

2020

ASTROL Product Introduction

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Sun.King Power Electronics Group Limited
賽晶電力電子集團有限公司

Astrol Electronic AG



Goals of this webinar

- To get an overview over the new Astrol products and platforms
- To have an idea of the possible application of each product group
- To know the strong points of the products



Astrol Electronic AG

Sun.King Power Electronics Group Limited
赛晶电力电子集团有限公司



Astrol established
in Baden,
Switzerland

Astrol

Start Cooperation
with ABB

ABB Astrol

Sun.King IPO in
Hong Kong



Astrol becomes part
of Sun.King Group

Astrol

1996

2001

2006

2010

2011

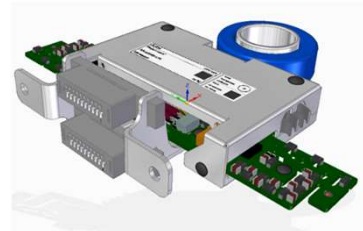
2016

2020

Customized Electronic Solutions



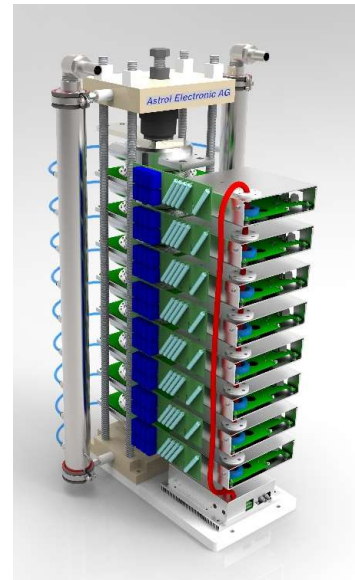
Gate Drive Units and Power Supplies



Trigger Controllers and Optical Interfaces



Power Switches



AC- and DC- Breakers



Corporate Snapshot

Introduction

Stock Code	: 0580.HK
Listing Date	: October 2010
Issued Shares	: 1.6 Billion

Group Companies

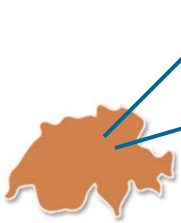
In Germany



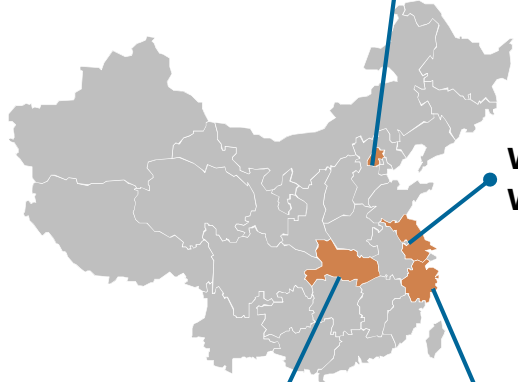
In Switzerland:

