SIGMA RESEARCH INC.

Application Manual

Fiber Optic Switch (FiberSwitch™)

Model: FOS-01

Fiber Optic Interface (FOI)

Model: FOI-01-221

SIGMA RESEARCH Inc.
259 Edgeley Blvd, Unit #2
Vaughan, Ontario, Canada L4K 3Y5
Tel: +1 (905) 669-6888
Fax: +1 (905) 669-6444
info@sigmaresearch.ca
www.sigmaresearch.ca

Notice of Proprietary Rights

Index

1.0 Introduction

The information contained in this document is intended to be accurate but cannot be comprehensive for every installation and is not a substitute for professional design advice. The Application Manual provides a number of typical applications of the Fiber Optic Interface and Fiber Optic Switch that are the most commonly used. Many user specific applications can be developed starting from the typical applications presented in this manual. Sigma Research can provide support and work with your engineering contractor to develop your specific applications. The attached typical schematic diagrams shall be used for reference only and not as construction drawings.

2.0 Overview

The FOI was primarily designed to work in conjunction with Fiber Optic Switches (FiberSwitch™) but it can be used for many other applications shown in this manual. As the Fiber Optic Switches can be installed in hazardous areas, the FOI must provide a safe optical radiation as required by IEC 60079-28 and ANSI/ISA 60079-28. The above mentioned standard requires that the optical radiation must be less than 15mW for the most restrictive hazardous areas (Zone 0, Gr. IIC, T6) to meet the requirements for inherently safe optical radiation "op is". The FOI optical emitting ports use VCSEL diodes with a max. optical power of 1mW.

Therefore the FOI is rated as follows:

ANSI/ISA 60079-28: [AEx op is Ma] I (Mining)
[AEx op is T6 Ga] IIC (Gas)
[AEx op is T60°C Da] IIIC (Dust)

IEC 60079-28: [Ex op is Ma] I (Mining)
[Ex op is T6 Ga] IIC (Gas)
[Ex op is T60°C Da] IIIC (Dust)

NEC 500,505,506 (CEC): [Class I, II, III, Div. I, 2/Zone 0/Zone 20] Gr. A, B, C, D, E, F, G Temp. Code T6

! FOR INSTALLATION IN NON-HAZARDOUS LOCATIONS ONLY
! POUR INSTALLATION DANS DES ENDROITS NON DANGEREUX

The FOI itself cannot be installed in hazardous area but provides a safe optical radiation for hazardous locations. Nevertheless, the FOI can be also used for non-hazardous applications that require remote control over very long distances. Several applications of this kind are illustrated further below in the application manual.

3.0 Field of Application in Hazardous Areas

3.1 Oil Refineries

Almost the entire processing area of the oil refineries is hazardous due to the presence of flammable liquids, gas/vapours and/or dusts.

3.2 Chemical, Petrochemical & Pharmaceutical Industries

These industries constitute the majority of installations with hazardous areas due to the presence of flammable liquids, gas/vapours and/or dusts.

3.3 Offshore Oil Platforms

Almost the entire processing area of the offshore oil platforms is hazardous due to the presence of flammable liquids, and gas/vapours.

3.4 Fuel Terminal Facilities

Loading/unloading operations always release flammable vapors that produce explosive atmosphere.

3.5 Oil & Gas Pipelines, Terminal & Pumping Stations

This example considers the environments in which a gas or flammable vapors leakage could generate an explosive atmosphere.

3.6 LNG Facilities & Terminals

This example considers the environments in which a gas leakage during processing and loading/unloading operations could generate an explosive atmosphere.

3.7 Sugar Refineries

Sugar dust is flammable and accumulations provide a ready source of fuel. Airborne sugar dust can be ignited by sparks or even heat accumulation and result in explosions.

3.8 Fuel Storage Tank Farms

This example considers the tank farms used for fuel storage (gasoline, diesel fuel, etc.) where fuel leakage could generate an explosive atmosphere.

3.9 Aviation Fuel Storage Tanks

Jet fuel is extremely flammable and a leakage could generate an explosive atmosphere.

3.10 Gas Fired Power Plants

The risk of explosion is related to the presence of the gas used for combustion which could leak from the installation.

3.11 Coal Fired Power Plants

The risk of explosion is related to the presence of the coal dust used for combustion. Airborne coal dust can be easily ignited by sparks or even heat and generate fire or explosion.

3.12 Coal Mines

Combustible dust and firedamp (methane gas) could generate explosions if an ignition source is present.

3.13 Coal Belt Conveyors

Combustible dust could generate explosions if an ignition source is present.

3.14 Grain Storage Silos

This example considers the silos used to store grains (wheat, corn, rice, soy, flours, etc.) in which loading, unloading and other processing operations take place which could generate an explosive atmosphere.

3.15 Wastewater Treatment Plants

The risk of explosion is related to the presence of the methane gas generated by the waste material.

3.16 Paint & Ink Storage Facilities

The risk of explosion is related to the presence of the paint solvents that generate explosive atmospheres.

3.17 Woodworking & Furniture Industries

Sawdust is flammable and accumulations provide a ready source of fuel. Airborne sawdust can be ignited by sparks or even heat accumulation and result in explosions.

3.18 Paint Booths

This example considers the environments in which spray painting is carried out with liquid paints containing flammable solvents capable of forming an explosive atmosphere.

3.19 Textile Industries

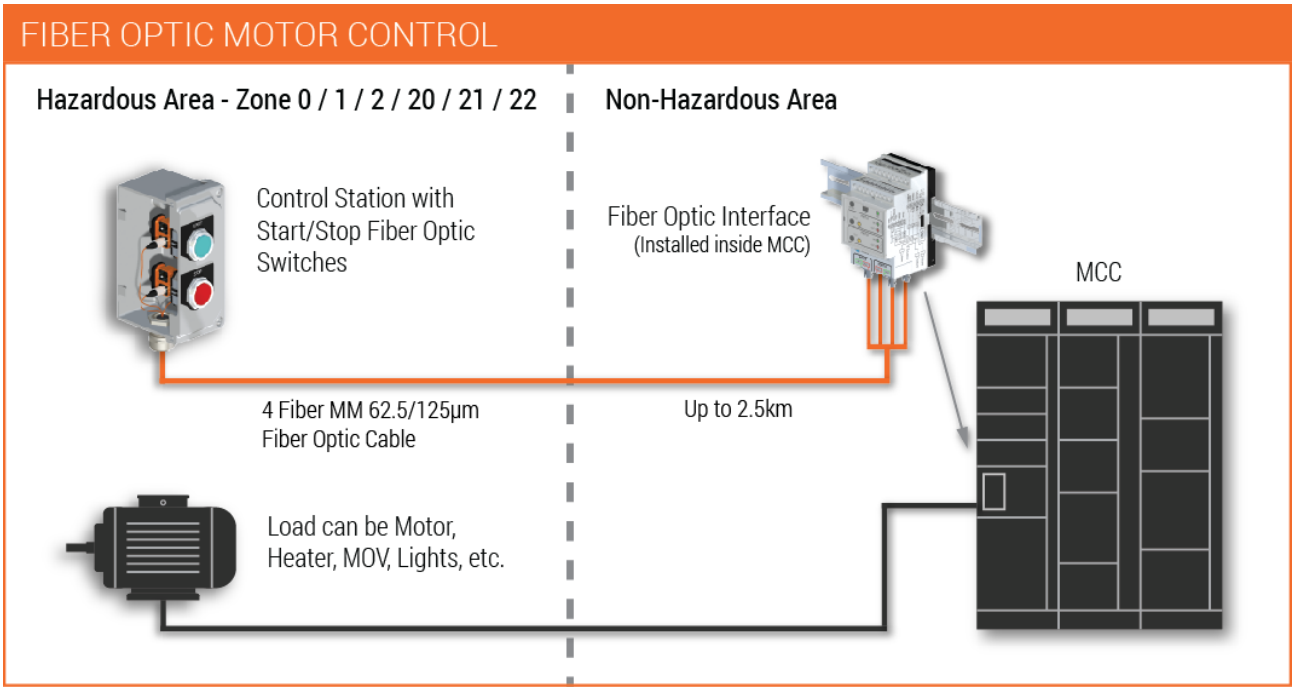
This example considers the environments in which flying fibers could ignite, generating fire or even explosions.

4.0 Field of Application in Non-Hazardous Areas

4.1 Electrical Substations

FOI can be used for miscellaneous interlocks between main substations and unit substations. See application "J" in paragraph 6 below.

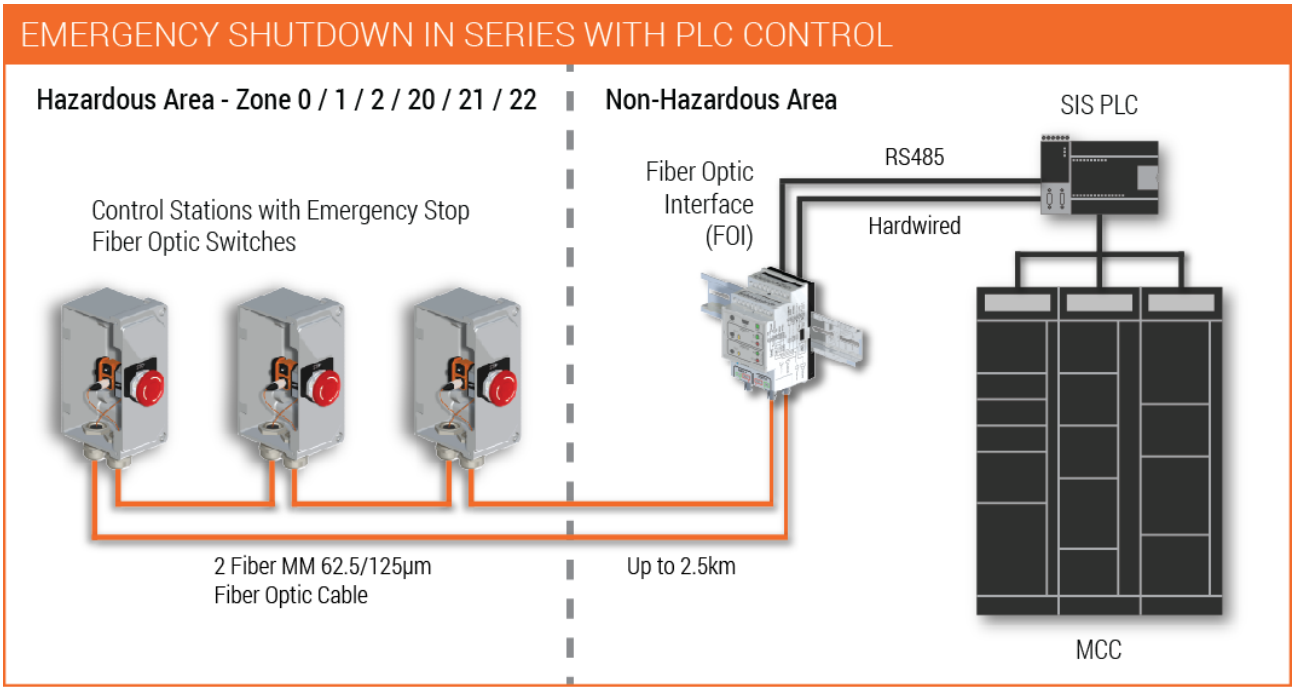
4.2 Industrial Plants



Fiber Optic Switches are a safer and more cost effective alternative to electrical switches in hazardous areas. They allow for control of various equipment up to a distance of 2.5km using a Fiber Optic Interface. Switches are available with a variety of operators (selector, mushroom, pushbutton) with 22mm IEC and 30mm NEMA options.

