HPS/RFL C37.94-T1 FSU Installation and Setup Guide

This document covers the installation and setup procedures for the HPS/RFL C37.94-T1 Fiber Service Unit (FSU). Instructions are included for the wall-mount and Rackmount versions. The following picture is the front of the wall-mount FSU.

Hubbell Power Systems, Inc. – RFL™ Products

353 Powerville Road ● Boonton Twp., NJ 07005-9151 USA

Tel: 973.334.3100 ● Fax: 973.334.3863

Email: Customer.Service@RFLelect.com ● www.rflelect.com

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Safety Instructions

Warnings and Safety Summary

The equipment described in this manual contains high voltage. Exercise due care during operation and servicing. Read the safety summary below.

Safety Summary

The following safety precautions must be observed at all times during operation, service, and repair of this equipment. Failure to comply with these precautions, or with specific warnings elsewhere in this manual, violates safety standards of design, manufacture, and intended use of this product. HPS/RFL assumes no liability for failure to comply with these requirements.

Ground the Chassis

The chassis must be grounded to reduce shock hazard and allow the equipment to perform properly. All DC equipment is provided with a rear-panel protective earth terminal, which must be connected to a proper electrical ground by suitable cabling. The location of the protective earth terminal is shown below. Refer to the wiring diagram, if supplied, with the unit for additional information on chassis and/or cabinet grounding.

A protective earth stud is located at the right rear wall-mount and the Rackmount units. Connect ground to the Ground Stud or directly to the Terminal Block.

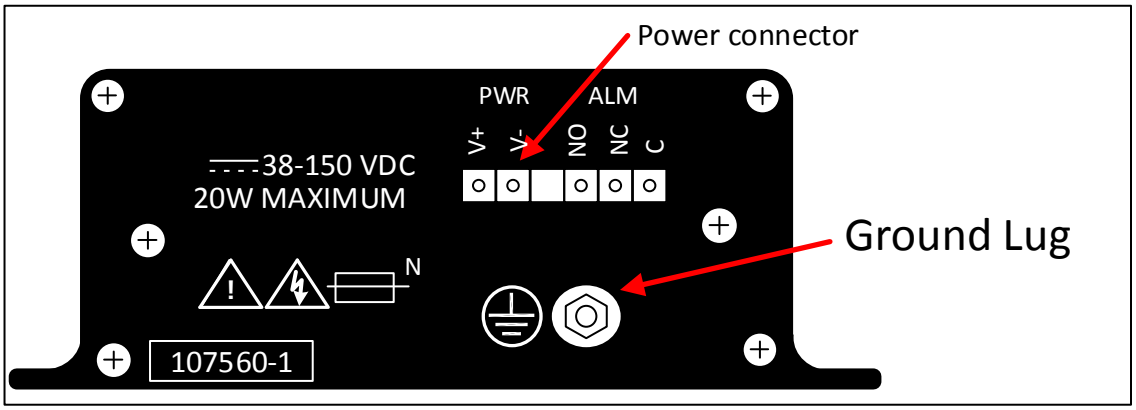


Figure 1. Location of FSU Wall-Mount Protective Earth Stud - Rear Panel

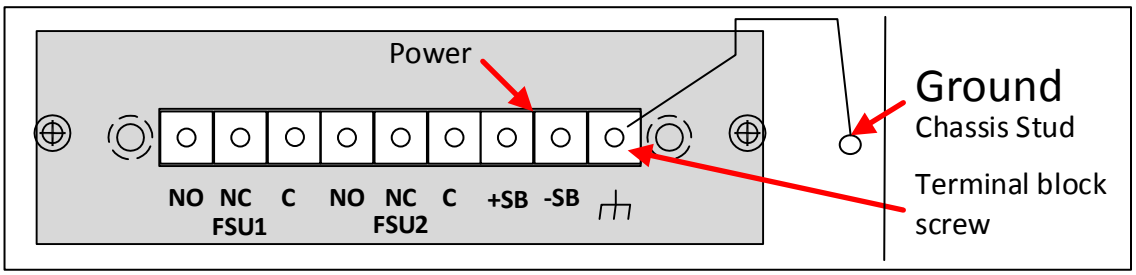


Figure 2. Location of FSU Rackmount Protective Earth Stud - Rear Panel

Do not Operate in an Explosive Atmosphere or in Wet or Damp Areas

Do not operate the product in the presence of flammable gases or fumes, or in any area that is wet or damp. Operating any electrical equipment under these conditions can result in a definite safety hazard.

Keep Away from Live Circuits

Operating personnel should never remove covers. Component replacement and internal adjustments must be done by qualified service personnel. **Before attempting any work inside the product, disconnect it from the power source.** This will remove any dangerous voltages that may still be present after power is removed.

Unrestricted operator access is only permitted to the front of the unit when hazardous voltage is applied. It is the responsibility of the installer to restrict access to the rear terminal blocks where hazardous voltage may exist.