Astrol Electronic AG

swiss sem



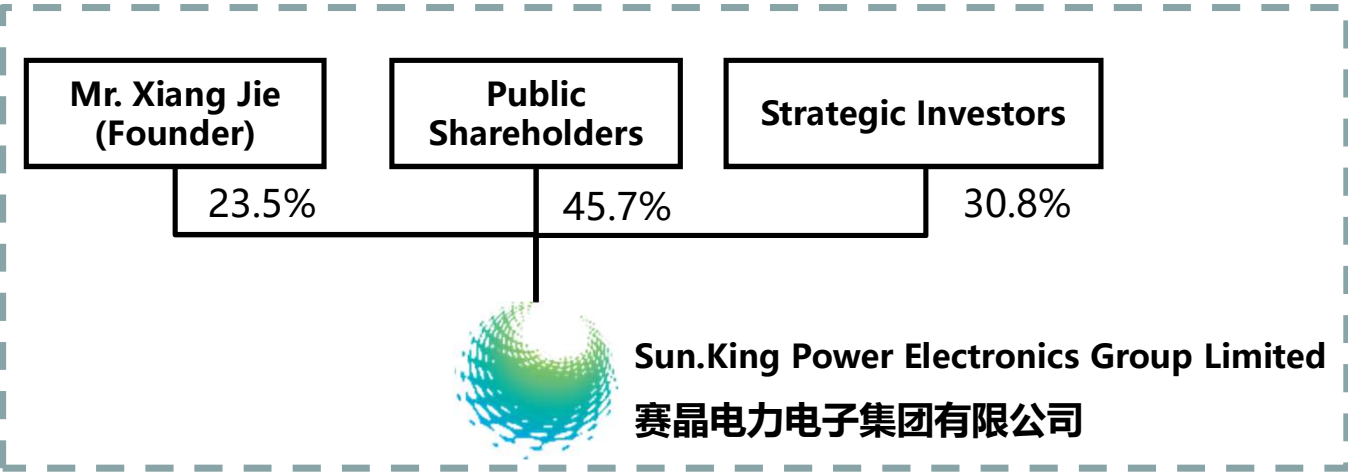
Beijing Sun.King



Wuxi Sun.King
Wuxi Astrol

Jiashan Sun.King
Zhejiang Sine
Jiashan Keneng

Wuhan Landpower





Products

Solid-State Circuit Breakers



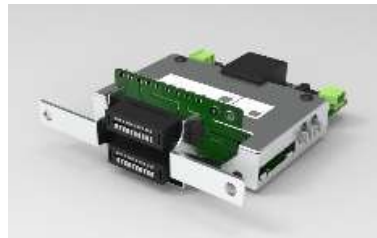
Marine DC-Grids
Smart-Grid DC and AC
Industrial / Research

Solid-State Power Switches



Pulsed Power
Railway Neutral Section
Electromagnetic Acceleration (e.g. Maglev Trains)
Fusion Power / Nuclear Research
Crowbar Switches
etc...

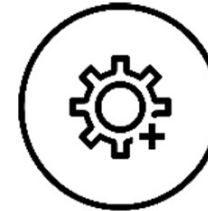
Gate Drive Units and Isolated Power Supplies



IGBT (all types of modules)
Thyristors
High di/dt thyristors

Digital gate drive units for series and parallel connection
Customized behaviour, feedback etc

Customized Electronics



Electronics design and manufacturing

- HW and SW design
- Prototype
- Industrialization
- Series production

Further Products



Battery Cyclers
Semiconductor Testing Equipment
FADEC 3 (Thyristor tester)
Various controllers and optical interfaces



Solid-State Breaker - Technology

What is the difference between Astrol Solid-State Power Switches and Astrol Solid-State Breakers?

Solid-State Power Switch

- Typically based on thyristors
- Current interruption needs zero-crossing of the current.
 - AC-Switches
 - Pulsed-power applications with capacitor discharge
- Not suitable for DC applications

Main function:

Controlled switch-on and in some applications switch-off

Capacitor discharge, energy dump etc

Solid-State Breaker

- IGBT based
- Immediate current interruption at anytime – no zero-crossing required
- Ultra-fast reaction time (within microseconds)
- Suitable for DC applications

Main function:

Protection Switch-off

Alternative to fuses and mechanical breakers



Solid-State Breaker - Technology

What is the difference between a mechanical breaker and the Astrol Solid-State Breaker?

Mechanical Breaker

- Moving parts to create an air-gap
- **Standard** Current interruption within **milliseconds (ms)**
- High maintenance cost
- Arcing
- Efficiency close to 100% (only conduction losses of copper)

Astrol Solid-State Breaker

- No moving parts, no air-gap
- **Ultra-fast** current interruption within **microseconds (μs)**
- Low maintenance cost
- No arcing
- Efficiency >99% (conduction losses of IGBT)



Solid-State Breakers - Application Areas

Under the following conditions, Astrol Solid-State Breakers are typically the most favorable solution :

Fast Switching

Some application require immediate switch-off within microseconds. Mechanical breakers are too slow.

Frequent Switching

No wear of electrodes, no moving parts. In contrast to a mechanical switch, the solid-state breaker can be considered maintenance-free.

Save Switching

In hazardous environments such as chemical plants, the breaker is not allowed to cause arcing. The solid-state breaker operates arc-free.

Marine On-Board DC-Grids

The ultra-fast DC breaker protects the onboard DC grids against short circuit currents in any part of the grid, enabling much more efficient topologies.