For more details see applications A to E in paragraph 6 below.

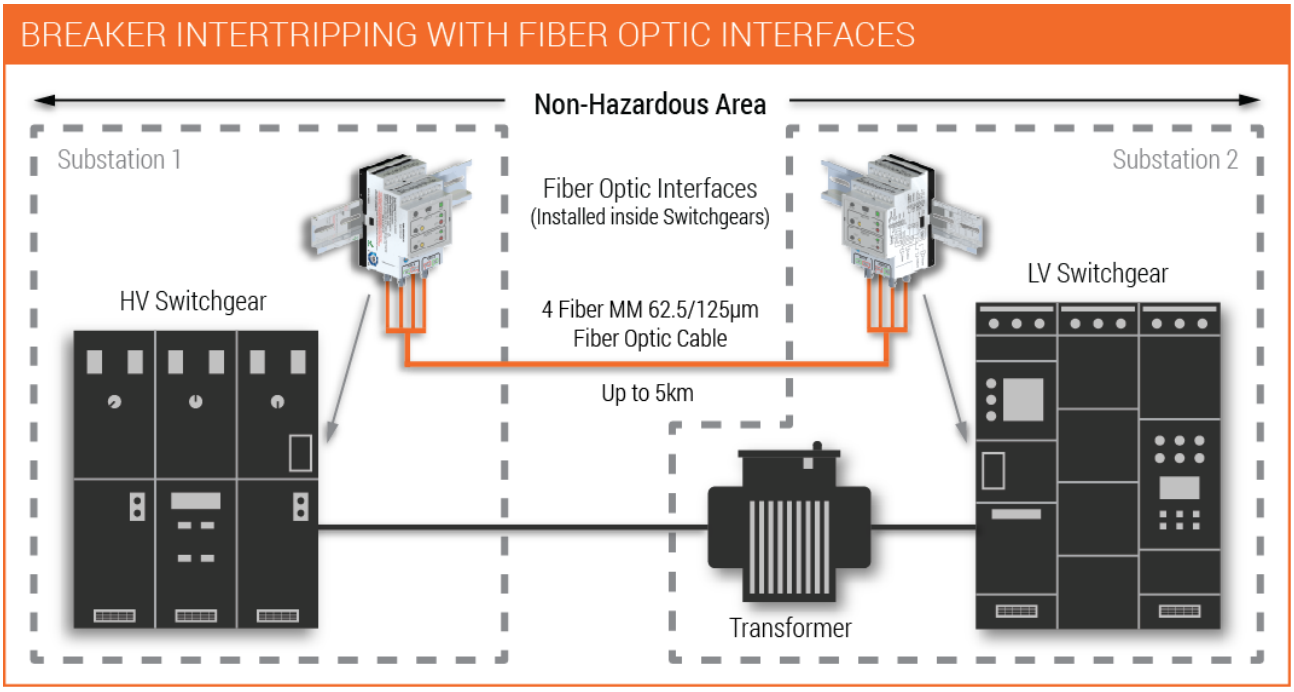
Emergency Shutdown Applications:



Fiber Optic Switches have the capability to be daisy chained to a Fiber Optic Interface, allowing for emergency shutdown applications with multiple switches. The Fiber Optic Interface can chain switches on two independent ports that can then be monitored by a PLC through RS485 and/or hardwire.

For more details see applications E to H in paragraph 6 below.

Breaker Inter-tripping:



Fiber Optic Interfaces offer a much more effective and less costly method of breaker intertripping between two substations. Interfaces are installed in each switch gear on 35mm din rail or panel mounted, and communicate via fiber optic cable up to a distance of 5km, allowing for control of high and low voltage breakers.

For more details see application J in paragraph 6 below.

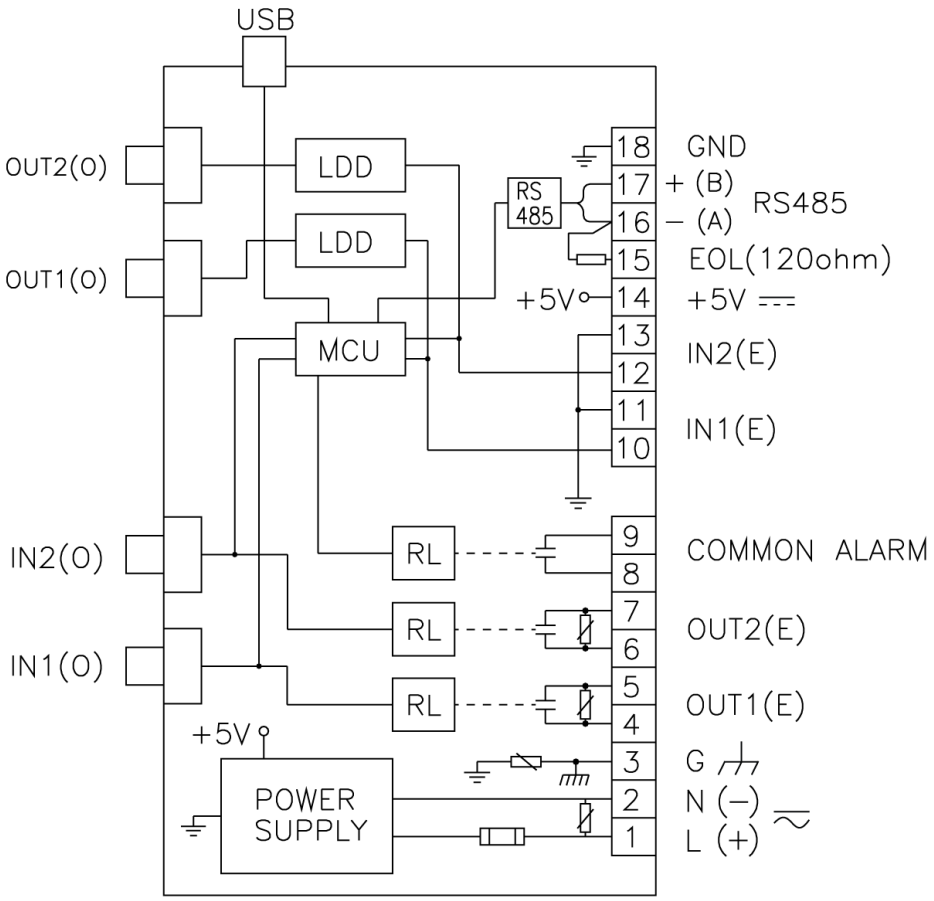
Miscellaneous Applications:

For details see applications I to M in section 6 below.

Networking Applications:

For details see applications N to S in section 6 below.

5.0 FOI Block Diagram



LEGEND

LDD - Laser Diode Driver

MCU - Microcontroller Unit

RL - Relay

EOL - End of Line Resistor (120 ohm)

(O) - Indicates Optical Input or Output

(E) - Indicates Electrical Input or Output

- Frame or chassis TERMINAL

- Earth (ground) TERMINAL

6.0 Typical Applications

6.1 FOI Using Fiber Optic Switches (FiberSwitch™)

A -Typical start-stop control of a motor starter using fiber optic

B -Typical start-stop control of a motor starter using fiber optic and PLC interlock

C -Typical redundant start-stop control of a motor starter using fiber optic

D - FOI with one fiber optic switch in remote location

E - FOI with one fiber optic switch in remote location

F - Fiber optic switches connected in series

G - Fiber optic switches connected in series with separate return fiber optic cable

H - Fiber optic switches in redundant mode connected in series with separate return fiber optic cable