Do not Substitute Parts or Modify Equipment

Because of the danger of introducing additional hazards, do not install substitute parts or make unauthorized modifications to the equipment. The product may be returned to HPS/RFL for service and repair, to ensure that all safety features are maintained.

Read the Manual

Operators should read this manual before attempting to use the equipment, to learn how to use the equipment properly and safely. Service personnel must be properly trained and have the proper tools and equipment before attempting to make adjustments or repairs.

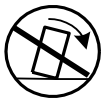
Service personnel must recognize that whenever work is being done on the product, there is a potential electrical shock hazard and appropriate protection measures must be taken. Electrical shock can result in serious injury, because it can cause unconsciousness, cardiac arrest, and brain damage.

Throughout this manual, warnings appear before procedures that are potentially dangerous, and cautions appear before procedures that may result in equipment damage or service outage if not performed properly. The instructions contained in these warnings and cautions must be followed exactly.

Additional Warnings

WARNING!
Follow all of your company's policies and procedures regarding the installation of DC powered equipment. If there is a conflict between any procedure in this manual and your company's safety rules, then your company's safety rules must take priority.

Additional Cautions



CAUTION

Any installation using an enclosed cabinet with a swing-out rack must be securely fastened to the floor. This will prevent the cabinet from falling forward when the rack is moved outward.

CAUTION

This equipment contains static sensitive devices. Persons working on this equipment must observe electro static discharge (ESD) precautions before opening the unit or working on the rear of the chassis. As a minimum you must do the following: Use anti-static devices such as wrist straps and floor mats.

Additional warnings and cautions appear throughout the manual, these warnings and cautions must be followed exactly.

NOTICE
RFL products are not designed for safety critical direct control of nuclear reactors and should not be used as such.

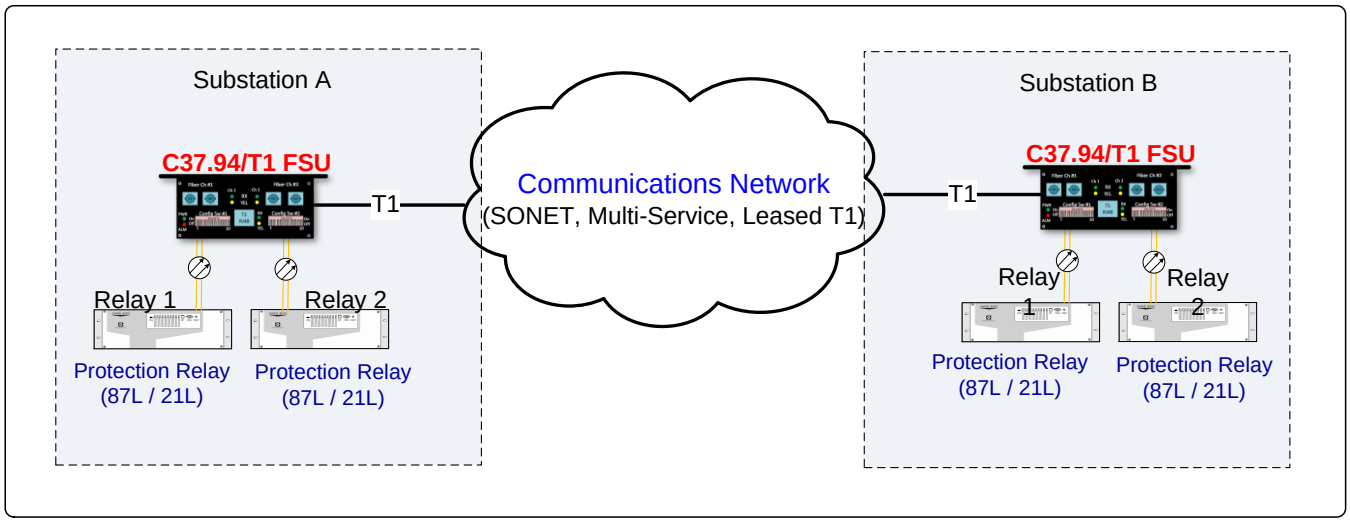
NOTICE
The use of ungrounded instruments such as hand held voltmeters has been shown to generate Electro-Static Discharge. Care should be taken when using such devices on test points internal to HPS/RFL equipment. Specifically, the use of probes manufactured under the Pomona brand is not recommended.

DESCRIPTION

The HPS/RFL C37.94-T1 Fiber Service Unit (FSU) is standalone device that serves as a media converter between electrical T1 signals and optical IEEE C37.94 fiber protocol.

Each FSU allows for the conversion of up to two [2] C37.94 output devices into a single T1. The C37.94 fiber interface comes also with a non-standard Single-mode LED as an option for longer distances. The FSU is manufactured for wall/panel mounting, however, a rack mounting option is available with 1RU (1.75") 19" rack mount chassis.

