TPC Bus Bar Measurement

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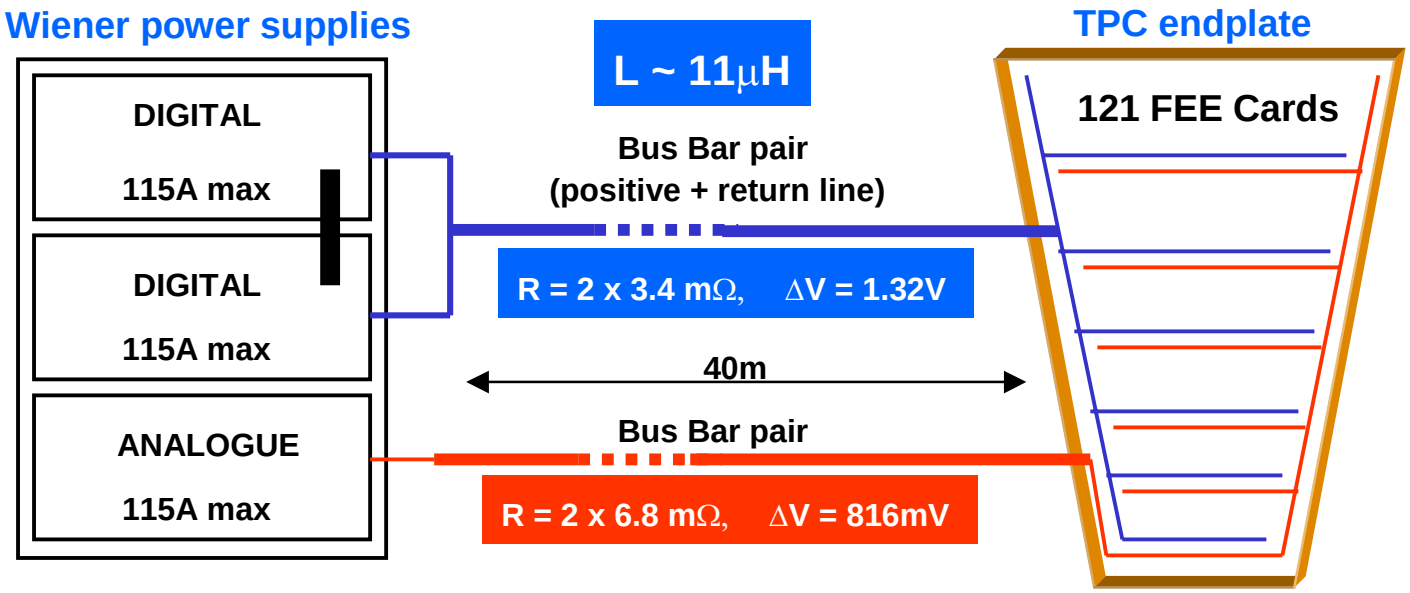
OUTLINE

- TPC low voltage distribution scheme
- Digital current variation
- Test Setup
- Measurements preliminary results
- Conclusion