6.2 FOI Used For Miscellaneous Applications

I -Bi-directional I/O transmission over fiber optic

J -Breaker inter-tripping in redundant configuration

K -Motor starter with PLC control over fiber optic

L - Bi-directional repeater with dual I/O in remote location

M -Bi-directional repeater with single I/O in remote location

6.3 FOI Used in Network Applications

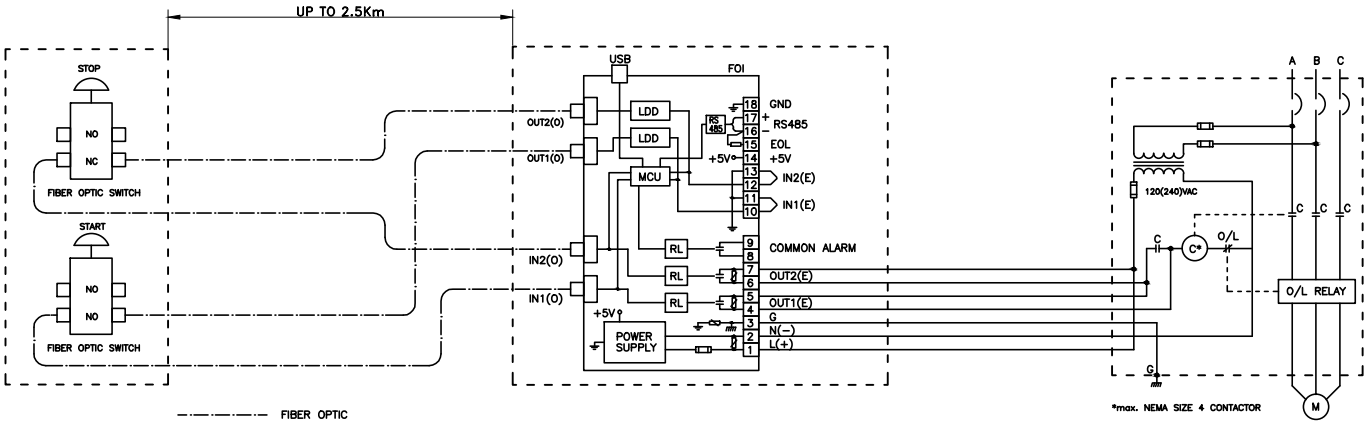
N - Networkable switches over RS485

O - Networkable switches over RS485 with extended range over fiber optic

P - Networkable switches over RS485 and Ethernet

Q - Networkable switches over RS485 and Ethernet with extended range

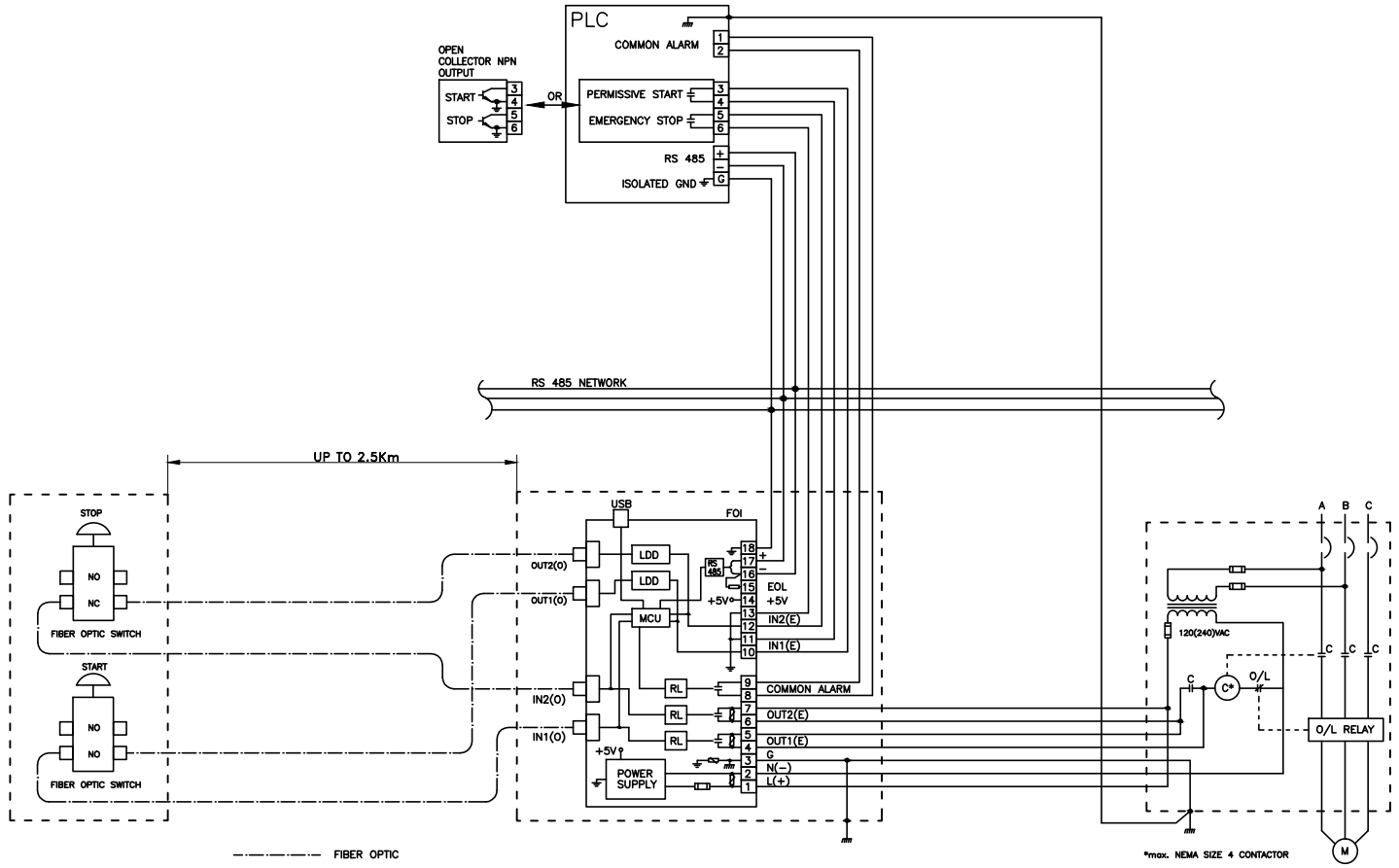
R - Networkable switches over RS485 and Ethernet in remote location with battery voltage monitoring