The T1 port can interface with the HPS/RFL IMUX 2000, HPS/RFL GARD and other types of T1 multiplexers and terminals. The fiber port interfaces with C37.94-compliant Short Haul Fiber end devices.



The characteristics of the units are shown in **TABLE 1** and **TABLE 2**. Mounting dimensions for the Wall-mount unit are shown in **FIGURE 10** and dimensions for the rackmount are show in **FIGURE 11**.

Table 1. FSU T1 Characteristics

Assy. Num. Multimode	Assy. Num. Single Mode	Interface Type	Interface Cable Connector	Pinouts
Wall-mount RF-SP107560-1 **Rackmount** RF-SP107580-1 RF-SP107580-3	**Wall-mount** RF-SP107560-2 **Rackmount** RF-SP107580-2 RF-SP107580-4	T1 ESF/SF and AMI/B8ZS (Switch selectable)	RJ48C	1,2 = RX, 4,5 = TX, 7,8 = Chassis ground

Table 2 FSU Fiber Characteristics

Assembly Number	Type	Wavelength/ Mode	Connector Type	Fiber Type	Typical Distance (3dB margin)
Wall-mount units					
RF-SP107560-1	One FSU Multi-mode	820/850nm LED (Short Haul)	ST	50 or 62.5 um multi-mode	13db, equiv. 2km
RF-SP107560-2	One FSU Single mode	1300nm LED (Short Haul)	ST	9 um single-mode	equiv. 10km
Rackmount units					
RF-SP107580-1	One Multimode FSU	820/850nm LED (Short Haul)	ST	50 or 62.5 um multi-mode	13db, equiv. 2km
RF-SP107580-2	One Single-mode FSU	1300nm LED (Short Haul)	ST	9 um single-mode	equiv. 10km
RF-SP107580-3	Two Multi-mode FSUs	820/850nm LED (Short Haul)	ST	50 or 62.5 um multi-mode	13db, equiv. 2km
RF-SP107580-4	Two Single-mode FSUs	1300nm LED (Short Haul)	ST	9 um single-mode	equiv. 10km

SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the HPS/RFL C37.94-T1 FSU. Because all HPS/RFL products undergo constant refinement and improvement, these specifications are subject to change without notice.

IEEE Standard: C37.94-2002 for N times 64 kilobit per second optical fiber interfaces between teleprotection and multiplexer equipment.

T1 Signal Connector Type:
RJ48C

Data Rate: Programmable from 64 kb/s to 768 kb/s in accordance with **TABLE 6**.

Power Supply Specifications

Supply Voltage:	48/125Vdc nominal (38 to 150Vdc)
Power Consumption:	Less than 10W for single wall-mount and single rackmount Less than 20W for rackmount configuration with two FSUs

Environmental considerations

Operating Temperature:
-20^{O}C to +55^{O}C (-22^{O}F to +140^{O}F)

Relative Humidity: 95 percent @ 40^{o}C, non-condensing.

Dimensions for wall-mount units: Shown in **FIGURE 10**.

Width:	5.13 inches (13 cm)
Height:	1.77 inches (4.5 cm)
Depth:	11 inches (28 cm)

Dimensions, Rackmount Unit: Shown in **FIGURE 11**

Width:	19 inches nominal, hole spacing 18.312 inches
Height:	1.72 inches
Depth:	approximately 12.75 inches

Alarm Output

Alarm Relay Contact: Form C (SPDT)
Contact Rating: 100mA, @ 300Vdc, Non- inductive

System

- IEC 61850-3: Environmental
- EN 61000-4-3 / -6-4: Radiated RFI Immunity
- EN 61000-4-6 / -6-2: Conducted RFI Immunity
- IEEE 1613: Environmental, ESD, shock & vibration

Power supply and alarm

- EN 61000-4-4 / IEEE 1613: EFT 4kV
- EN 61000-4-5: Surge
- EN 60255-1 / IEEE 1613: 2.8kV Hi-Pot, 5kV impulse
- EN 60255-22-1: Damped oscillatory
- IEEE 1613 / ANSI C37.90.1: Oscillatory
- IEC 60834-1: Power supply disturbance
- Bellcore TR332 Issue 5, Method 1: MTBF >1,000,000 Hours, Case 3, Temp = 25 C

FSU Wall-Mount Interfaces:

For more information see **FIGURE 5**

Front Panel

T1 Electrical:	One port
C37.94 optical:	Two port pairs

Rear Panel

Power Supply:	Compression terminal block, 2 positions: Supply Positive and Negative
Chassis Ground:	Grounding stud
Alarm Contacts:	Compression terminal block, 3 positions (form C)

FSU Rackmount Interfaces:

For more information see **FIGURE 7**

Rear Panel (See TABLE 2 for the configurations available)

T1 Electrical:	One port per FSU
C37.94 optical:	Two port pairs per FSU
Power Supply:	Screw terminal block, 3 positions: Supply Positive, Negative and ground
Ground:	Terminal Ground Screw
Alarm Contacts:	Screw terminal block, 3 positions (form C)

Note: If there is one FSU the FSU2 alarm contacts are not connected.

