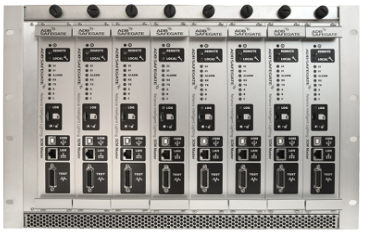
RELIANCE Intelligent Lighting

Individual Light Control and Monitoring System



The RELIANCE® Intelligent Lighting (IL) system is designed to provide individual monitoring of airfield lighting using the series circuit as a means of communication for the lamp and sensor status information coming from the airfield.

The same concept is used for lighting control, and as such provides the foundation for an SMGCS or A-SMGCS. This includes for example automation of stop bars, with or without sensors, and taxiway guidance in combination with status monitoring.

The RELIANCE Intelligent Lighting system is a cost-effective solution for upgrading existing or new series circuits with selective switching and/or individual monitoring of all or a selected number of lights in an airfield.

Basic system characteristics

- RELIANCE IQ
- LMS - Light Monitor and Switch Unit
- SIU - Sensor Interface Unit
- SCM and NCU - Series Circuit Modem and Network Concentrator Unit
- SCF - Series Circuit Filter
- Control System Interface
- Flexibility
- Availability
- Installation Requirements and Maintainability
- Failsafe Operation

For more detailed information regarding the RELIANCE Intelligent Lighting system components, see the System block diagram in this data sheet and the User' Guides.

RELIANCE IQ

The implementation of LED-based airfield lighting required electronics built into the light fixtures to convert 6.6A to whatever current the LEDs required. This opens the opportunity to use these electronics to also integrate the ILCMS functionality of the external remote into the fixture. This streamlining of the units increases reliability because there are far fewer secondary connectors as potential points of failure. In addition, intensity can be controlled by using powerline commands rather than following the CCR current.

The RELIANCE Intelligent Lighting (IL) system, using the IQ products, is designed to provide selective switching and / or monitoring of airfield lighting by use of an addressable switching unit inside each individually controlled light fixture. A RELIANCE IQ light fixture is connected to the secondary side of a standard series circuit isolation transformer. Communications to/from a RELIANCE IQ light fixture uses a unique power line communication technique developed by ADB SAFEGATE where the communication signals are superimposed on the series circuit current.

LMS

The LMS concept used in the RELIANCE Intelligent Lighting system is designed to provide selective switching and/or monitoring of airfield lighting. Each light is individually controlled by the use of an addressable LMS switching unit connected to a standard series circuit isolation transformer. Communications to/from the LMS uses a unique power line communication technique, developed by ADB SAFEGATE, where the communication signals are superimposed on the series circuit current.

SIU

Sensors for presence and direction detection of aircraft and vehicles on the airfield can easily be interfaced to the RELIANCE Intelligent Lighting system using an SIU. The SIU communicates the detect/no-detect status signals as well as its own status to the series circuit in the same manner as the LMS. The SIU is also connected to the secondary side of a standard isolation transformer using the standard 2-pin FAA-style connectors while its connection to the sensor is established using an IP68-rated, 7-pin connector. The SIU can supply the sensor with a DC-voltage.

SCM and NCU

The NCU concentrates all status information coming from the field, for example lamp and sensor status. It transfers commands to the SCM, which constitutes the interface to the series circuit. The SCM interfaces to the series circuit through a standard isolation transformer and to the NCU via standard RS485 or RS232 serial communication.

SCF

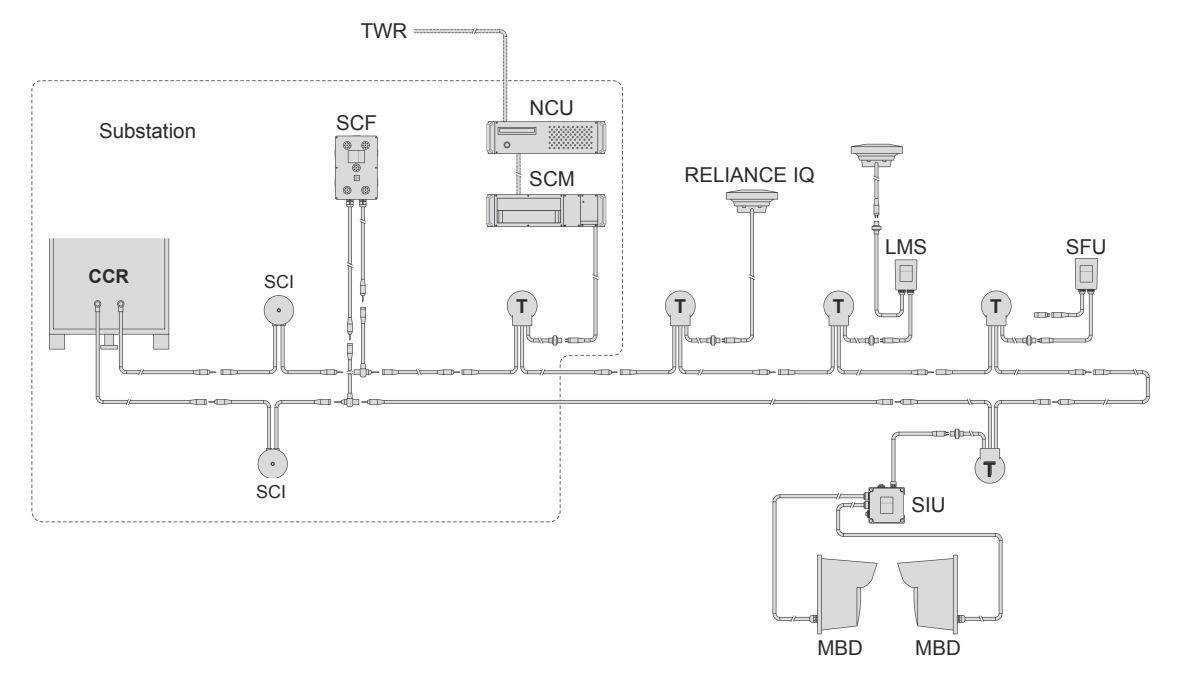
The SCF is connected across the CCR series circuit output and is used to contain the communication signaling within the airfield circuit and minimize feedback into the regulator.