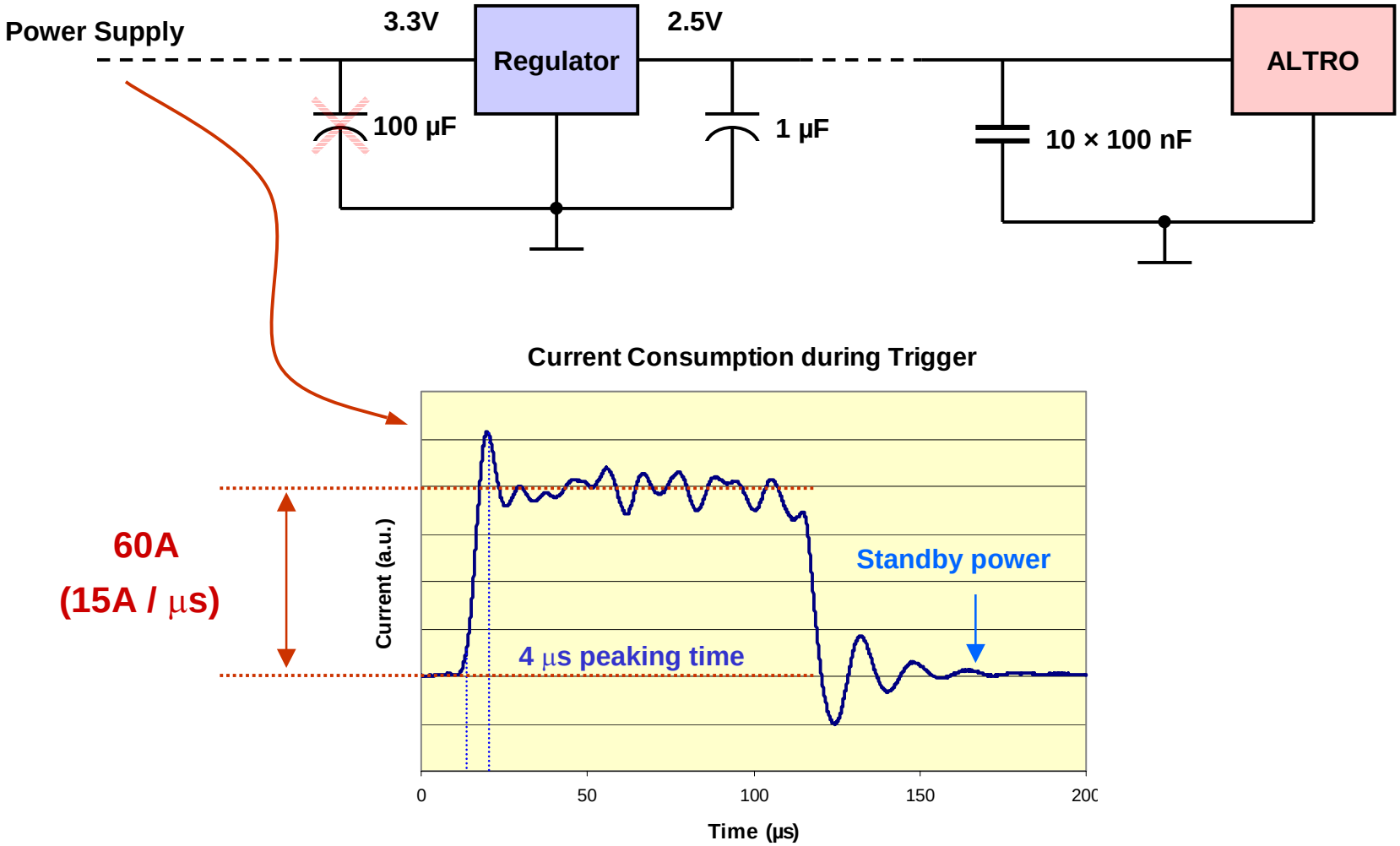
TPC Low Voltage Distribution Scheme



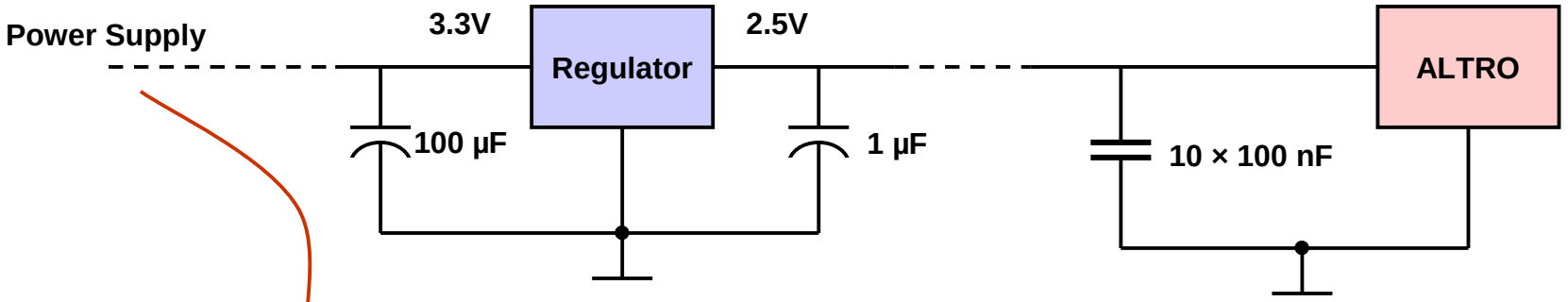
Bus Bar description	Voltage on load (V)	I stdby (A)	I max (A)	Bus bar Section (mm2)
Analogue	4.0	60	60	100
Digital	3.3	133	194	200