Microgrids are very low inductive → require ultra-fast detection and turn-off



Power Distribution – Smart Grid


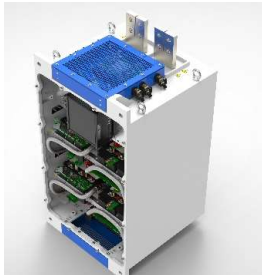
The ultra-fast breaker

- protects grid connected equipment such as batteries, power electronics etc. from short circuits and over currents.
- Disconnects faulty parts from the grid and limits the propagation of fault currents to other parts of the system





Solid-State Breakers - Product Offering

Model	3-Phase AC-Breaker	Marine DC-Breaker	Universal Solid-State Breaker
Voltage rating	11kV nominal 27kV peak	1kV	1kV
Current rating	300A nominal 600A peak	200A air-cooled 500A - 5kA water-cooled	2kA
Phase / Pole design	3-phase AC	Bi-directional DC - one pole	Bi-directional DC - one pole
switching speed	Ultra-fast (<10μs)	Ultra-fast (<10μs)	Ultra-fast (<10μs)
IGBT type	Stakpak IGBTs	Hipak IGBTs	Hipak IGBTs
Cooling	Deionized water cooling	Air cooling / water cooling / optional ambient air cooling	Water cooling
Product Certification	-	DNV, Lloyd's	-
Typical application	Power Distribution, Smart Grid, Industry	On-board DC distribution	Industry, Research
First delivery	2019	2018	2020
Picture			

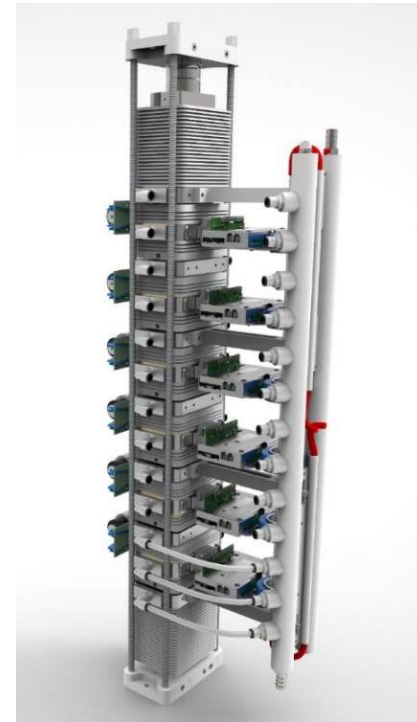


3-Phase AC-Breaker for Smart Grid Application AA-10755-001

Switch off in us



3-Phase 11kV
AC-Breaker



12-level IGBT assembly
with series connected
StakPak modules



Smart Node Application (Soft power processing)