FSU INSTALLATION

Rackmount and Wall-Mount FSU Installation and Setup

Installation involves mounting the FSU module in its desired location, connecting all signal, coaxial and power cables, and programming the module data rate and other configuration settings.

To install the module, proceed as follows:

1. Carefully inspect the module for any signs of shipping damage. If you suspect damage to the module, immediately call HPS/RFL Customer Service at the number given at the bottom of this document.

2. Check the assembly number on the front panel of the module to make sure the unit is compatible with your interface requirement as shown in **TABLE 1** and **TABLE 2**.

NOTE
All cabling, to and from the C37.94-T1 FSU interface connector, must use shielded twisted pair to minimize crosstalk and interference from external sources.

CAUTION
Improper voltage to the C37.94-T1 FSU may result in component damage.
Before attempting to make power connections to the fiber service unit, make sure that your power source is compatible with the C37.94-T1 FSU.

A suitably rated power disconnect device and over current protection device (e.g. fuse or circuit breaker) must be installed in the FSU power feed from the station battery. The overcurrent protective device must be rated at 2A minimum, not to exceed the capacity of the feed wiring.

3. Install the C37.94-T1 FSU wall-mount using the dimensions in **FIGURE 10** and the rackmount as shown in **FIGURE 11.**

4. Connect input power to the following terminals on the rear-panel terminal block connector TB1, as shown in the back panel in **FIGURE 5** for the wall-mount unit and **FIGURE 7** for the rackmount unit.

Station battery positive:	Power connector V+
Station battery negative:	Power connector V-
Ground:	Ground connection

5. Fiber optic cables with type ST series bayonet fiber optic connectors must be connected to the fiber optic heads on the connector panel of the FSU and to the far end chassis. The connection points are shown in **FIGURE 5** for the wall-mount unit and **FIGURE 7** for the rackmount unit. When connecting fiber optic cables, make sure the connectors are properly aligned before locking. This will help minimize losses in the connector.

6. For the FSU select the data rate using DIP switches SW2 positions 1-4 for port 1 and SW2 positons 5-8 for port 2 in accordance with **TABLE 6**. The FSU data rate must be set to the same data rate as the unit at the other end of the fiber.

7. The FSU is now installed and is ready to be placed in service. For more information consult the Instruction Manual for the HPS/RFL GARD 8000 or IMUX 2000 as applicable.

Application Examples

The following examples show the RF-107560/RF-107580 connected in different networks.

Note: In the following figure the blocks representing the 107560 and 107580 emphasize signal flow. For the connectors see **FIGURE 5** for the wall-mount unit and **FIGURE 7** for the rackmount unit.

