### **Optical rebuild kit for large thyristor DC drive**



#### File: optical\_reb\_kit\_R00

The basic structure of a large DC drive consist of

A control module, for the speed and torque control of the motor, this unit should be a ABB regulation DC800-R02 or Siemens regulation Sinamics DCM control module,

A power part with several large disc thyristors mounted inside different switchboards,

An electronic interface from the control module and the power part.



When a replacement of an old DC driver regulation is required (because this unit doesn't work fine or isn't possible to purchase some replacement card), a good solution is to replace only the control module and the electronics for interfacing the regulation to the existing power part.

#### File: optical\_reb\_kit\_R00

In this way several objective are achieved:

- The total cost of the revamping is low compared to the solution of replacing of power part,
- The control module should be installed far from the power part (until 150 meters with the extended solution, -E boards),
- The new control module is more powerful and accurate,
- The replacement card of the control module and of the interfacing are easy and available for several years,
- Is possible to replace the old regulation with the new regulation in few days,
- Depending on the actual hardware is possible to customize the solution, allowing the possibility to work with the actual regulation and with the new regulation with a fast and simple switchover from the 2 systems

### Hardware condition

The items to satisfy for allowing the optical rebuild kit to work without problem are listed below:

The DC drive armature current should be higher than 1000 Adc,

The existing power part should have a maximum of 6 thyristors per valve (for the extended solution with the optical multiplier 1x4 is possible to connect up to 12 thyristors per valve),

The synchronization transformers to the control regulation has to be connected near the control regulation (maximum distance 5 meters),

The maximum phase-phase voltage of the incoming line can be up to 1500 Vac because of the firing pulse boards used for interface the electronics to the power part,

The pulse electrical-optical conversion has to be performed near the control regulation (maximum distance: 2 meters),

The maximum distance from the thyristor panel and the control panel is 30 meters for the standard solution, or 150 meters for the extended solution of the electronic boards (–E boards), in this case only modifying the electronic boards in the first optical link from control to power panel is possible to reach this result, continuing to use plastic optical fibers.

Below is possible to see all the items that can be used for the optical rebuild kit, only some of this item should be required depending on the specific application (power topology, 2Q or 4Q quadrants, number of paralleled thyristors).

Description	Item code	Item Rev.	Note
Electrical-optical Interface for ABB DC800-R2 regulation	CSP101 CSP101-E	В	6 pulse, for distance from regulation and power part up to 30 meters (up to 150 meters for the $-E$ type)
Electrical-optical Interface for Siemens Sinamics DCM control module regulation	CSP109 CSP109-E	A	6 pulse, for distance from regulation and power part up to 30 meters (up to 150 meters for the $-E$ type)
Optical multiplier 1 to 2 (standard solution)	CSP102 CSP102-E	В	1 input pulse, 2 output pulses, for distance from regulation and power part up to 30 meters (up to 150 meters for the –E type)
Optical multiplier 1 to 4	CSP135 CSP135-E	A	1 input pulse, 4 output pulses, for distance from regulation and power part up to 30 meters (up to 150 meters for the –E type)
Optical to thyristor pulse converter 1 to 3	CSP103	В	1 input pulse, 3 output thyristor pulses, parallel connected, for distance from board to the thyristor up to 2 meters
Optical to thyristor pulse converter 1 to 6	CSP136	A	1 input pulse, 6 output thyristor pulses, parallel connected, for distance from board to the thyristor up to 2 meters
Thyristor pulse switchover pulse card	CSP110	А	Switchover of thyristor pulse gate from old and new regulation
Optical fiber patch cable	POF-xxx		1 optical pulse, plastic optical fiber, with connectors, cable length = xxx meters (can be used for the standard and extended lengths)

#### Electrical-optical Interface for ABB DC800-Rx regulation



Board name	CSP101B
Description	Electro-optical conversion for ABB regulation
Power supply	24V= nominal, range 15 ÷ 32 Vdc
Max current consumption	400mA during RUN condition 130 mA during STOP conditino
Input contact	1 free contact for enable (close=enable, open=disable)
Output contact	1 free contact for status (close=OK, open=fault)
Output pulses	6 (optical)
Flat cable input	Maximum length 1 meter
pulse frequency	maximum 1Mbit/sec for transmitters, used 11 kHz
Optical fiber cable lenght	Up to 35 meters for CSP101B board, Up to 150 meters for CSP101B-E board.
Ambient temperature	Min -10℃, maximum 50 ℃
Dimension	160 x107 mm, installed over DIN rail