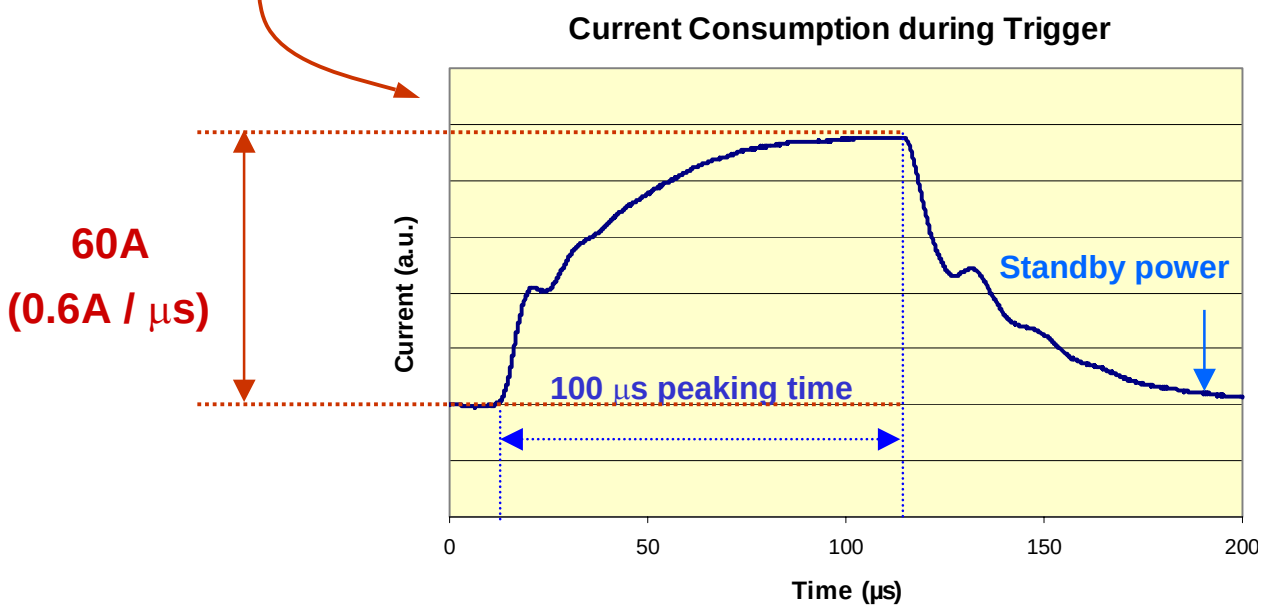
What is the transient response of the bus bar?