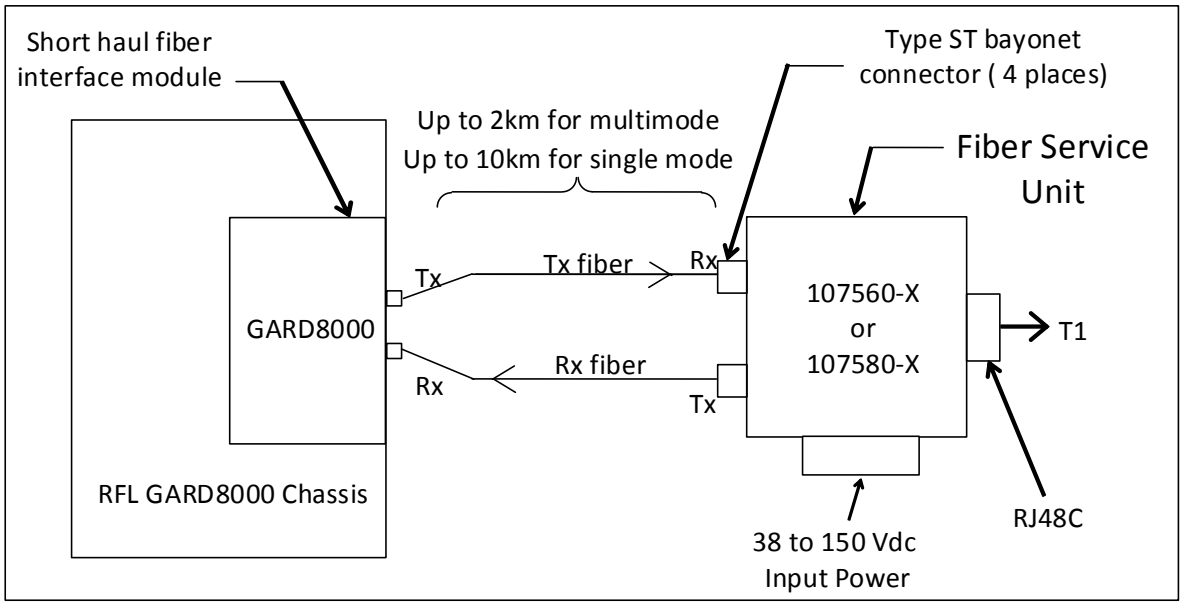


Figure 3. Connecting the FSU to an HPS/RFL GARD8000

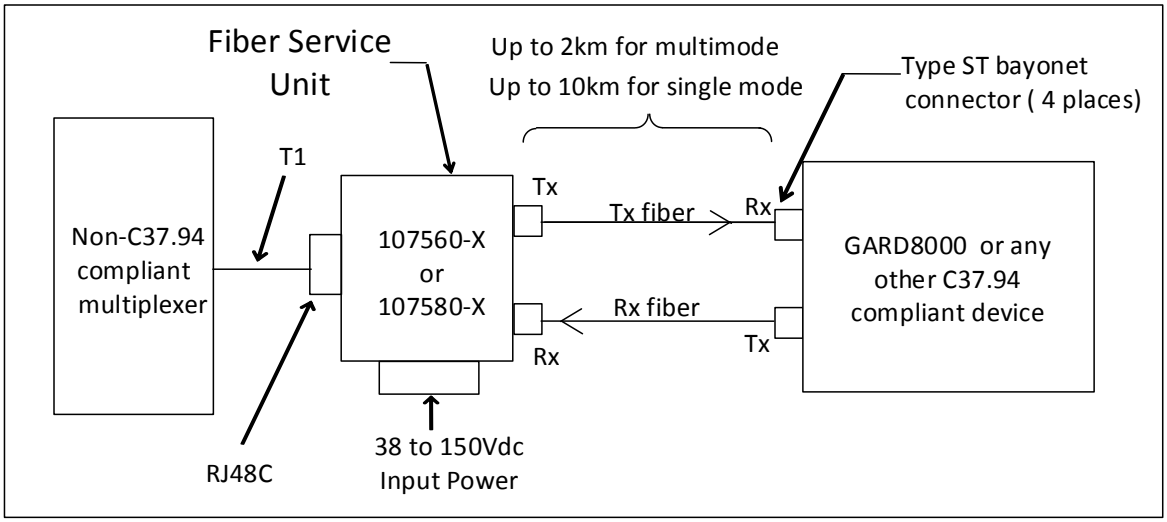


Figure 4 Connecting the FSU to a non-C37.94 compliant multiplexer

CONTROLS AND INDICATORS

The HPS/RFL C37.94-T1 Wall-Mount and Rackmount FSU (107560 and 107580 respectively) have user controls and indicators as shown in FIGURE 5 for wall-mount and FIGURE 7 for rackmount.

Wall-Mount FSU controls and indicators

FIGURE 5 shows the location of all controls, indicators and connectors on the front and rear panels of the FSU Wall-mount. The wall-mount FSU indicators are described TABLE 3 and controls (switches) are described in TABLE 5.