#### Optical multiplier 1 to 2



Board name	CSP102B
Description	Optical multiplier 1x2
Power supply	24V= nominal, range 15 ÷ 32 Vdc
Max current consumption	230mA during RUN condition 120 mA during STOP conditino
Output contact	1 free contact for status (close=OK, open=fault)
Input pulse	1 (optical)
Output pulses	2 (optical)
pulse frequency	maximum 1Mbit/sec for transmitters, used 11 kHz
Optical fiber cable lenght	Up to 35 meters for CSP102B board, Up to 150 meters for CSP102B-E board.
Ambient temperature	Min -10℃, maximum 50 ℃
Dimension	73 x107 mm, installed over DIN rail

	Board name	CSP103B
	Description	Optical to thyristor pulse converter 1 to 3
	Power supply	28V= nominal, range 22 ÷ 32 Vdc
O I DOM I DO	Max current consumption	1000mA during RUN condition 150 mA during STOP conditino
	Output contact	1 free contact for status (close=OK, open=fault)
	Input pulse	1 (optical)
	Output pulses	3 (electrical) insulated from them
	pulse frequency	11 kHz nominal (20 kHz maximum for pulse transformers)
0	insulation output gate- input pulse	5 kVrms 50Hz 1 sec
	Gate-cathode pulse thyristor cable length	Up to 2 meters
	Ambient temperature	Min -10℃, maximum 50 ℃
	Dimension	195 x107 mm, installed over DIN rail

#### Thyristor pulse gate switchover



#### Electrical-optical Interface for Siemens DCM regulation



Board name	CSP109A
Description	Electro-optical conversion for SIEMENS DCM regulation
Power supply	24V= nominal, range 15 ÷ 32 Vdc
Max current consumption	400mA during RUN condition 130 mA during STOP condition
Input contact	1 free contact for enable (close=enable, open=disable)
Output contact	1 free contact for status (close=OK, open=fault)
Output pulses	6 (optical)
Flat cable input	Maximum length 1 meter
Optical fiber cable lenght	Up to 35 meters for CSP109A board, Up to 150 meters for CSP109A-E board.
pulse frequency	maximum 1Mbit/sec, used 11 kHz
Ambient temperature	Min -10℃, maximum 50 ℃
Dimension	160 x107 mm, installed over DIN rail

#### Application example (ABB regulation)

The optical rebuild kits are available for 2Q and 4Q drive converter, and for several circuit connection (B6 six pulse bridge connection, M6 six pulse star connection), and with the power part up to 12 thyristors parallel connected.

Below is possible to see a real application example installed in Bokaro steel plant (India),

the circuit topology is two M3.2 double three pulse star connection, one for the forward bridge and one for the reverse bridge; 2 secondary winding of a main transformer are used, 2 control regulation are used, each one is synchronized with a different secondary winding of the transformer.

For each ABB regulation 2 boards CSP101B are used for convert the electrical pulses to optical pulses, the control regulation and this boards are installed in the control room, then the optical fiber are connected up to the power part.

Inside each panel of the power part, each pulse the optical pulses is doubled by a CSP102 board,

then each output pulse of the CSP102 board are converted to 3 electrical pulse for the direct gate-catode connection of the thyristors by the CSP103B boards.

The maximum distance of the optical fiber cable is in this case equal to 25 meters.

Inside each power panel 9 thyristors are present, 3 for each phase, 3 CSP102 boards are present for the optical pulse multiply and 3 CSP103B are present for the thyristors pulse connection.

Each electronic boards are powered with a 24V power supply and a cumulative status of all the electronic boards is connected to the ABB regulation,

in addition at each CSP101B board an enable input contact is connected for enable the output pulse to the power part, this enable signal is connected to the delayed emergency circuit of the drive, for disabling the pulses after the OFF3 stopping was performed.

In this installation also the switchover boards are present for a fast and simple commutation from the old control system to the new control system regulation.