Dynamic Digital Current Consumption

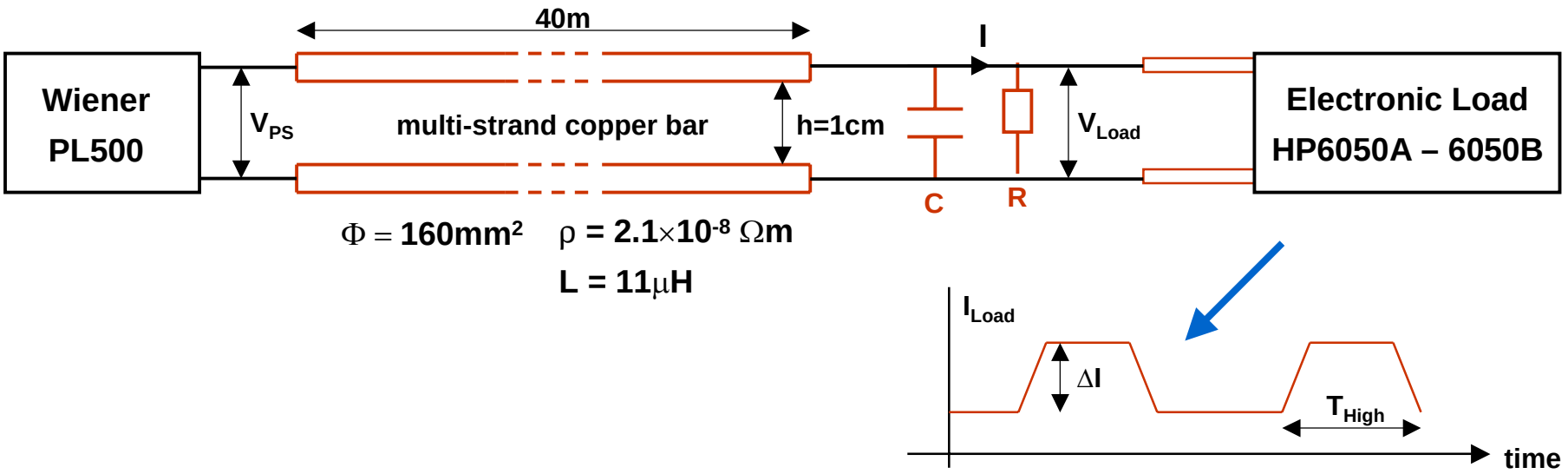


Dynamic Digital Current Consumption





Test setup

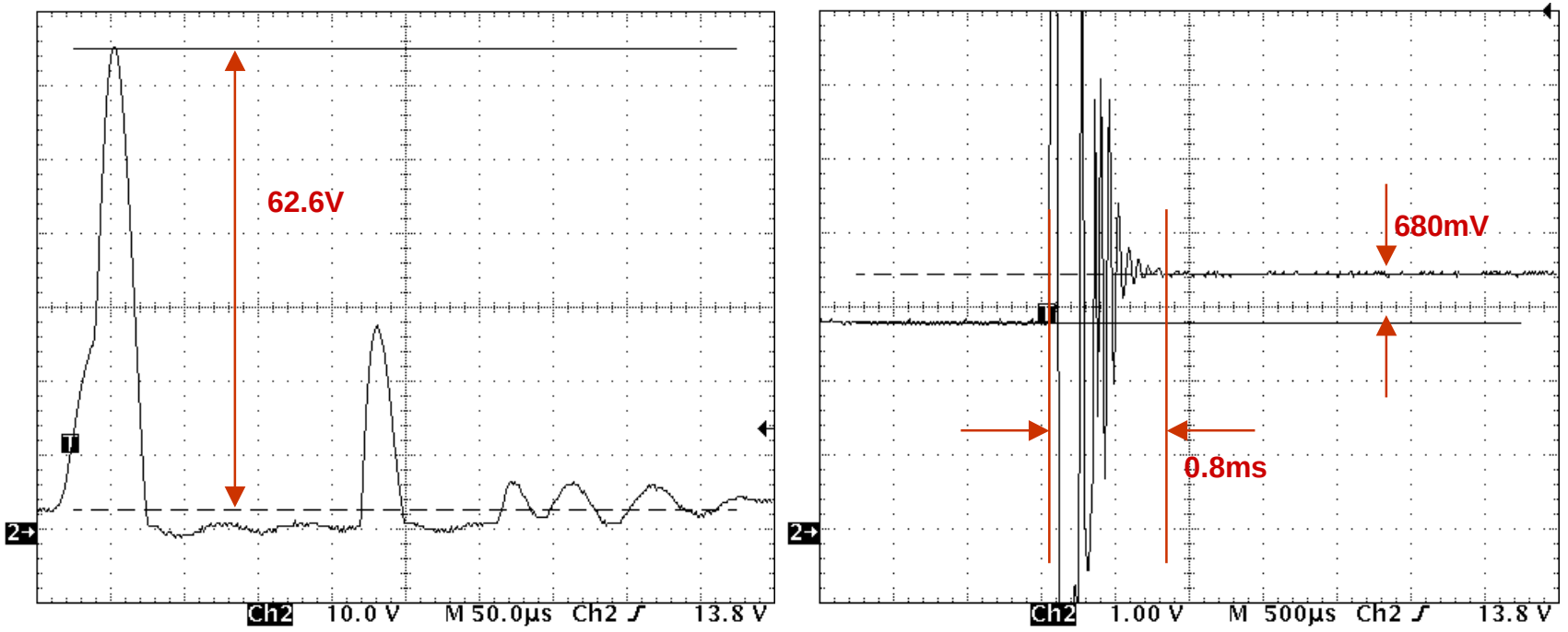


Test Configurations

Configuration A:	**R = ∞**	**C=0**
Configuration B:	**R=25mΩ**	**C=0;**
Configuration C:	**R=25mΩ**	**C=70mF**
Configuration D:	**R = ∞**	**C=70mF**

Measurement 1 (configuration A)