TYPICAL START–STOP CONTROL OF A MOTOR STARTER USING FIBER OPTIC

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL
APPLICATION A

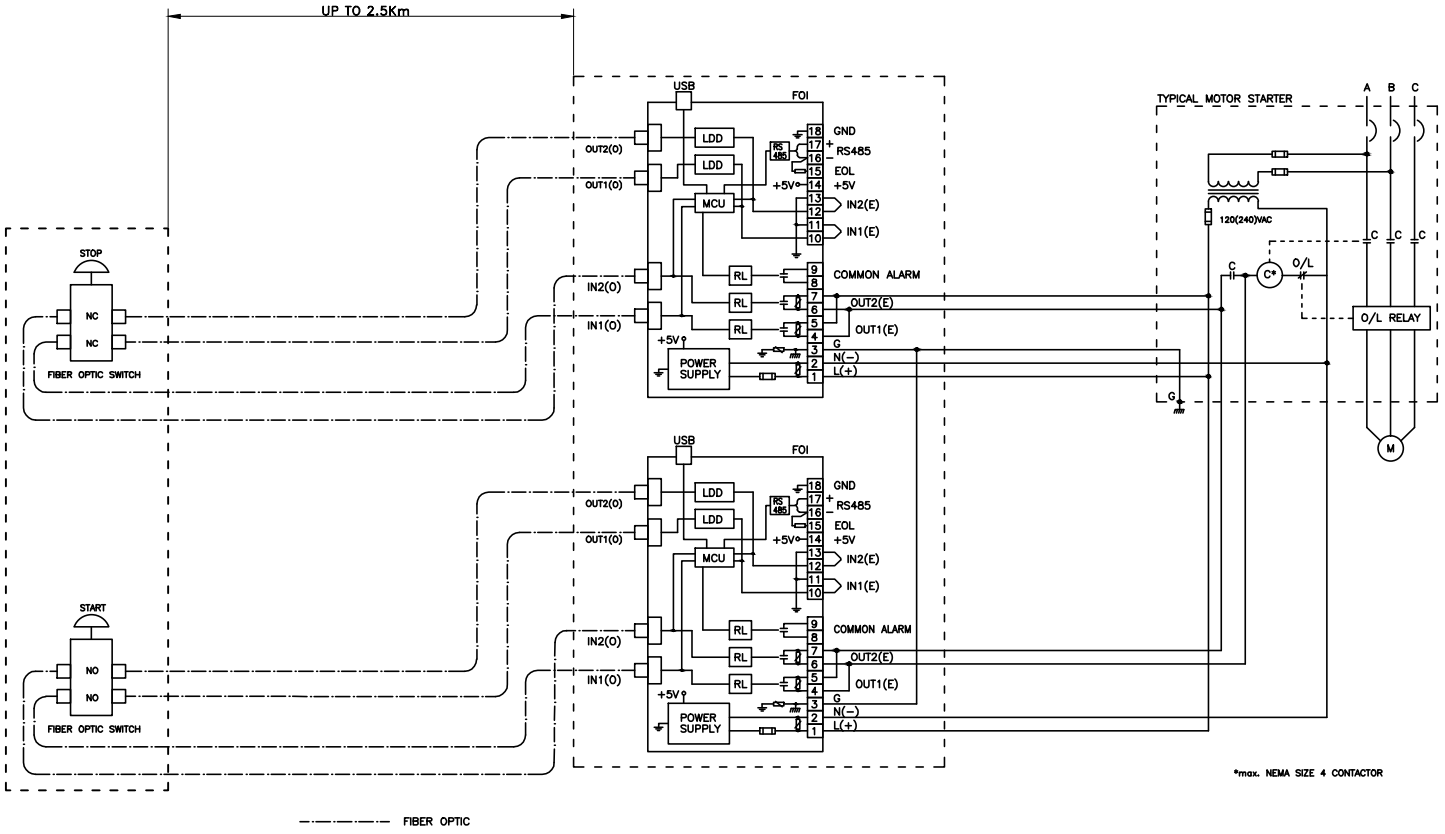


TYPICAL START–STOP CONTROL OF A MOTOR STARTER USING FIBER OPTIC AND PLC INTERLOCK

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL

APPLICATION B

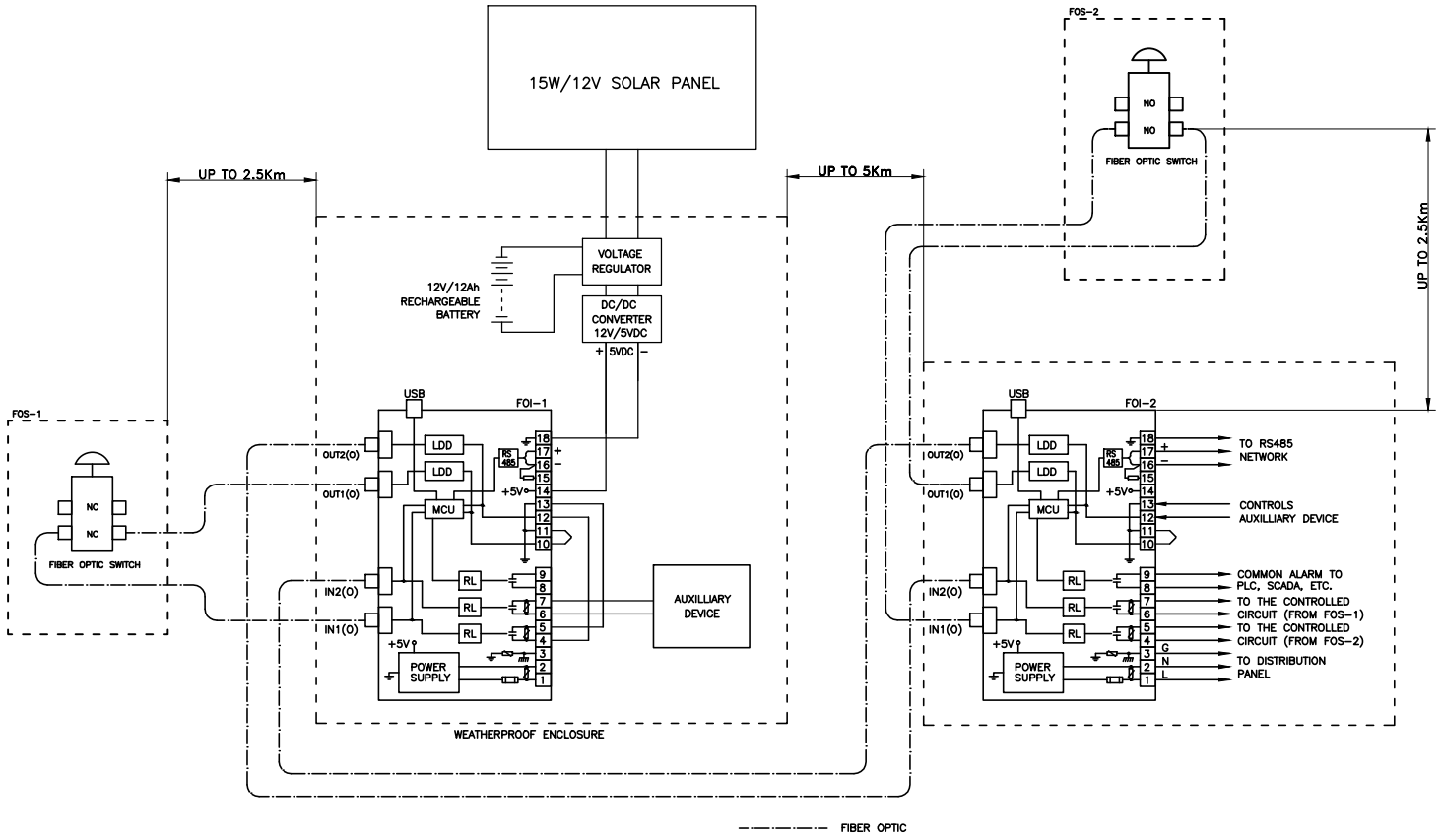


TYPICAL REDUNDANT START–STOP CONTROL OF A MOTOR STARTER USING FIBER OPTIC

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL

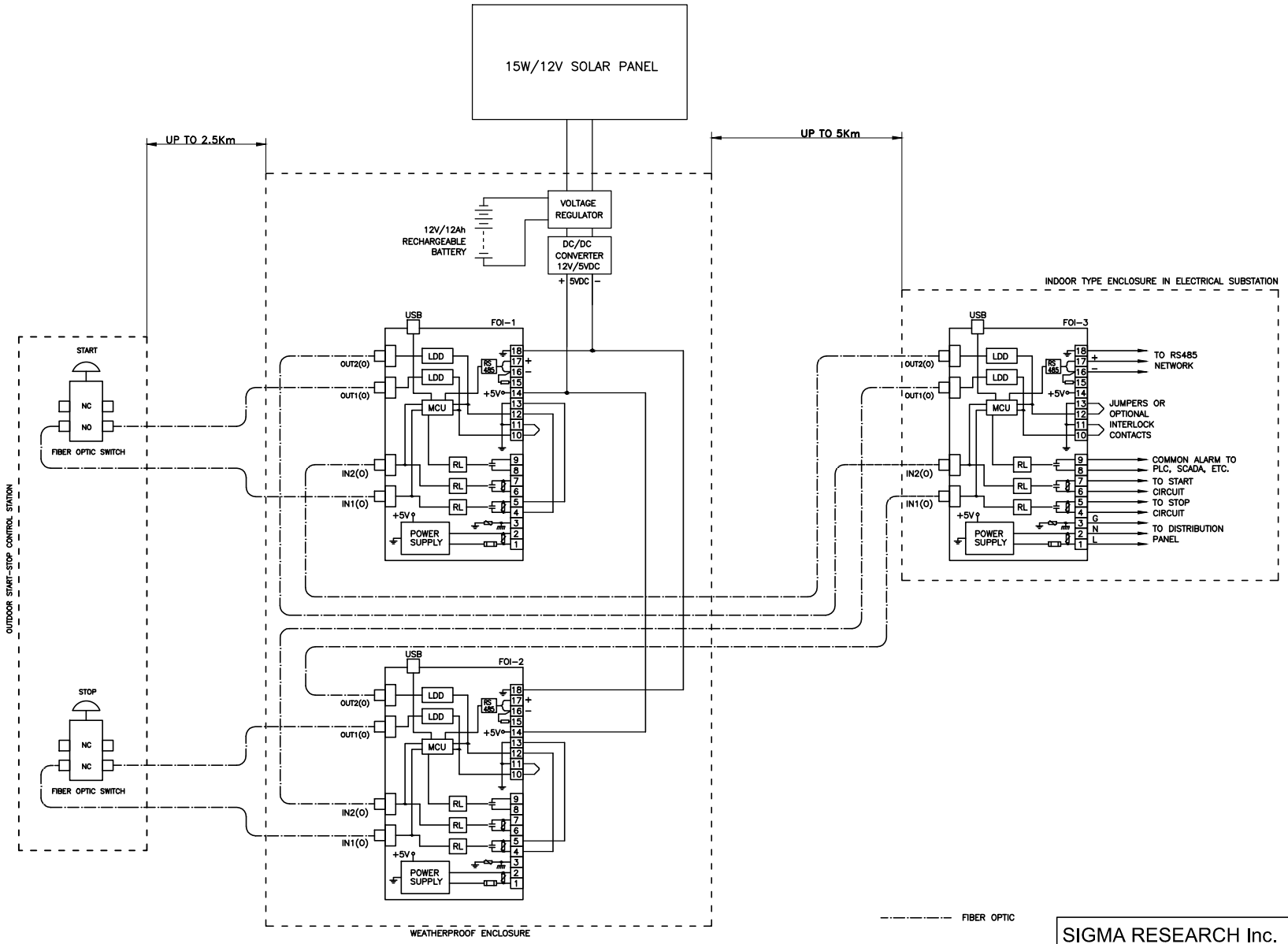
APPLICATION C



FIBER OPTIC INTERFACE WITH ONE FIBER OPTIC SWITCH IN REMOTE LOCATION

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL
APPLICATION D

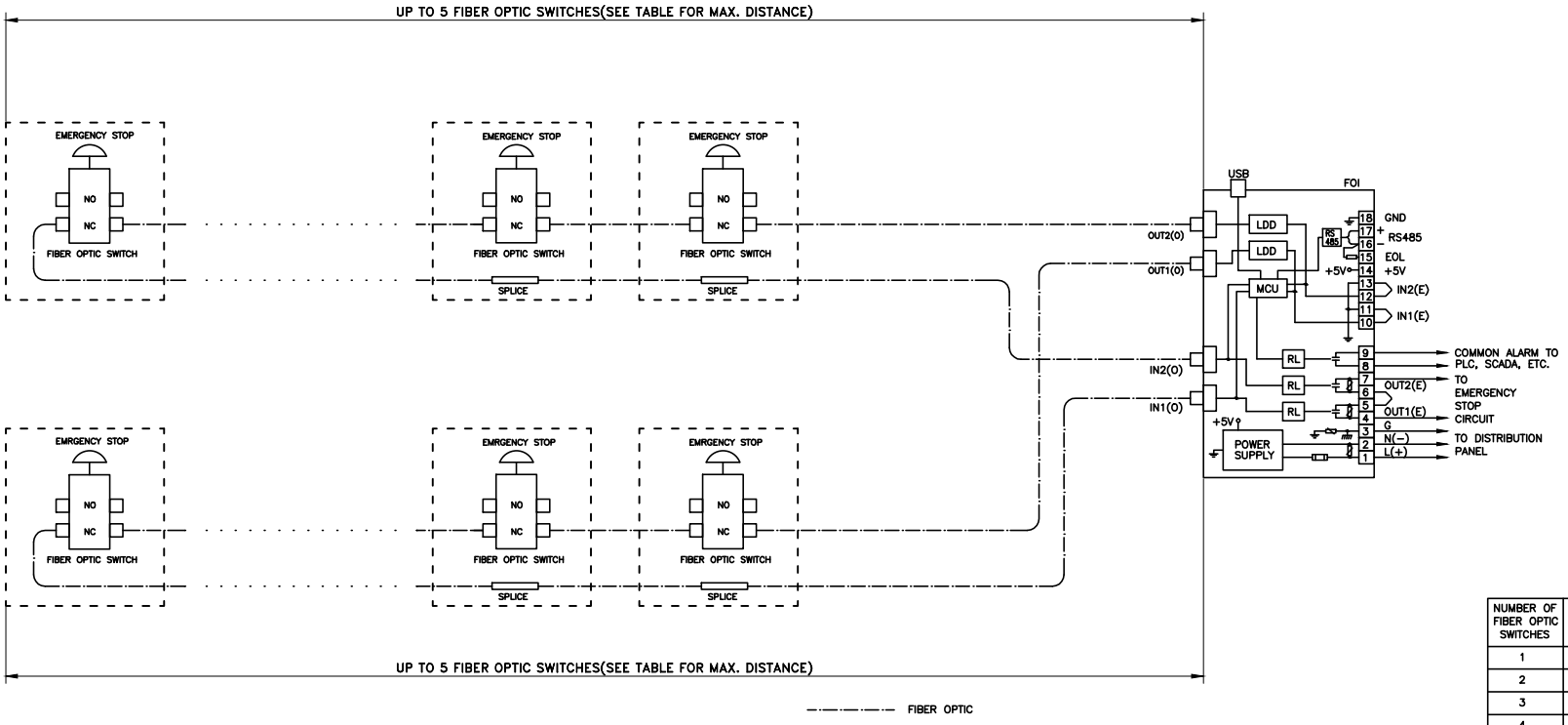


FIBER OPTIC INTERFACE WITH TWO FIBER OPTIC SWITCHES IN REMOTE LOCATION

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL

APPLICATION E



NUMBER OF FIBER OPTIC SWITCHES	MAXIMMUM DISTANCE* m (ft)
1	2,500m(8,200')
2	2,000m(6,560')
3	1,500m(4,920')
4	1,000m(3,280')
5	100m(328')