Control system interface

The NCU operates as the RELIANCE Intelligent Lighting system main interface interpreting commands sent from the host/supervisor system, including the RELIANCE Intelligent Lighting system, and in turn controlling the remote appropriate lighting as directed.

It maintains all lighting and error status as well as that of sensor detection as reported from the airfield components and thus is the central point of the RELIANCE Intelligent Lighting system as

operated from each substation. Individual lights can be grouped in lighting segments spanning one or more series circuits, for example an interleaved stop bar. In turn, the NCU provides alarm status for percentage and adjacent lamp failure within those defined lighting segments per requirements for low visibility operations. Airfield lighting and RELIANCE Intelligent Lighting system component status are constantly monitored and updated to the host/supervisor system upon occurrence.



RELIANCE Intelligent Lighting system block diagram

Flexibility

The segmentation of lights into selectively controlled blocks is made in the software, and not by means of cables and CCRs or selector switches. This reduces the installation and hardware costs substantially and increases the flexibility of the airfield lighting system. A segment can easily be redefined or added in the software with the possible addition of isolation transformers and LMSs in the airfield. The RELIANCE Intelligent Lighting system is designed to be modular and expandable, so that it can be readily modified to monitor and control additional lighting functions and series circuits.

Availability

The series circuit cable transfers power to the lamp on the circuit and the same physical channel is used by the RELIANCE Intelligent Lighting system for communication. This implies that whenever there is power available to the lamps, the RELIANCE Intelligent Lighting system will have access to its communications channel and control and monitoring will be available. A discontinuity on the cable shield will not normally influence neither the lights nor the RELIANCE Intelligent Lighting system availability.

Installation requirements and maintainability

The RELIANCE Intelligent Lighting system electrical requirements on a series circuit level are the same as a light fitting or an isolation transformer. The RELIANCE Intelligent Lighting system does not put any additional constraints on how the installation is done, hence there is no conflict either with for example electrical safety code, nor general or local standards, when installing this type of system. If a new series circuit is to be designed, ADB SAFEGATE has a set of general recommendations or preferences to apply regarding cable routing etc.

High-voltage equipment, connected to the primary of the series circuit, and low-voltage equipment, connected to the secondary of the series circuit, are physically separated. By separating them, the impact on system availability and personnel hazards due to maintenance efforts, is minimized.

Failsafe operation

If a fault is detected on any system component, the NCU will provide the information to the host-system upon occurrence for the appropriate actions to be taken. Typical actions would be displaying a message to the maintenance station terminal and, if necessary, some

indication at the operator terminals to signify any interference to operations.