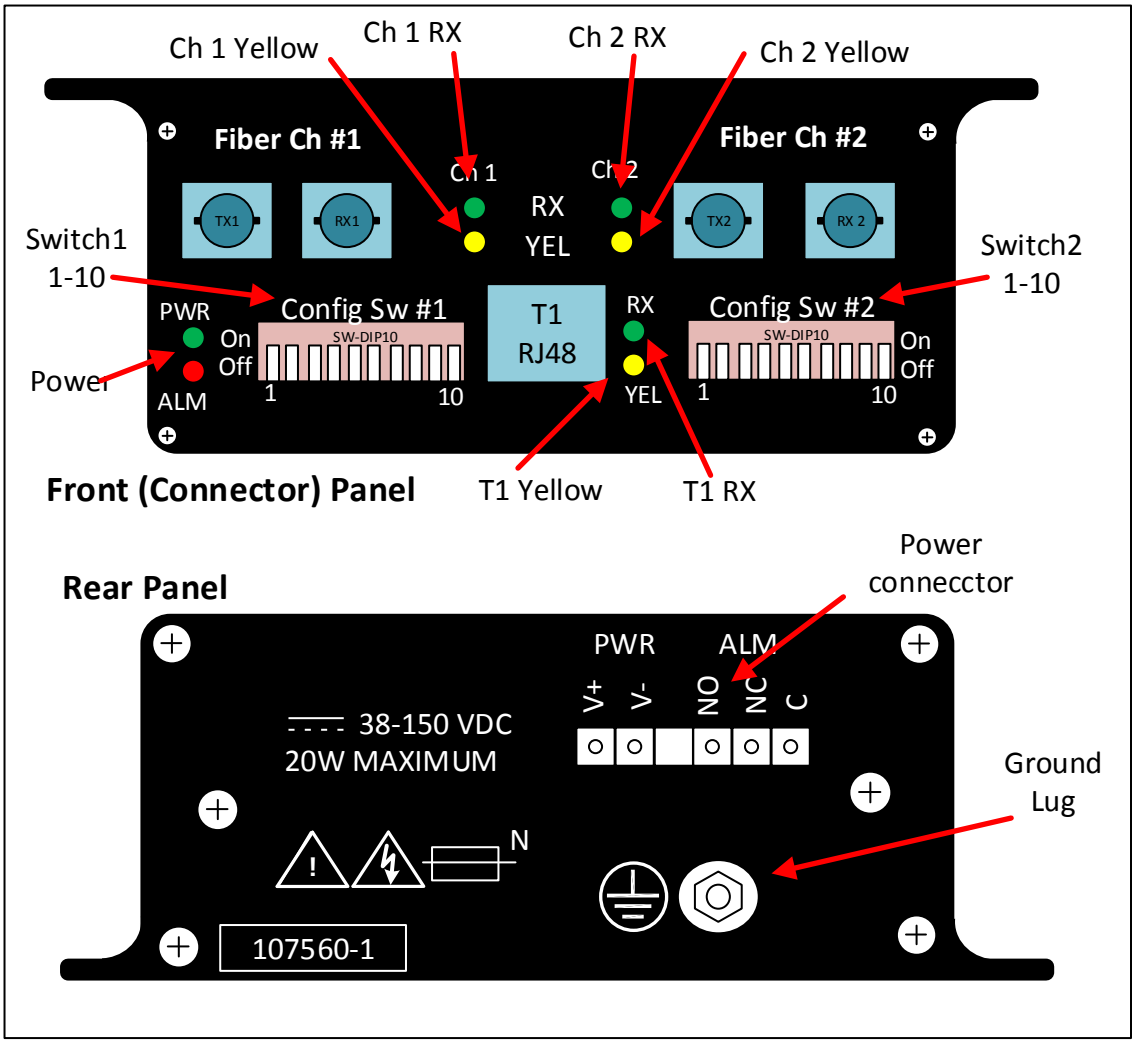


Figure 5 Wall-Mount FSU, front and rear panel controls and indicators (107560-1 and 107560-2)

Rackmount FSU front and rear panel

FIGURE 6 shows the location of indicators on the rear panels of the FSU rackmount.

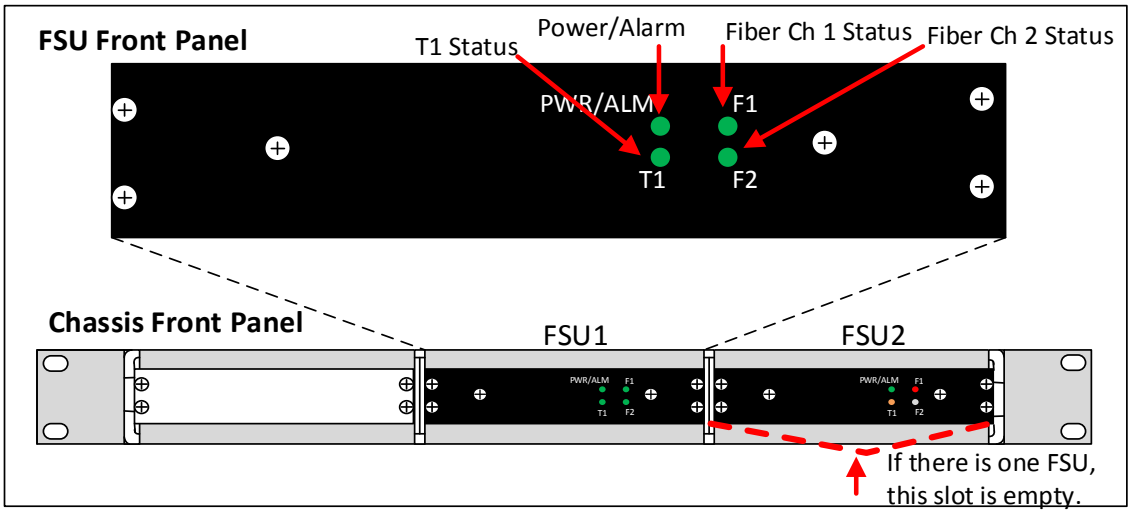


Figure 6 Rackmount FSU, front (107580-1 through -4)

FIGURE 7 shows the location of controls, indicators and connectors on the rear panels of the FSU rackmount. Rackmount FSU indicators are described TABLE 3 and controls are described in TABLE 5.