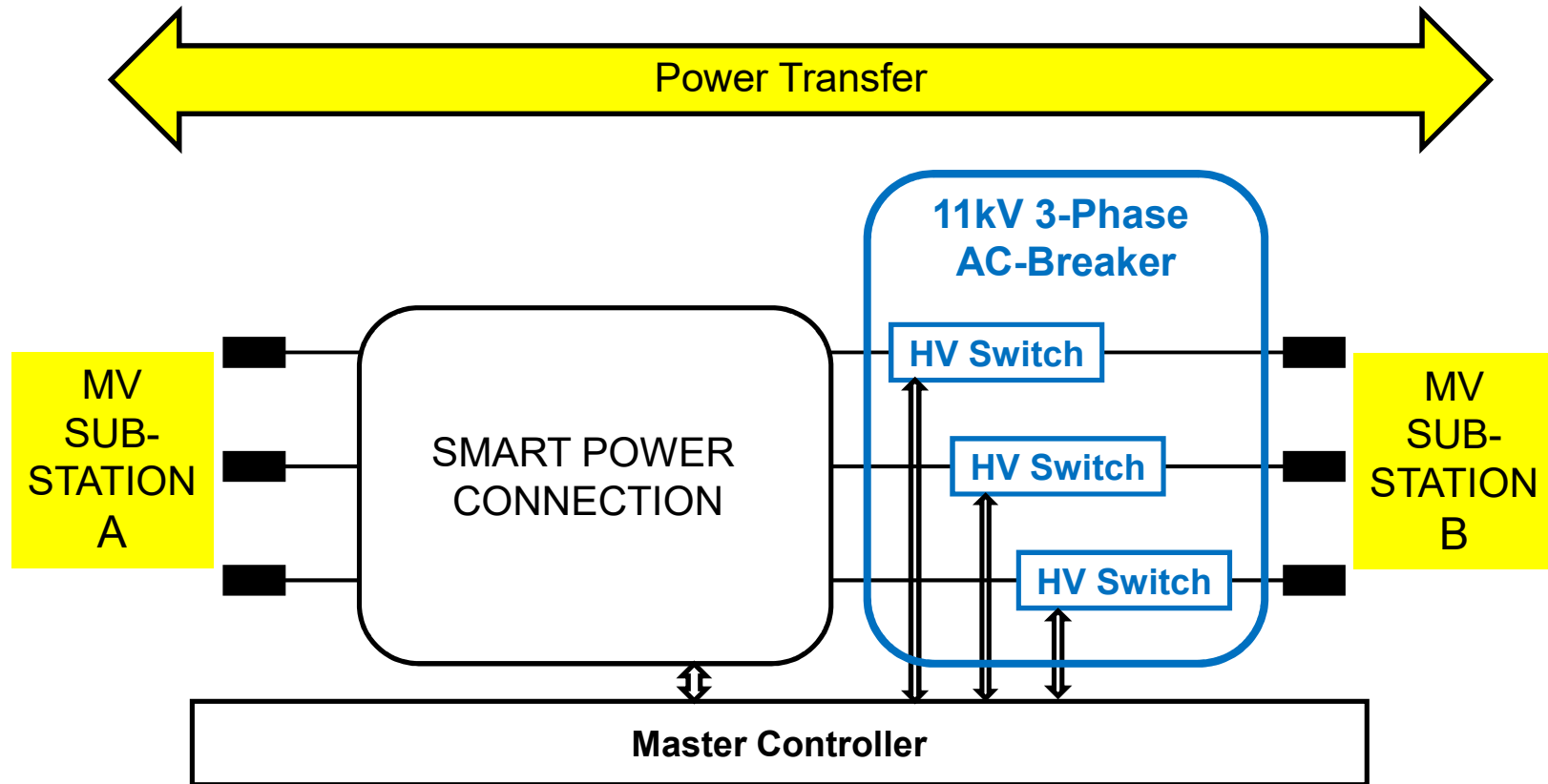
Primary objective of the project

To strengthen the power grid and improve flexibility to cope with changing power demand (for EV-charging etc)

System scope

Connection of two Medium Voltage Substations

The main purpose of the system is to act as a soft power processing unit between two neighbouring electrically connected MV substations. The system will facilitate a controlled transfer of power between the sub-stations bringing flexibility to the MV network and improving the utilisation of the existing infrastructure.

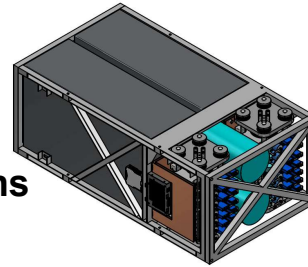




Solid-State Power Switches Overview

Pulsed Power

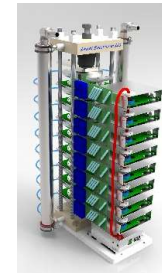
Integrated solutions



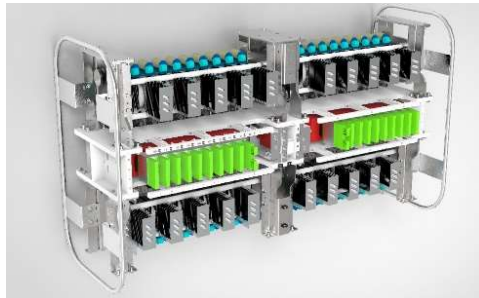
Assemblies with standard semiconductor elements