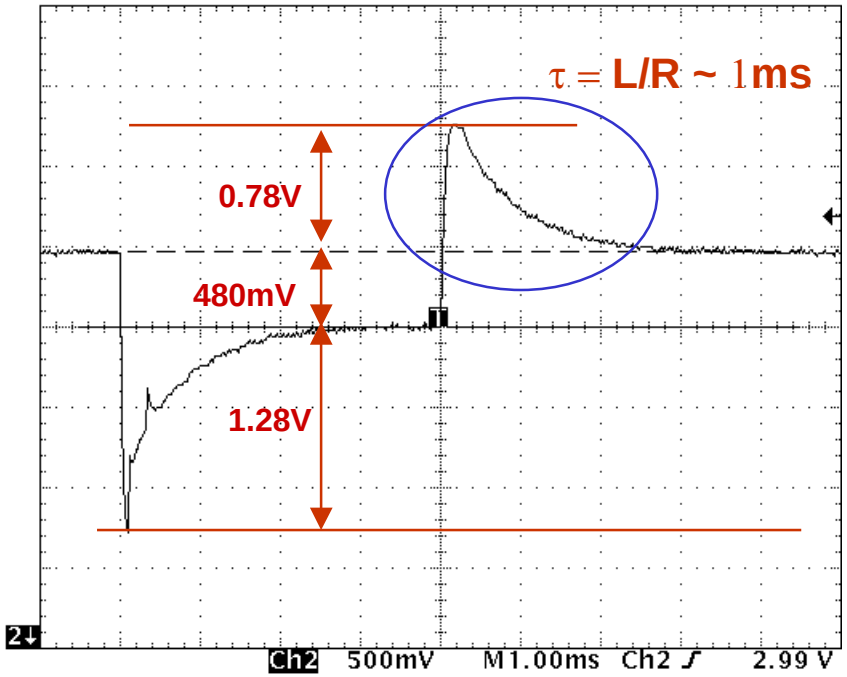
Test Parameters			
ΔI (A)	Freq (Hz)	ΔT_{HIGH} (ms)	Slew rate (A/μs)
60	100	4	10



A sudden interruption of the current can damage the Front End Cards !

Measurement 2 (configuration B)

Test Parameters			
ΔI (A)	Freq (Hz)	ΔT_{HIGH} (ms)	Slew rate (A/μs)
41.6	100	4	10



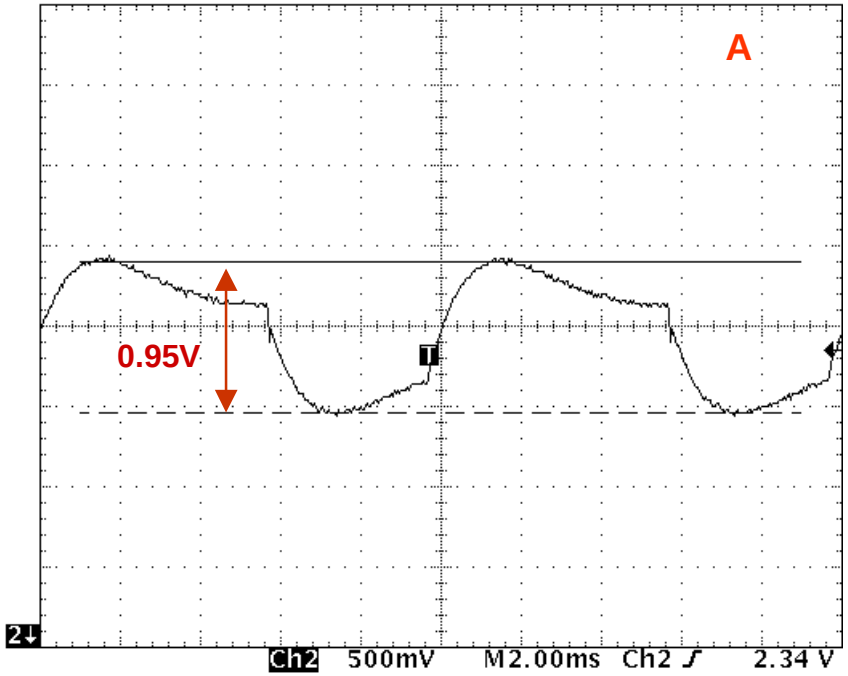
A current swing of 41.6A produces a transient voltage of ~1.8V

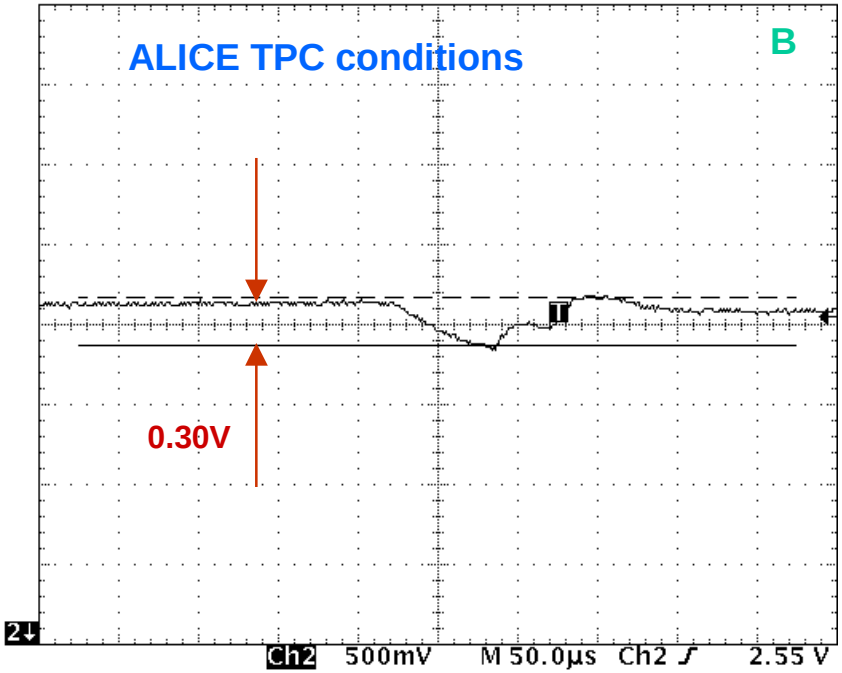
Voltage drop across the bar for a current swing of 60A