#### POWER PART OF THE INSTALLATION OF A LARGE DC DRIVE (CROP SHEAR) IN INDIA STEEL PLANT



11/23

CONNECTION OF ABB CONTROL REGULATION TO THE PULSE-OPTICAL CONVERSION BOARDS AND TO THE OPTICAL MULTIPLIER 1x2

(STANDARD SOLUTION,

2-(M3..)2 CONNECTION, up to 35 meters optical fiber cable long)



CONNECTION OF ABB CONTROL REGULATION TO THE PULSE-OPTICAL CONVERSION BOARDS AND TO THE OPTICAL MULTIPLIER 1x2

#### (EXTENDED

SOLUTION,

2-(M3..)2 CONNECTION, up to 150 meters optical fiber cable long)



CONNECTION OF OPTICAL PULSE OF 1<sup>st</sup> ABB CONTROL REGULATION TO THE OPTICAL-ELECTRICAL 1x3 PULSE CONVERSION OF THE THYRISTOR

(for simplicity the switchover boards are not showed)



14/23

CONNECTION OF OPTICAL PULSE OF 1<sup>st</sup> ABB CONTROL REGULATION TO THE OPTICAL-ELECTRICAL 1x3 PULSE CONVERSION OF THE THYRISTOR

(for simplicity the switchover boards are not showed)



CONNECTION OF OPTICAL PULSES OF 1<sup>st</sup> ABB CONTROL REGULATION TO THE OPTICAL-ELECTRICAL 1x3 PULSE CONVERSION OF THE THYRISTOR

(switchover boards are showed)





SWITCH SOLUTION (SWITCH FROM OLD AND NEW CONTROL POSSIBLE)

#### Application example 2 (SIEMENS SINAMICS DCM regulation)

Below is possible to see an application example with the circuit topology equal to two M3.2 double three pulse star connection, one for the forward bridge and one for the reverse bridge; 2 secondary winding of a main transformer are used, 2 control regulation are used, each one is synchronized with a different secondary winding of the transformer.

In the first case, for each SIEMENS SINAMICS DCM regulation 2 boards CSP109B are used for convert the electrical pulses to optical pulses, the control regulation and this boards are installed in the control room, then the optical fiber are connected up to the power part with a distance up to 35 meters from the control room. All the features of the others boards are similar to the described solution.

In the second case, for each SIEMENS SINAMICS DCM regulation 2 boards CSP109B-E are used for convert the electrical pulses to optical pulses, the control regulation and this boards are installed in the control room, then the optical fiber are connected up to the power part with a distance up to 150 meters from the control room. All the features of the others boards are similar to the described solution.

CONNECTION OF SIEMENS CONTROL REGULATION TO THE PULSE-OPTICAL CONVERSION BOARDS AND TO THE OPTICAL MULTIPLIER 1x2

## (STANDARD SOLUTION

2-(M3..)2 CONNECTION, up to 35 meters optical fiber cable long)



CONNECTION OF SIEMENS CONTROL REGULATION TO THE PULSE-OPTICAL CONVERSION BOARDS AND TO THE OPTICAL MULTIPLIER 1x2

## (EXTENDED SOLUTION

2-(M3..)2

CONNECTION, up to 150 meters optical fiber cable long)



#### Application example 3 (SIEMENS SINAMICS DCM regulation, 2 six pulse bridge connection)

When a single secondary winding is used, for example in two six pulse bridge connection, one for forward direction and one for the reverse direction, only one SIEMENS SINAMICS DCM regulation is required and the topology look like the figure below.



CONNECTION OF SIEMENS CONTROL REGULATION TO THE PULSE-OPTICAL CONVERSION BOARDS AND TO THE OPTICAL MULTIPLIER 1x2

(STANDARD SOLUTION

2-B6 CONNECTION, up to 35 meters optical fiber cable long)



SIEMENS

OPTICAL

THE

THE

2-B6

to

long)





#### SISTEM POWER S.r.I.

**Registered office:** N. 25, Via Galileo Galilei - PESCARA (PE) - ITALY - 65122 P.IVA: 02013440686 - R.E.A. n. 146665 - Cap. Soc. 50.000 Euro **Officies and factory :** Strada Vicinale Stradone - Cepagatti (PE) - ITALY - 65012

# Tel. +39 085 9152000 Fax +39 085 9153130

## www.sistempower.it email: info@sistempower.it