Assemblies with special high di/dt thyristors



AC-Switches

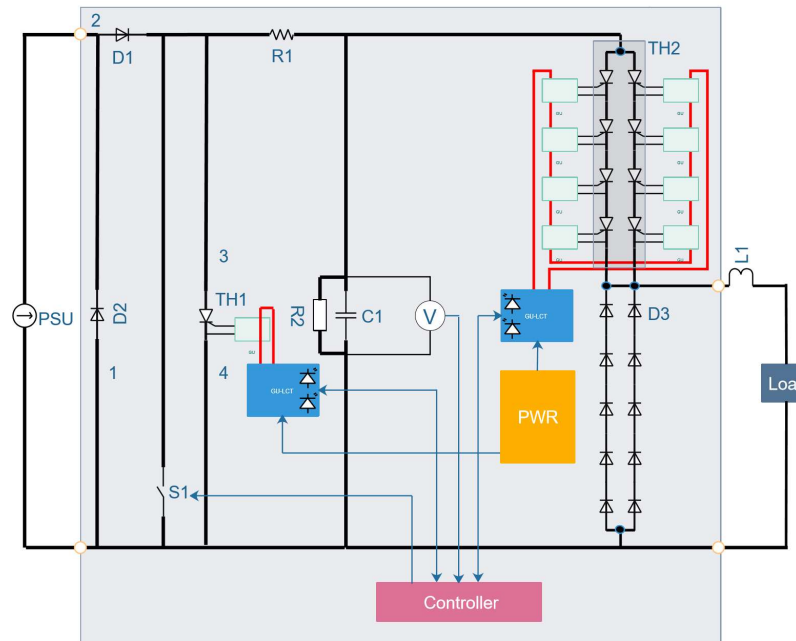




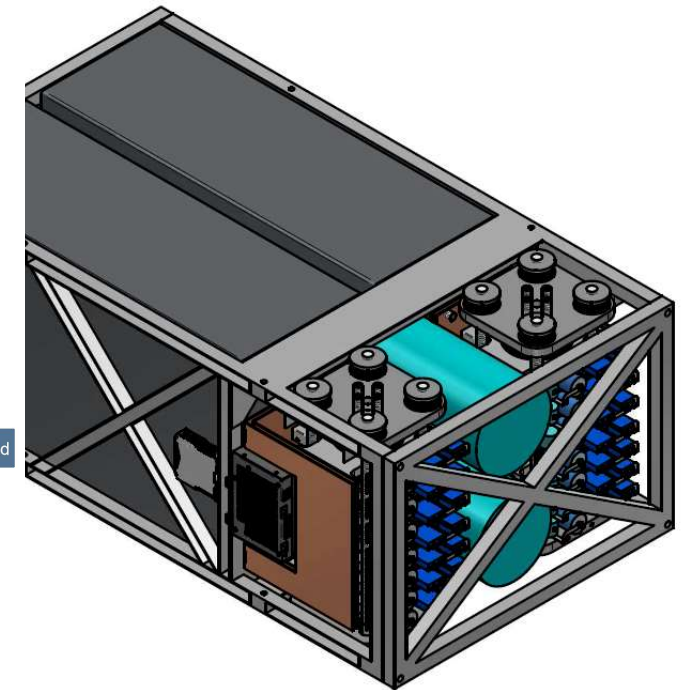
Solid-State Power Switches - System Integration

Power Electronics

- ▶ PSU Charging power supply
- ▶ S1 Mechanical discharge switch (in case of fault)
- ▶ TH1 Electrical discharge switch (in case of fault)
- ▶ TH2 Main switch
- ▶ D1, D2 Protection diodes for charging supply
- ▶ D3 Crowbar diode for main switch
- ▶ R1 current limiting in charging part
- ▶ Mechanical impact on all components (in case of fault)
- ▶ C1 Main storage capacitor
- ▶ L1 Output inductance
- ▶ S1 Mechanical discharge switch