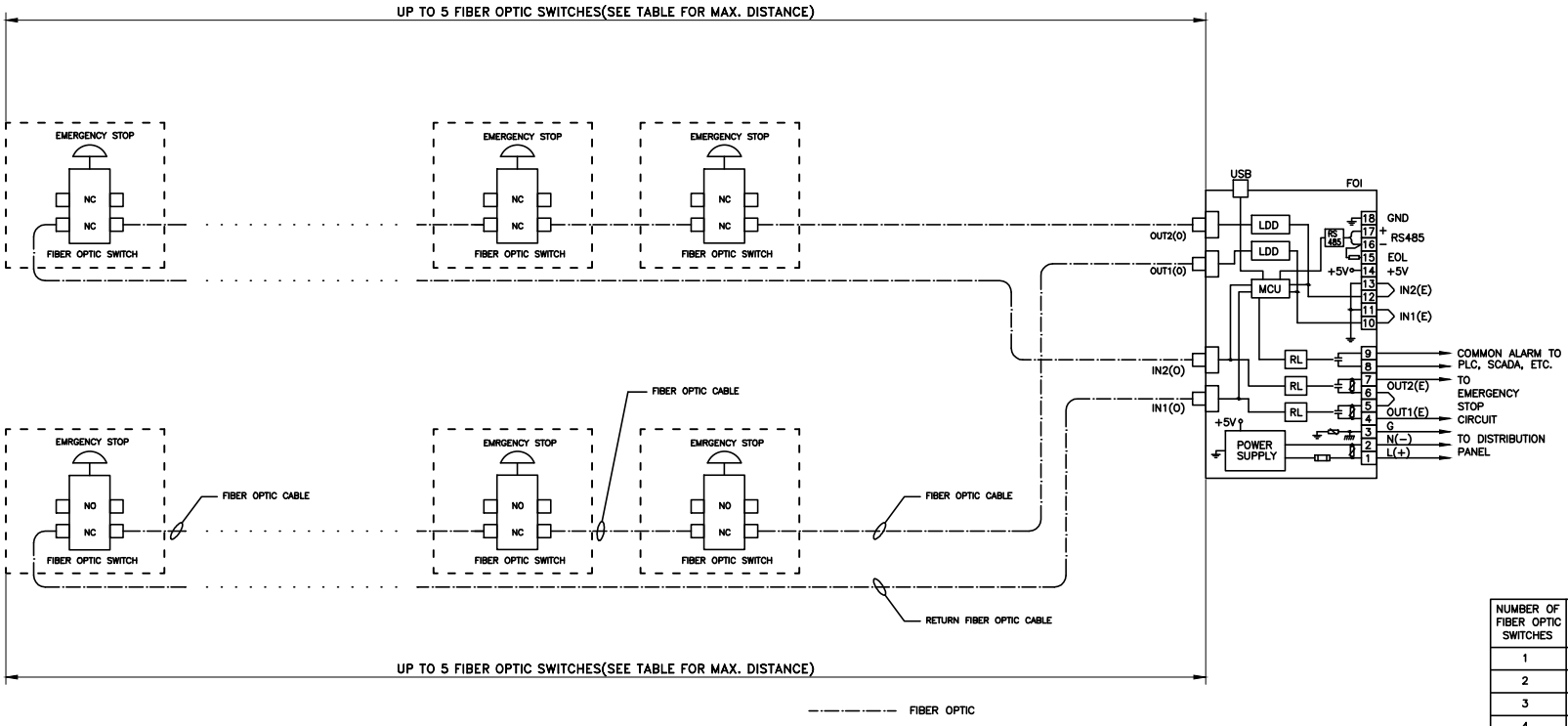
* THIS IS THE THEORETICAL MAX. DISTANCE. TO DETERMINE THE EXACT DISTANCE, PERFORM AN OPTICAL POWER BUDGET CALCULATION, TAKING INTO COSIDERATION THE POWER LOSS PRODUCED BY ALL FO SPLICES, CONNECTORS, ETC.

FIBER OPTIC SWITCHES CONNECTED IN SERIES

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL

APPLICATION F



NUMBER OF FIBER OPTIC SWITCHES	MAXIMMUM DISTANCE* m (ft)
1	2,500m(8,200')
2	2,100m(6,900')
3	1,700m(5,580')
4	1,200m(3,940')
5	300m(985')

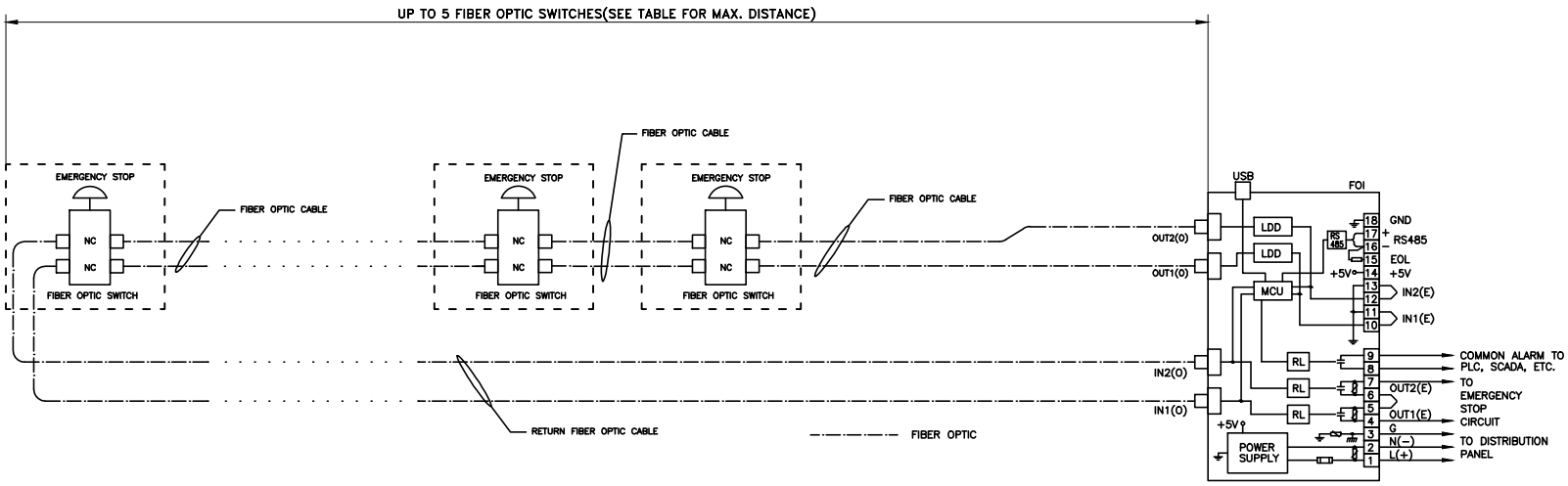
* THIS IS THE THEORETICAL MAX. DISTANCE. TO DETERMINE THE EXACT DISTANCE, PERFORM AN OPTICAL POWER BUDGET CALCULATION, TAKING INTO COSIDERATION THE POWER LOSS PRODUCED BY ALL FO SPLICES, CONNECTORS, ETC.

FIBER OPTIC SWITCHES CONNECTED IN SERIES WITH SEPARATE RETURN FIBER OPTIC CABLE

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL

APPLICATION G



NUMBER OF FIBER OPTIC SWITCHES	MAXIMMUM DISTANCE* m (ft)
1	2,500m(8,200')
2	2,100m(6,900')
3	1,700m(5,580')
4	1,200m(3,940')
5	300m(985')

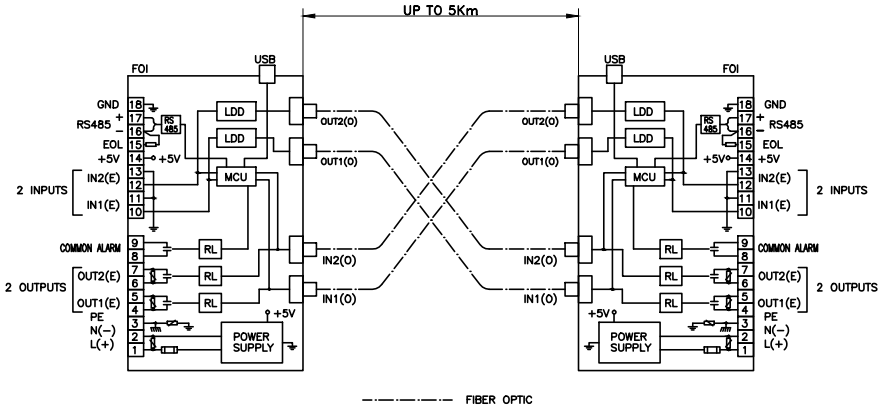
* THIS IS THE THEORETICAL MAX. DISTANCE. TO DETERMINE THE EXACT DISTANCE, PERFORM AN OPTICAL POWER BUDGET CALCULATION, TAKING INTO COSIDERATION THE POWER LOSS PRODUCED BY ALL FO SPLICES, CONNECTORS, ETC.