- ΔV low load (dc) 0.90 V
- ΔV high load (dc) 1.32 V
- ΔV (transient) 3.40 V

Measurements 3 (configuration C)

Test Parameters			
ΔI (A)	Freq (Hz)	ΔT_{HIGH} (ms)	Slew rate (A/μs)
41.6	100 A	4 A	10
"	1000 B	0.1 B	"

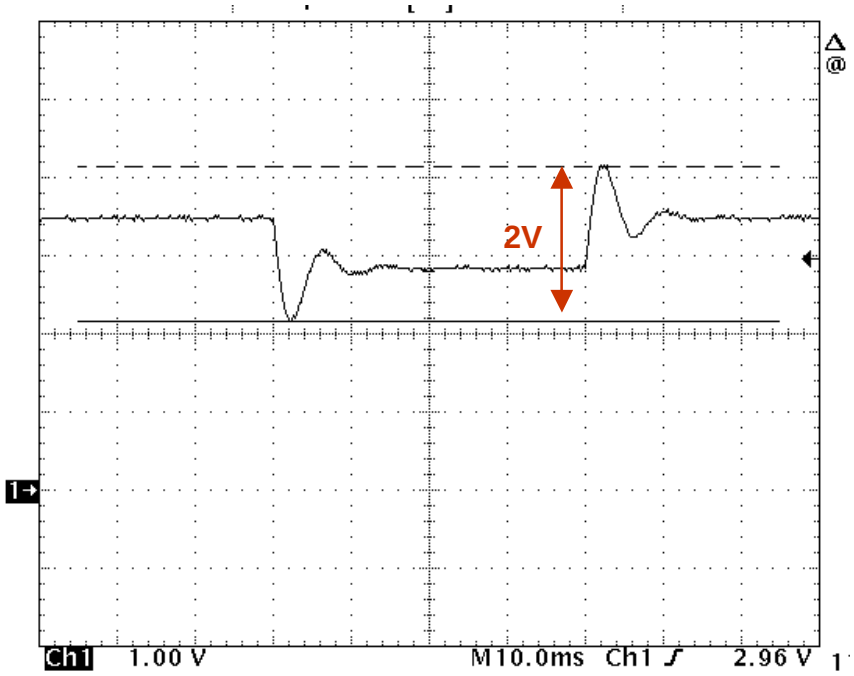




70mF in parallel to the electronic load assorbes the large transient spikes

Measurements 4 (configuration D)

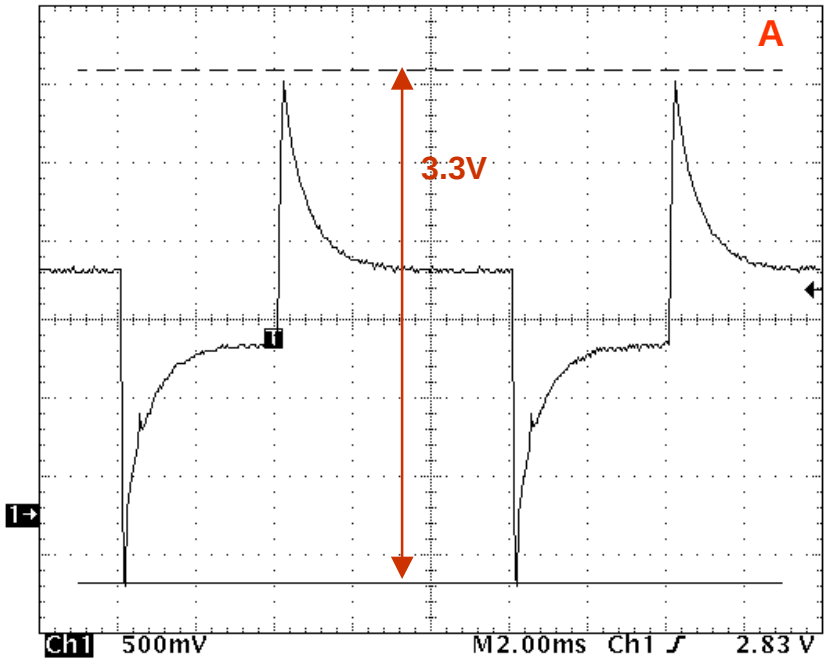
Test Parameters			
ΔI (A)	Freq (Hz)	ΔT_{HIGH} (ms)	Slew rate (A/μs)
60	10	40	10