Electrical Design



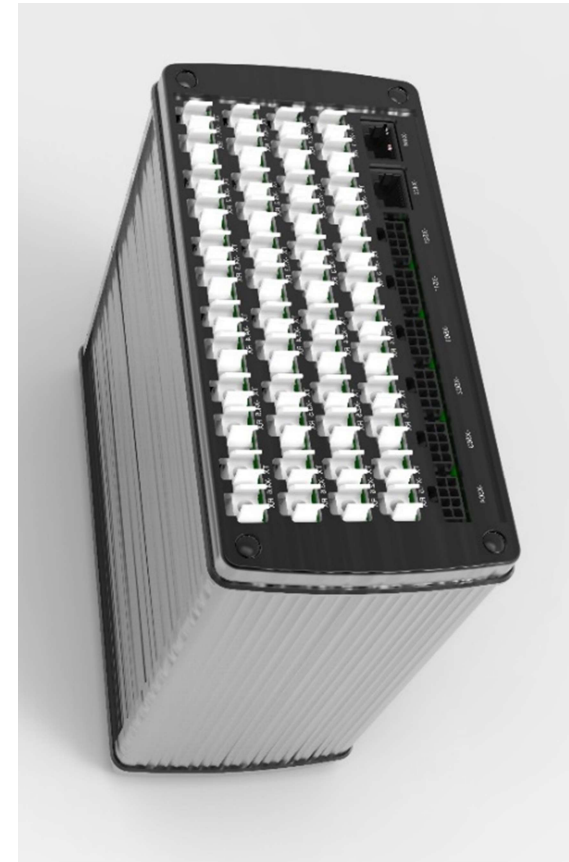
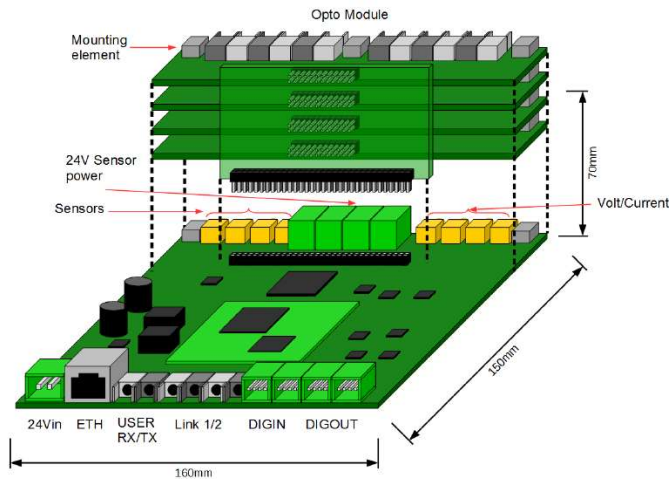
Mechanical Design

System Control and Monitoring

- ▶ Charger and thyristor control
- ▶ Current and voltage measurement
- ▶ HMI and configuration software



Solid-State Power Switches - Astrol controller COMICON



COMICON controller

- ▶ Charger control
- ▶ Thyristor control
- ▶ Switch failure feedback
- ▶ Charging system failure feedback
- ▶ Safety discharge control
- ▶ Voltage and current measuring control
- ▶ Safety system interface
- ▶ All control functions integrated in one device

Current and voltage measurement

- ▶ Capacitor voltage measurement
- ▶ HV output current curve
- ▶ Semiconductor failure detection
- ▶ Charging current measurement

HMI, operation settings

- ▶ System status monitoring
- ▶ Charging command
- ▶ Discharge sequence setting
- ▶ Operational discharge command
- ▶ Safety capacitor discharge command
- ▶ Charging system failure feedback
- ▶ Measurement data analysis mode
- ▶ Automatic measurement data storage



Products - Strong Points

Solid-State Circuit Breakers



- ✓ Biggest variety of products
- ✓ Especially designed for use as DC-Breaker – first product on the market
- ✓ Highest di/dt capability available, therefore very low-inductance system designs possible.
- ✓ No added inductance required
- ✓ Based on widely available semiconductor components

Solid-State Power Switches



- ✓ Special di/dt thyristors from ABB are exclusively used by Astrol
- ✓ Long-term experience with hundreds of systems in operation
- ✓ Close cooperation with ABB – allowing system specific simulation and out-of-spec use of semiconductors
- ✓ Best available reliability and system lifetime
- ✓ Everything designed in-house

Gate Drive Units and Isolated Power Supplies



Digital Drive Technology offers key advantages:

- ✓ Higher level of customization
- ✓ Parametrization and software updates possible
- ✓ Higher efficiency by digitally optimized switching → Energy Savings!
- ✓ Longer life-time of IGBTs
- ✓ Safer system by improved protection functions

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THANKS!