FIBER OPTIC SWITCHES IN REDUNDANT MODE CONNECTED IN SERIES WITH SEPARATE RETURN FIBER OPTIC CABLE

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL

APPLICATION H

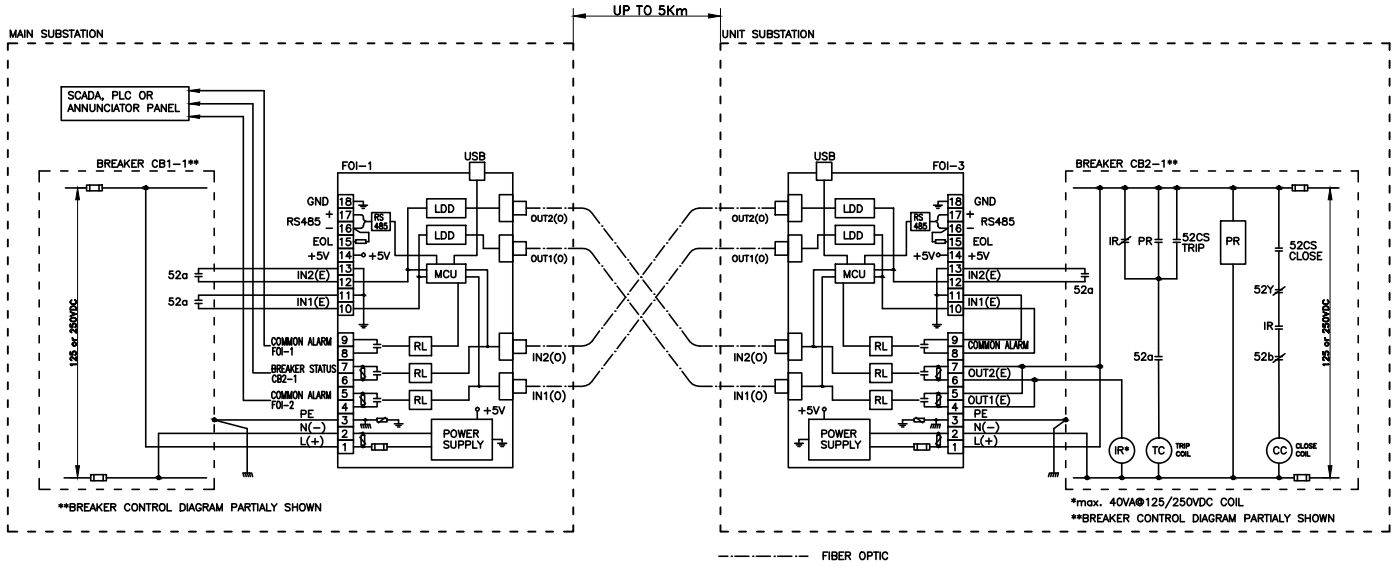


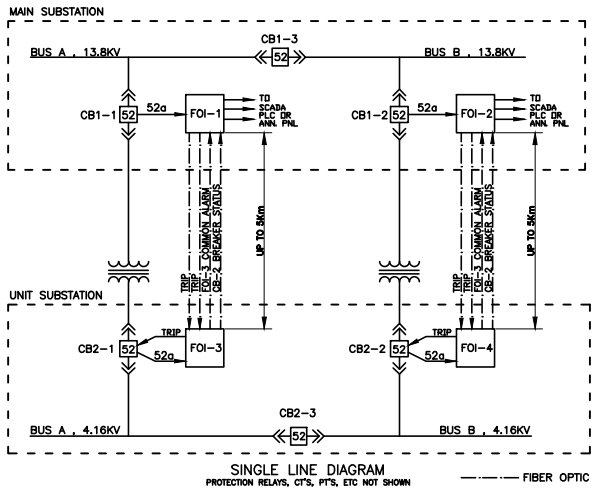
BI-DIRECTIONAL I/O TRANSMISSION OVER FIBER OPTIC

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE-APPLICATION MANUAL

APPLICATION I





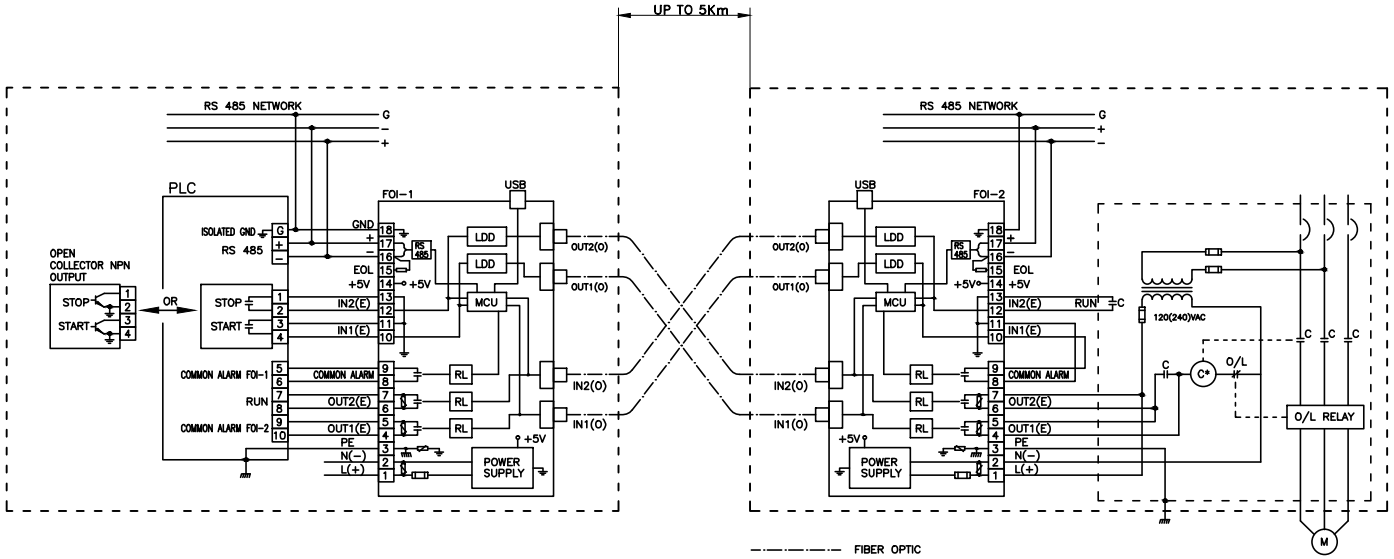
LEGEND

FOI – FIBER OPTIC INTERFACE
52a – BREAKER POSITION CONTACT (NORMALLY OPEN)
52b – BREAKER POSITION CONTACT (NORMALLY CLOSED)
52Y – ANTI-PUMP RELAY CONTACT
52CS – BREAKER CONTROL SWITCH
PR – PROTECTION RELAY