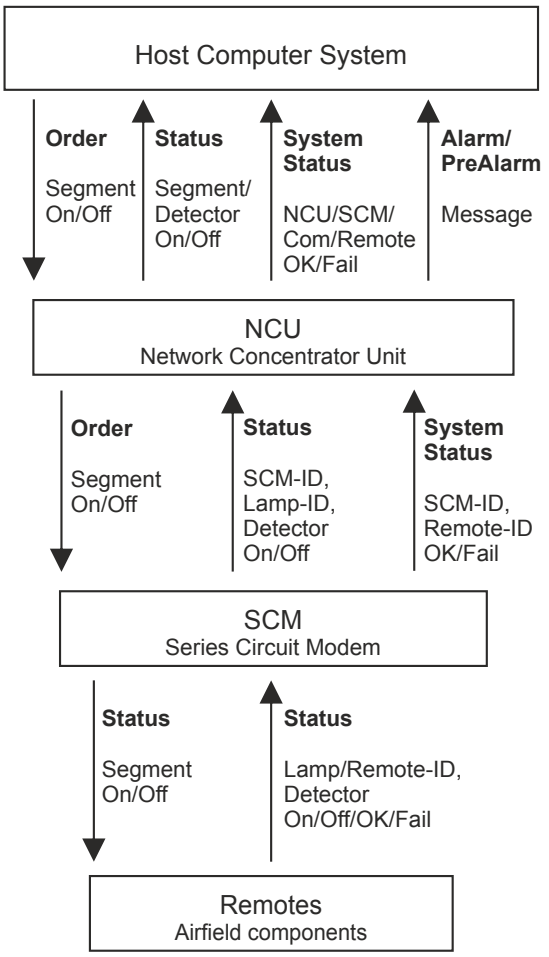
In normal operations, the RELIANCE Intelligent Lighting system appears on the airfield as commanded by the host-system. In case of equipment or communication failures associated with the RELIANCE Intelligent Lighting system, the associated airfield lighting adopts the Failsafe or "safe-state" setting. This can happen on an individual circuit basis or the entire airfield depending upon one or more of the following circumstances:

1. A **Set Failsafe** command is given by the host-system: The NCU sets airfield lighting to a predefined Failsafe state as commanded by the host-system. The airfield remains in this state under host-system control until the airfield lighting is commanded to another state.
2. Loss of communications with the host-system: The NCU assumes an error in the host-system control and sets airfield lighting to its predefined Failsafe state. The airfield remains in this state under RELIANCE Intelligent Lighting system control until communications is restored with the host-system and the airfield lighting is commanded to another state.
3. Loss of control operations by the NCU: Both redundant NCU computers or their application are turned OFF but the RELIANCE Intelligent Lighting system circuits remain ON. In such case, the signaling on the series circuit from the SCM will cease due to lack of NCU/SCM communications, thereby forcing the Remote to assume their pre-programmed Failsafe state. The pre-programmed Failsafe state matches that as would be commanded.
4. Loss of SCM, SCF, or related component in series circuit interface or SCM communications with the NCU: In such case, RELIANCE Intelligent Lighting system signaling on the series circuit will cease as a result of the hardware failure, thereby forcing the LMS to assume their pre-programmed Failsafe state.

Communication principles

The communication between the components at the different levels is such that the higher level device always polls the lower level device, evaluates the answers, and determines the on/off and pass/fail status for the functions or components. If a unit fails to report within a predetermined amount of time, it is assumed to be failed until reported otherwise. The evaluation of conditions is performed at the lowest level possible and information condensed before transferred upward, resulting in minimized response time and transfer of information between each unit.

The information exchange is performed according to the structure shown in *Figure 2*.



RELIANCE Intelligent Lighting system information exchange

System response times

The RELIANCE Intelligent Lighting system is designed to provide up-to-date status information on individual lamps as well as light functions independently of the commanded lamp state, for example if the lamp is commanded on or off. This implies that provided the system and series circuit is energized, status on lights and light functions is continuously available.

The user of the system will be able to control desired light functions and on beforehand know in what shape the system is. Hence maintenance efforts may be launched as soon as any deficiencies are detected and well before the affected light functions are needed operationally.

The RELIANCE Intelligent Lighting system is designed to comply with operational requirements in terms of response times. In the chain of events, including air traffic controller reaction— system response time — physical changes in the field— pilot reaction, the system response time constitutes a minor part. Time critical functions like stop bar

control have priority over less critical functions like, for example, runway edge light monitoring.

Response times are measured from the RELIANCE Intelligent Lighting system interface from the point in time when a command is received to the point in time when the corresponding status information, true feed back, is available. The only exception to the above is when a RELIANCE ALCMS control system is host in which case the response time includes host processing and overhead as well. In this case the response time is equivalent to the system response time.

Stopbar response time

Maximum stop bar response time from receiving a command to true back indication is 2 seconds, typically less than 1 second. Sensor detection is typically reported within 1 second. The stopbar response time applies to both interleaved and non-interleaved configurations.

Lamp Monitoring response time

A lamp failure is detected and reported within 5 seconds regardless of system configuration.

Command Sequence response time

Maximum response time using multi segment commands result in system performance on par with the user requirements, typically 1-5 seconds. This applies regardless of the number of light segments involved. In case the light function only affects a few segments, the maximum response time is considerably lower. For single segment response time in general refer to Stopbar response time.

The consequence of the response time is that in an RELIANCE Intelligent Lighting system it is always possible to predict the maximum response time regardless of the system configuration.

References

SG591835-3013 LMS User Guide

SG591870-3002 SCF User Guide

SG591880-3003 SCM-Rack User Guide

SG591885-3018 SIU User Guide

SG591847-3017 NCU User Guide

SG591890-3006 International Standards Compliancy List