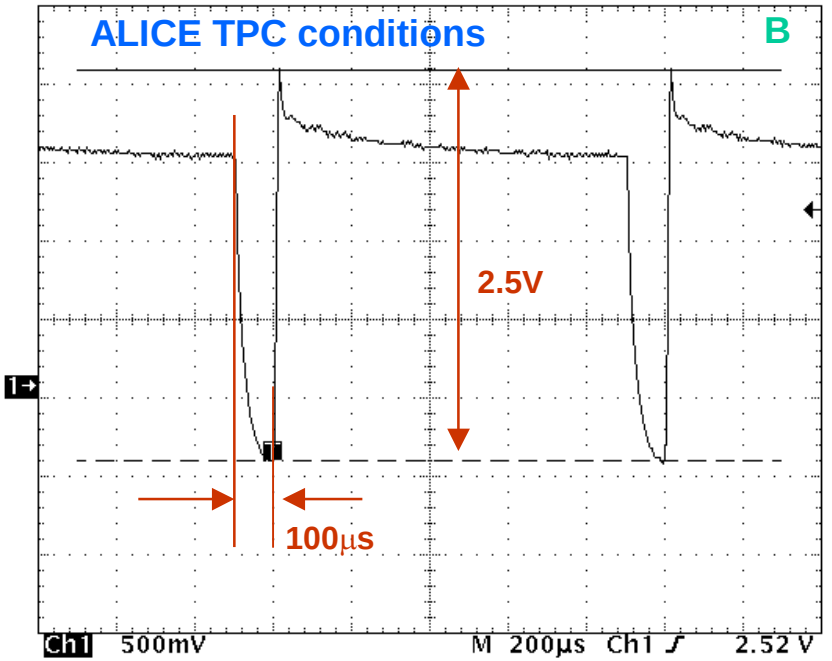


Measurements 5 (configuration A + sense wire)

The sensing feedback is not fast enough to react to the load variations

Test Parameters			
ΔI (A)	Freq (Hz)	ΔT_{HIGH} (ms)	Slew rate (A/μs)
60	100 A	4 A	10
"	1000 B	0.1 B	"

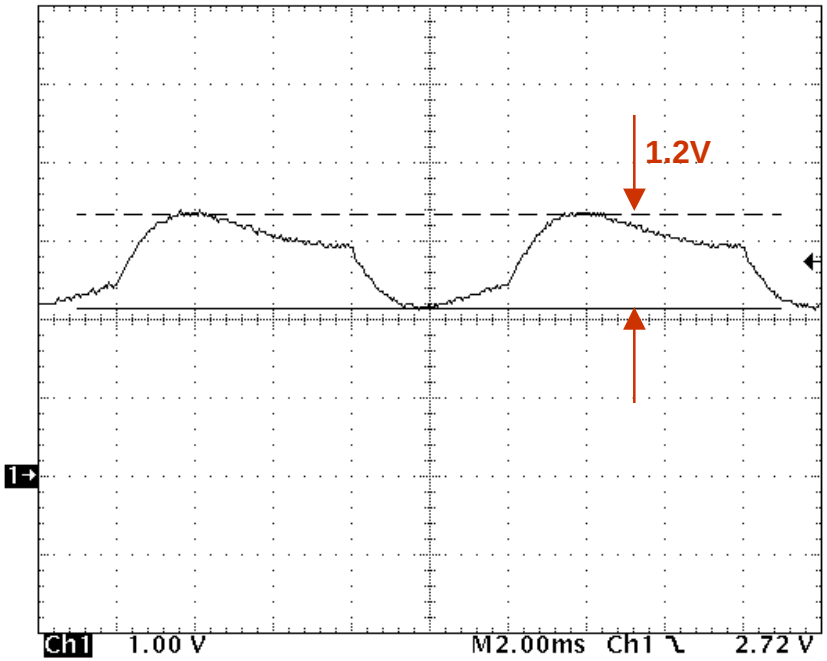




Measurements 6 (configuration C + sense wire)