BREAKER INTERTRIPING IN REDUNDANT CONFIGURATION

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL
APPLICATION J

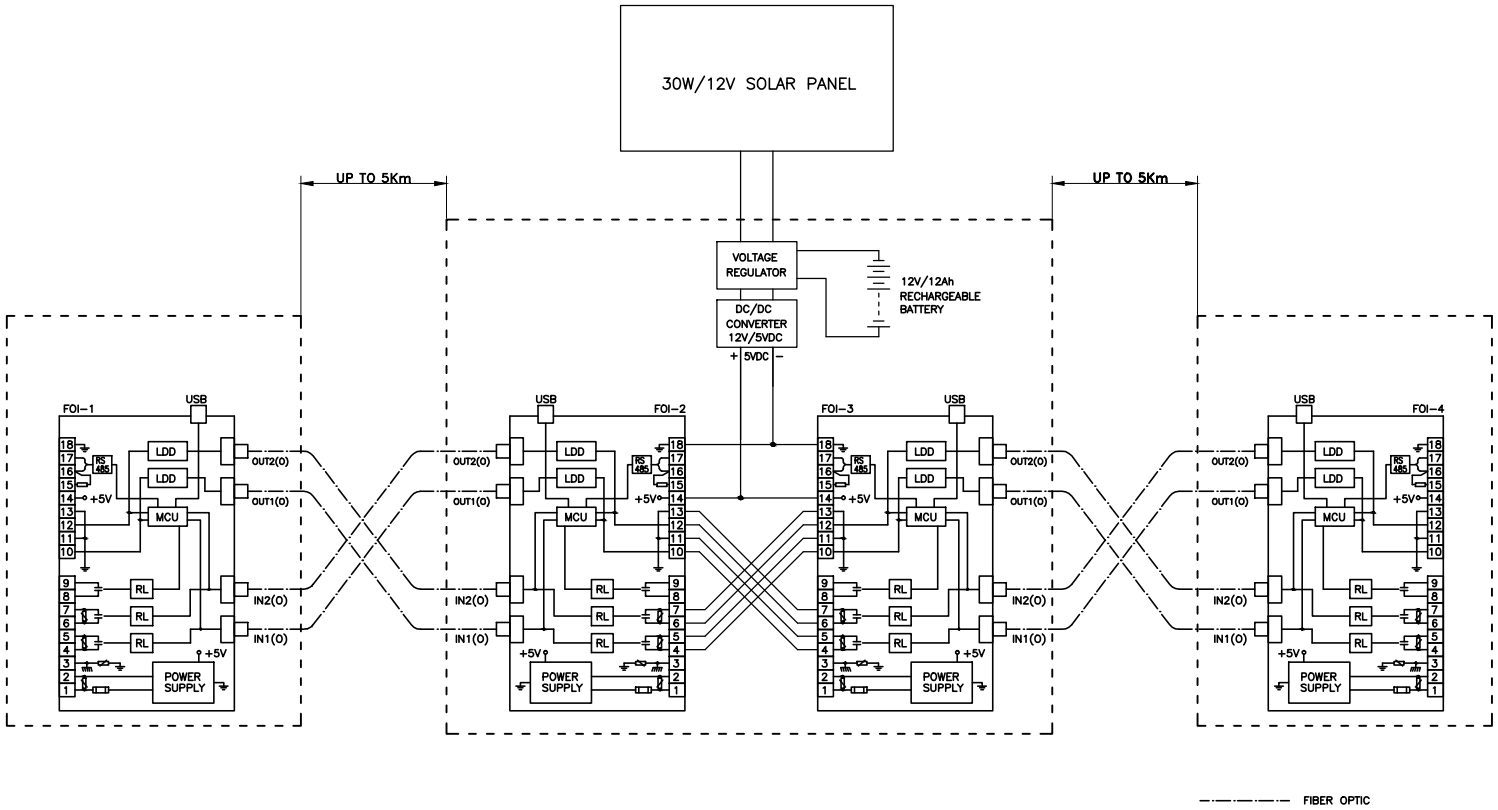


MOTOR STARTER WITH PLC CONTROL OVER FIBER OPTIC

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL

APPLICATION K

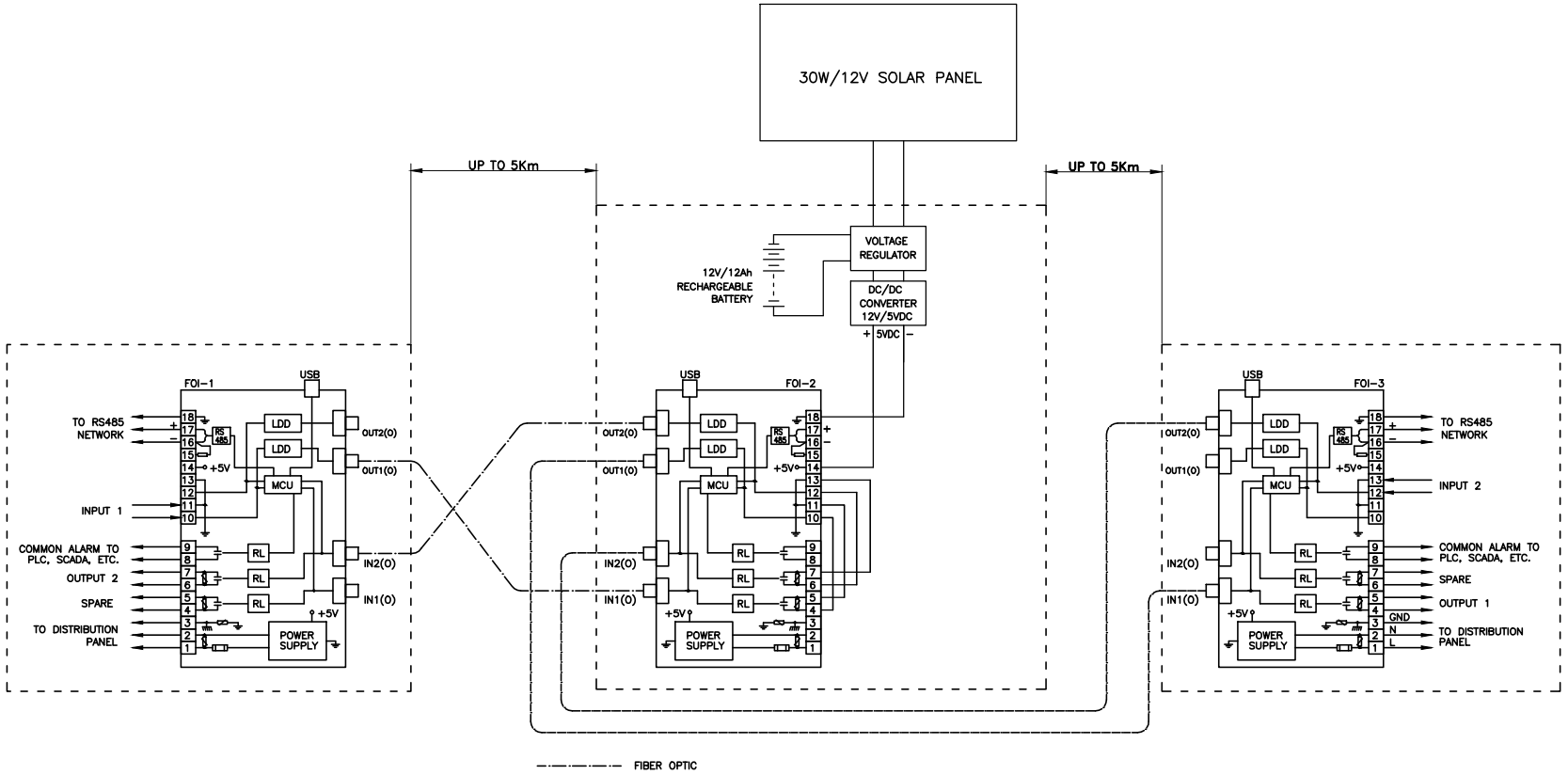


BI−DIRECTIONAL REPEATER WITH DUAL I/O IN REMOTE LOCATION

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE−APPLICATION MANUAL

APPLICATION L

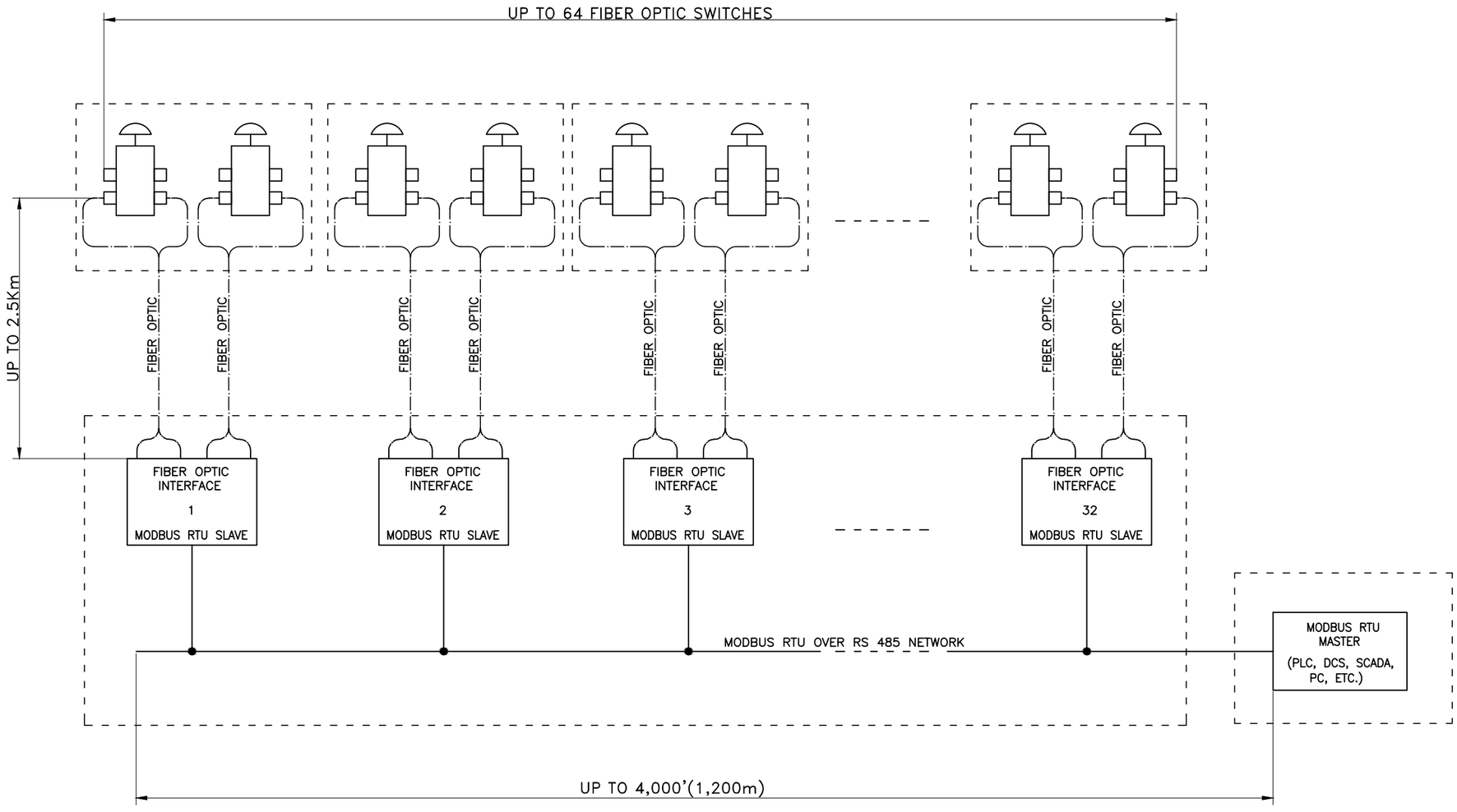


BI–DIRECTIONAL REPEATER WITH SINGLE I/O IN REMOTE LOCATION

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL

APPLICATION M

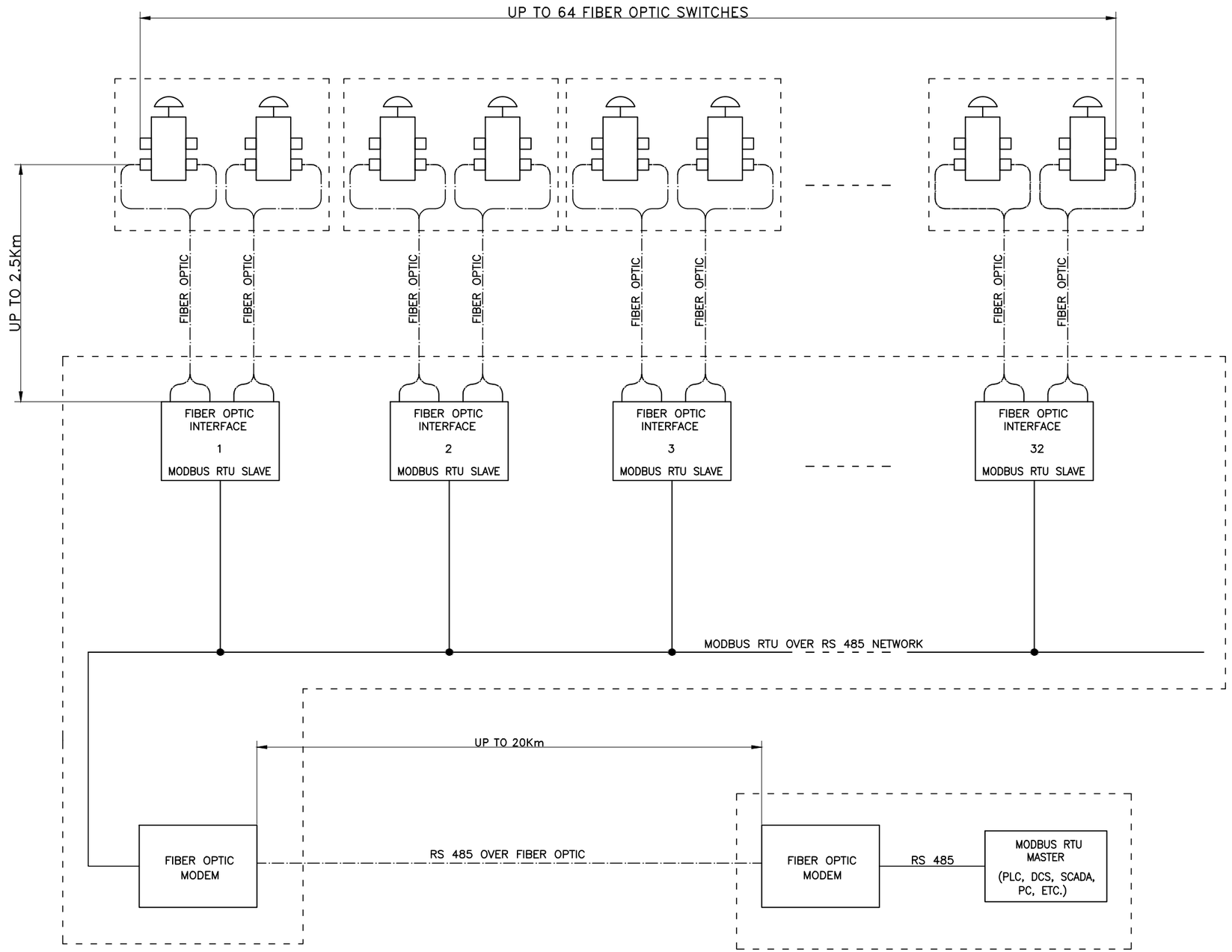


NETWORKABLE SWITCHES OVER RS485