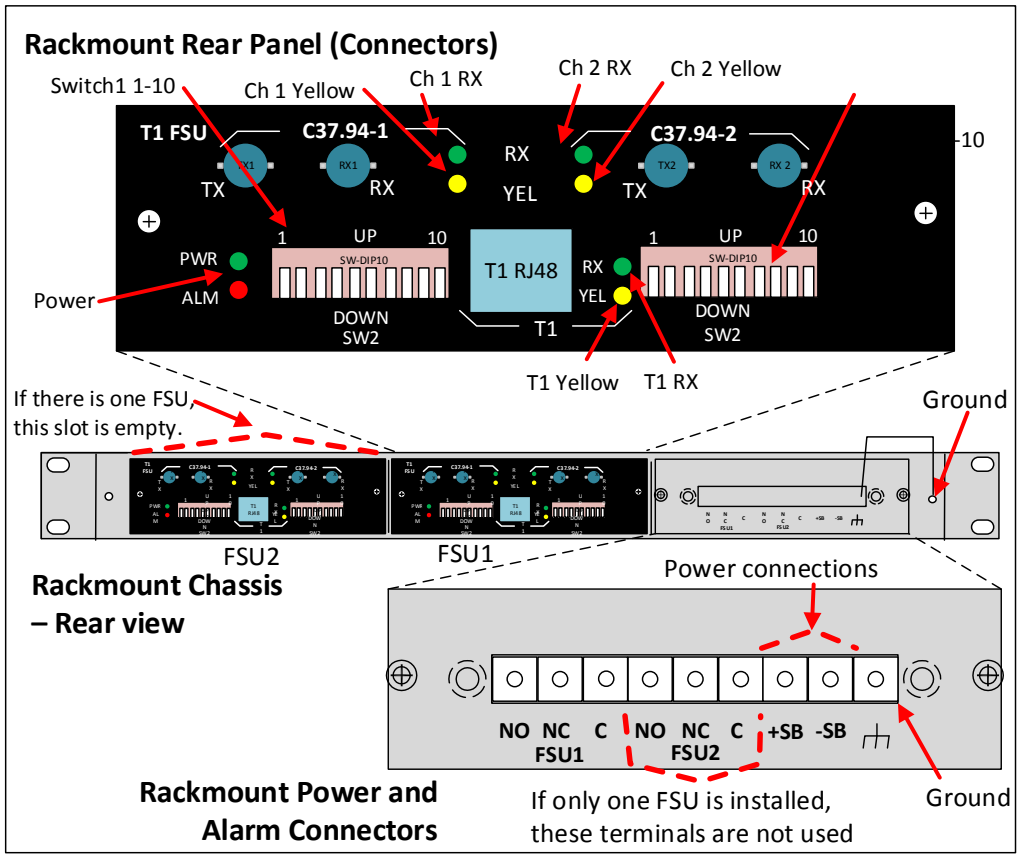


Figure 7 Rackmount FSU, rear panel controls and indicators (107580-1 through -4)

LED descriptions

To identify the LED indicator descriptions do the following:

1) Identify the LED label in the left column
2) Follow the row across to the color
3) Read the description for the LED indicator at the top of the column

Table 3 FSU Rackmount Front and Rear Panel indicators

		Description of Status					
LED	**Function**	**Power on**	**Alarm active**	**Interface enabled & RX alarm**	**Remote alarm received**	**Interface enabled & RX OK**	**Interface disabled**
Rackmount Front Panel Indicators (FIGURE 6)							
PWR/ALM	Power/Alarm	Green	Red				
T1	T1 Status			Red	Yellow	Green	
F1	Channel 1 status			Red	Yellow	Green	Off
F2	Channel 2 status			Red	Yellow	Green	Off
Connector Panel LEDs: - **Rackmount (back panel, FIGURE 7)** - **Wall-Mount (front panel, FIGURE 5)**							
PWR	Power	Green					
ALM	Alarm		Red				
T1 RX	T1 receive status			Red		Green	
T1 YEL	Remote alarm indication				Yellow		
Ch1 RX	Channel 1 receive status			Red		Green	Off
Ch1 YEL	Remote alarm indication				Yellow		
Ch2 RX	Channel 2 receive status			Red		Green	Off
Ch2 YEL	Remote alarm indication				Yellow		

Alarm contacts

Table 4 NC and NO Connections

Connection	Description
NC connected to COM	Indicates one of the following: • No power present • T1 receive major alarm • Channel 1 receive major alarm • Channel 2 receive major alarm
NO connected to COM	Power is present with No major Alarms

Table 5 Switch 1 and Switch 2 function

	Position	Function	Description
Switch 1	1	T1 TX Timing	Down: Loop (recovered) - see FIGURE 9 Up: Internal – see FIGURE 8
	2	T1 Framing	Down: ESF Up: SF
	3	T1 Line Code	Down: B8ZS Up: AMI
	4	T1 Jitter Attenuator	Down: Attenuator in RX path Up: Attenuator in TX path
	5-7	T1 Line Build-Out	See TABLE 8 for settings.
	8	T1 Loopback	Down: normal Up: loopback
	9	C37.94 Port #1 Loopback	Down: normal Up: loopback
	10	C37.94 Port #2 Loopback	Down: normal Up: loopback
Switch 2	1-4	C37.94 Port #1 bandwidth	0 (all Down): disable N=1-12: N times 64kb/s See TABLE 6 for bandwidth settings.
	5-8	C37.94 Port #2 bandwidth	0 (all Down): disable N=1-12: N times 64kb/s See TABLE 6 for bandwidth settings.
	9	C37.94 Port #1 Data Inversion	Down: normal Up: Invert Data
	9-10	C37.94 Port #2 Data Inversion	Down: normal Up: Invert Data