The sensing feedback is not fast enough to react to the load variations

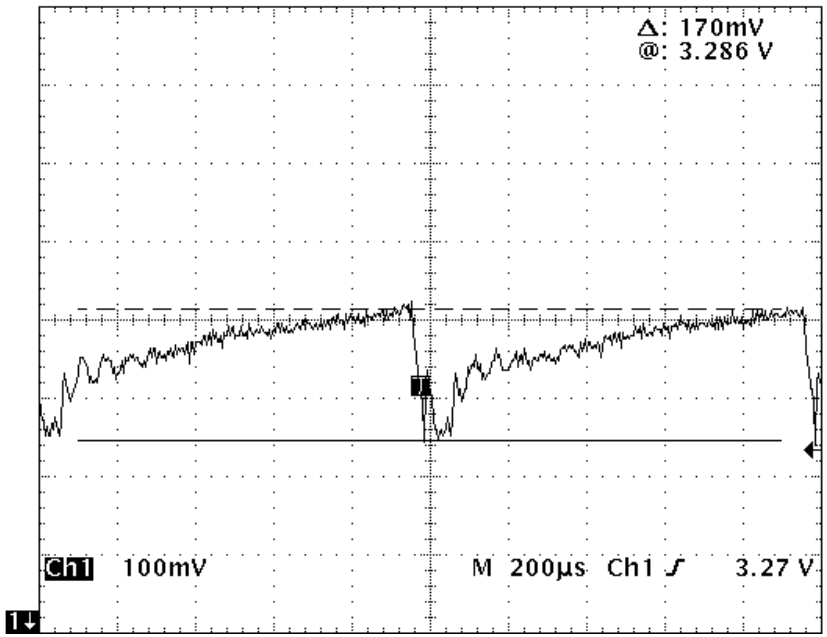
Test Parameters			
ΔI (A)	Freq (Hz)	ΔT_{HIGH} (ms)	Slew rate (A/μs)
41.6	100	4	10

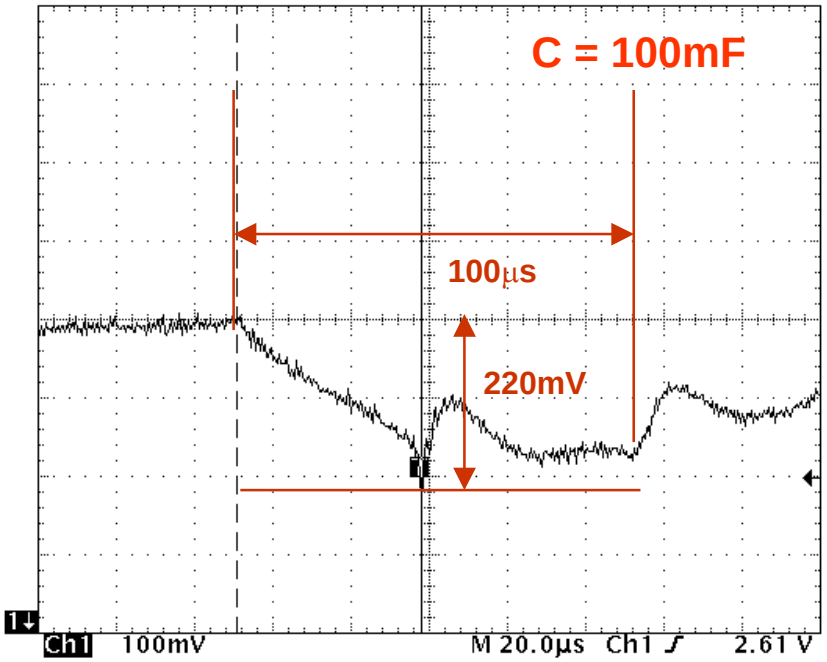


Measurements 7 (configuration C + sense wire)

The sensing feedback is not fast enough to react to the load variations

Test Parameters			
ΔI (A)	Freq (Hz)	ΔT_{HIGH} (ms)	Slew rate (A/μs)
41.6	1000	0.1	10





Summary and Conclusions

Configuration	Voltage (digital) on load	Voltage drop across bus bar	Required Voltage at the source
No CAP	3.3V	~3.4V	~6.7V
70mF CAP		~1.2V	~4.5V

- The distribution of the Analogue Voltage (static load) does not pose any problem
- The distribution of the Digital Voltage (dynamic load) requires the insertion of protection capacitors
- The protection capacitors have to be very close to the front-end cards
- The long term reliability of large-value capacitors (10mF) has to be verified!

TPC SECTOR TEST

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