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL

APPLICATION N

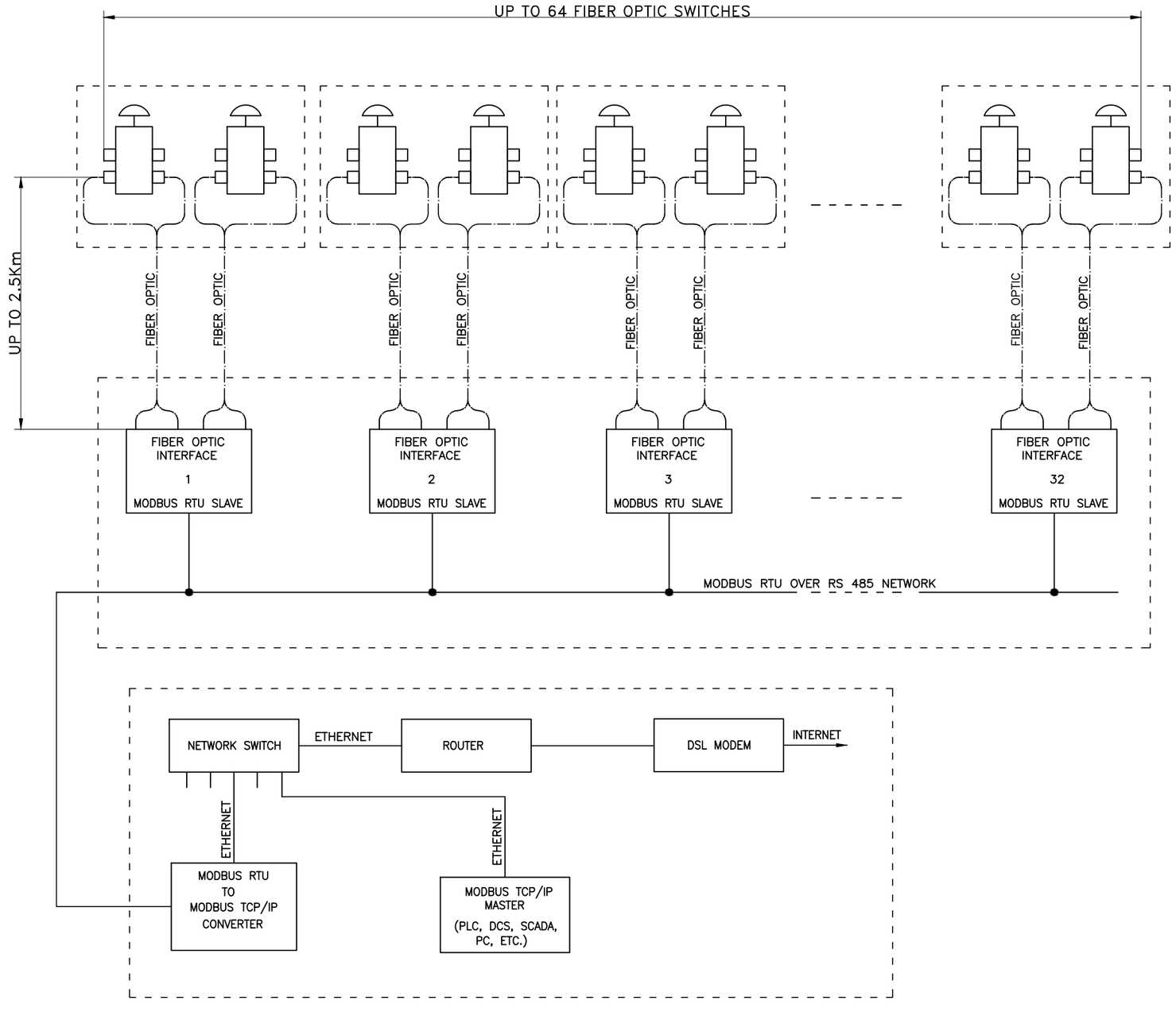


NETWORKABLE SWITCHES OVER RS485 WITH EXTENDED RANGE OVER FIBER OPTIC

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL

APPLICATION 0

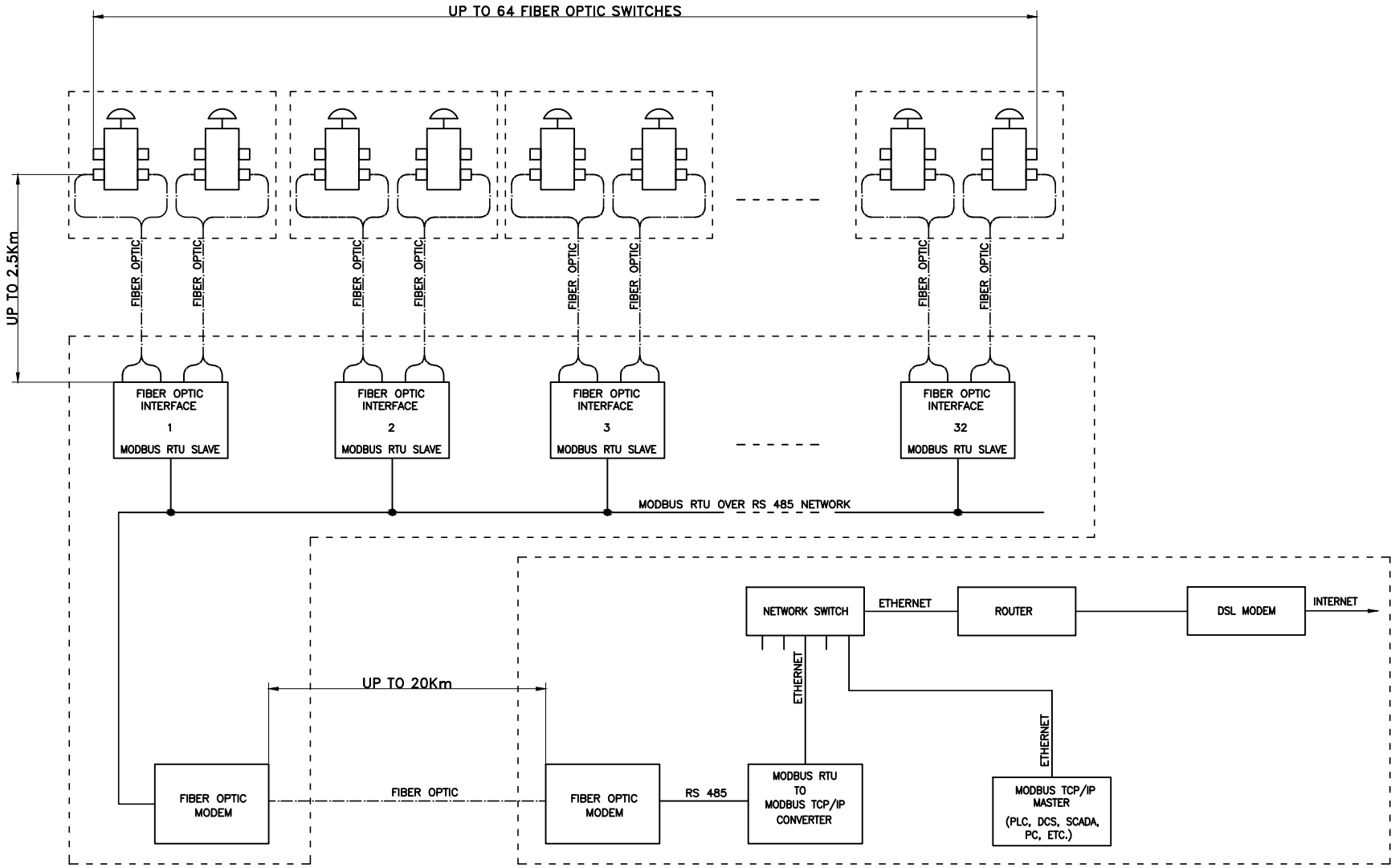


NETWORKABLE SWITCHES OVER RS485 AND ETHERNET

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL

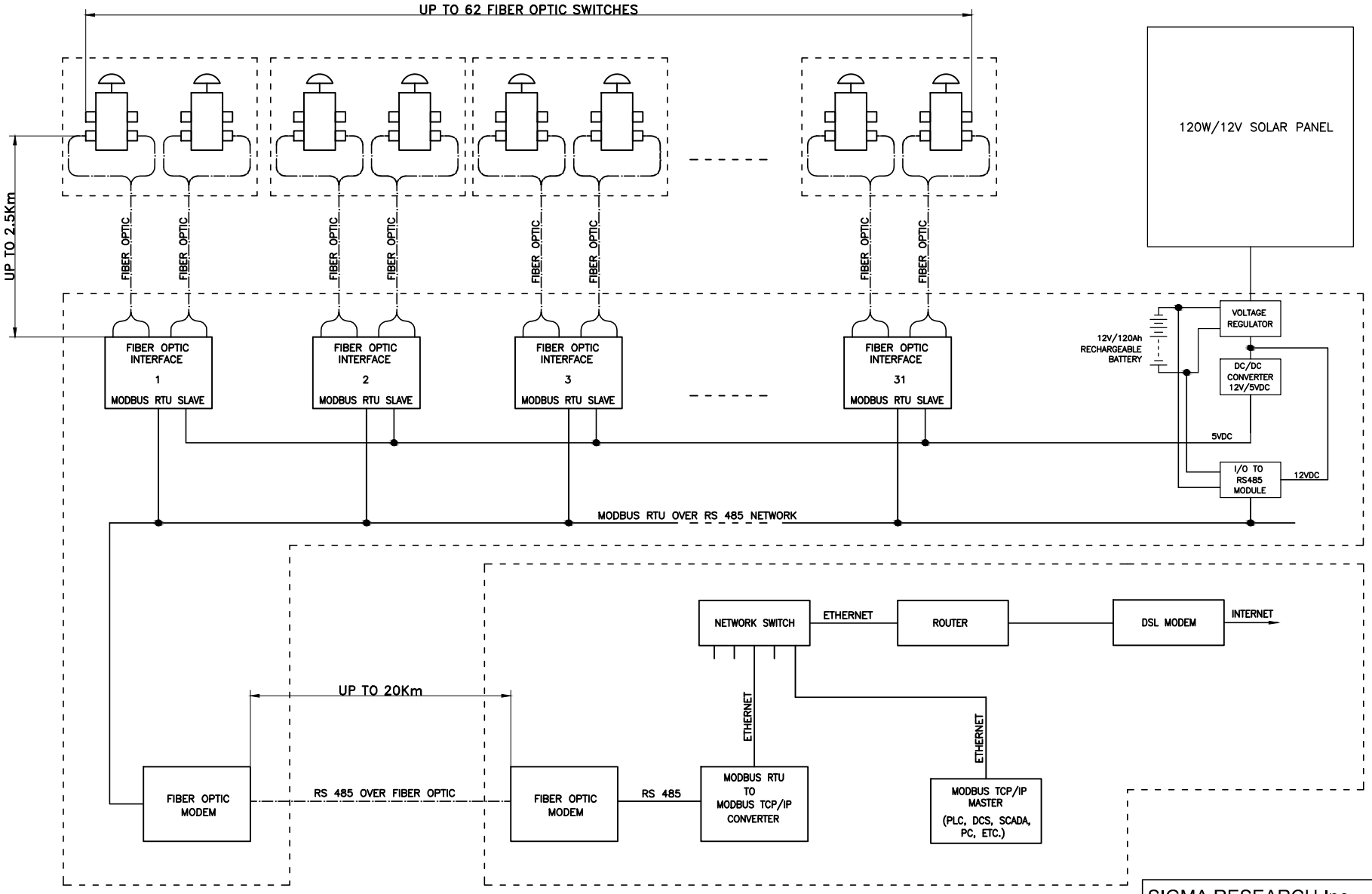
APPLICATION P



NETWORKABLE SWITCHES OVER RS485 AND ETHERNET WITH EXTENDED RANGE

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL
APPLICATION Q



NETWORKABLE SWITCHES OVER RS485 AND ETHERNET IN REMOTE LOCATION WITH BATTERY VOLTAGE MONITORING

SIGMA RESEARCH Inc.

FIBER OPTIC INERFACE–APPLICATION MANUAL
APPLICATION R