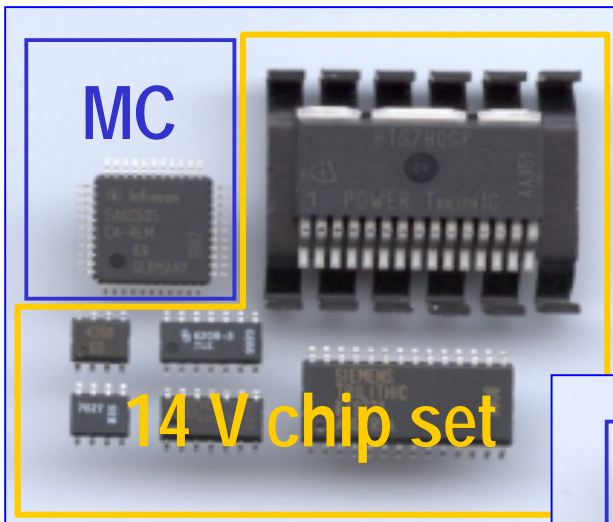
Vision



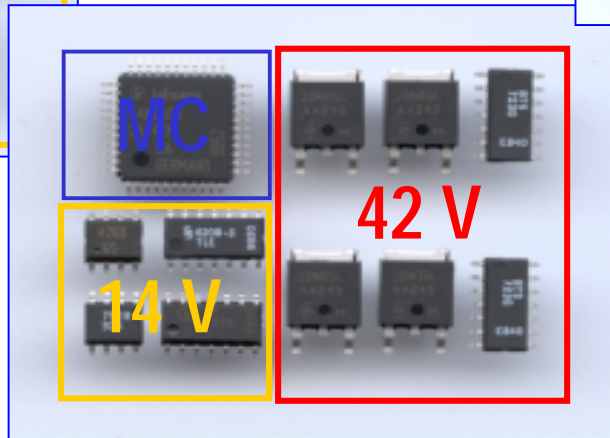
A Door Module's Road From 14V To 42V

viewed by semiconductor content and -partitioning

now integration of all functions saves costs



- standard devices
- cooling necessary



- standard devices
- no cooling
- not optimized, available today



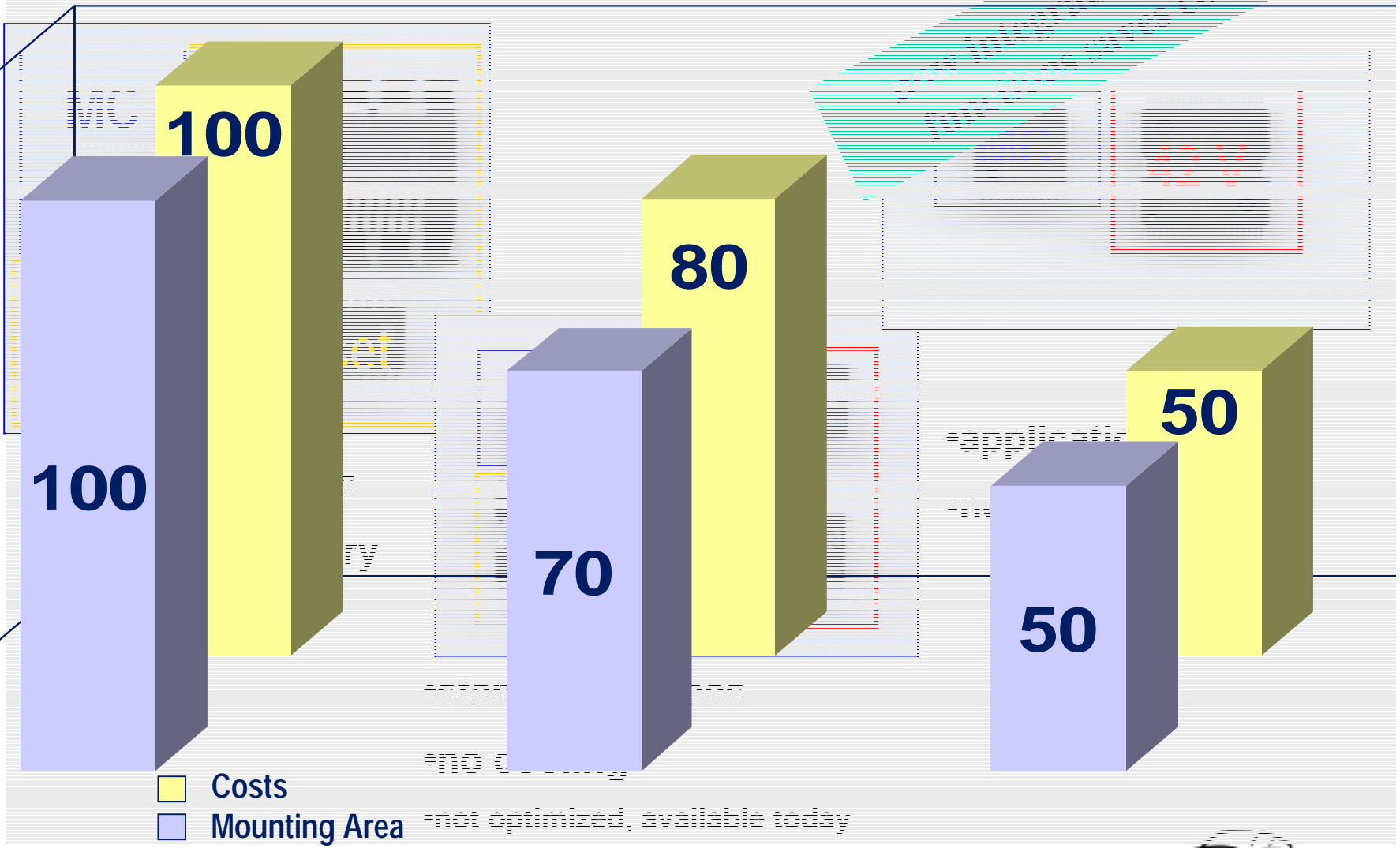
- application specific
- no cooling



A Door Module's Road From 14V To 42V

viewed by semiconductor content and -partitioning

Non-optimization of all functions and components



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Conclusion

- ✱ With 42V there is a dramatic cost reduction of power electronics for power window
- ✱ A mixed 14V/42V door module can be realized with existing mass semiconductors and actuators
- ✱ If at least the actuators for power window, door lock and mirror heating are designed for 42V, a monolithic door module electronic is feasible