CONFIGURATION DATA

System Timing

Available timing modes are:

- Internal (T1 TX and both Fiber-Optic TX from Internal Oscillator)
- Loop (T1 TX and both Fiber-Optic TX from T1 RX)

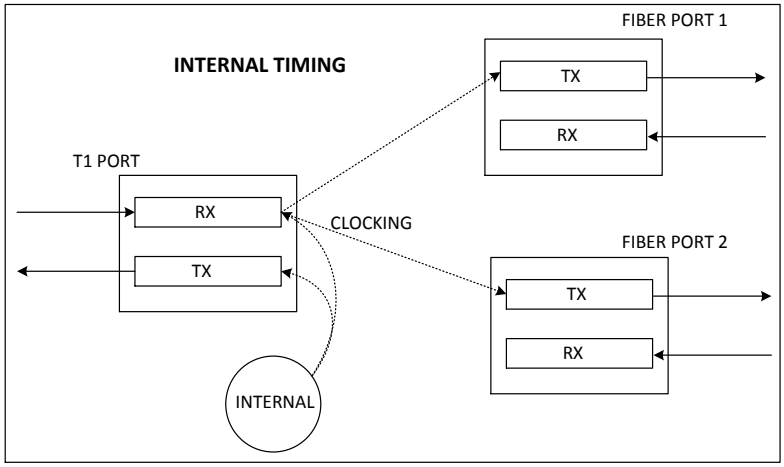


Figure 8 Internal timing

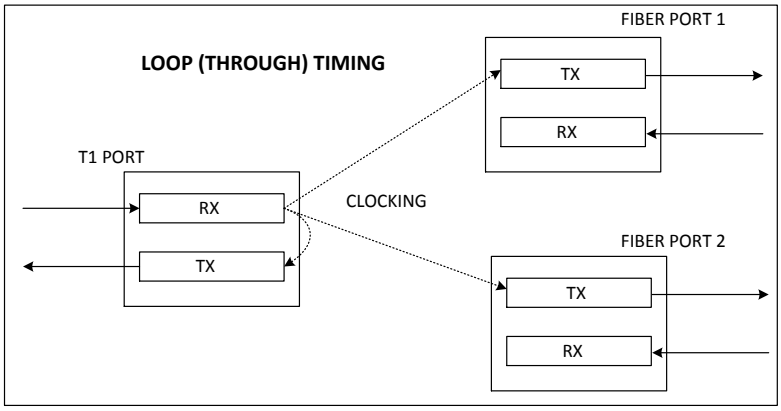


Figure 9 Loop timing

Settings

Table 6 C37.94 Bandwidth Settings

The bandwidth settings work the same on the two ports for the corresponding switch positions

SW 2 - Positions 1-2-3-4	C37.94 Port #1
SW 2 - Positions 5-6-7-8	C37.94 Port #2

Note: D=Down, U=Up.

Switch positions	Number of Timeslots (Bandwidth)
D-D-D-D	Port Disabled
D-D-D-U	N=1 (64 kb/s)
D-D-U-D	N=2 (128 kb/s)
D-D-U-U	N=3 (192 kb/s)
D-U-D-D	N=4 (256 kb/s)
D-U-D-U	N=5 (320 kb/s)
D-U-U-D	N=6 (384 kb/s)
D-U-U-U	N=7 (448 kb/s)
U-D-D-D	N=8 (512 kb/s)
U-D-D-U	N=9 (576 kb/s)
U-D-U-D	N=10 (640 kb/s)
U-D-U-U	N=11 (704 kb/s)
U-U-D-D	N=12 (768 kb/s)

Table 7 T1 Interface Connections

Signal	Pin Number
RX Data	1,2
TX Data	4,5
Chassis	7,8

Table 8 T1 Line Build-Out Settings

Note: D=Down, U=Up.

SW 1 Positions 5-6-7	Line Build-Out Selections
D-D-D	DSX-1 (0-133ft) / 0dB CSU
D-D-U	DSX-1 (133-266ft)
D-U-D	DSX-1 (266-399ft)
D-U-U	DSX-1 (399-533ft)
U-D-D	DSX-1 (533-655ft)
U-D-U	-7.5dB CSU
U-U-D	-15dB CSU
U-U-U	-22.5dB CSU

FSU Mounting dimensions

The following figure shows the dimensions to allow securing the FSU to a flat surface.

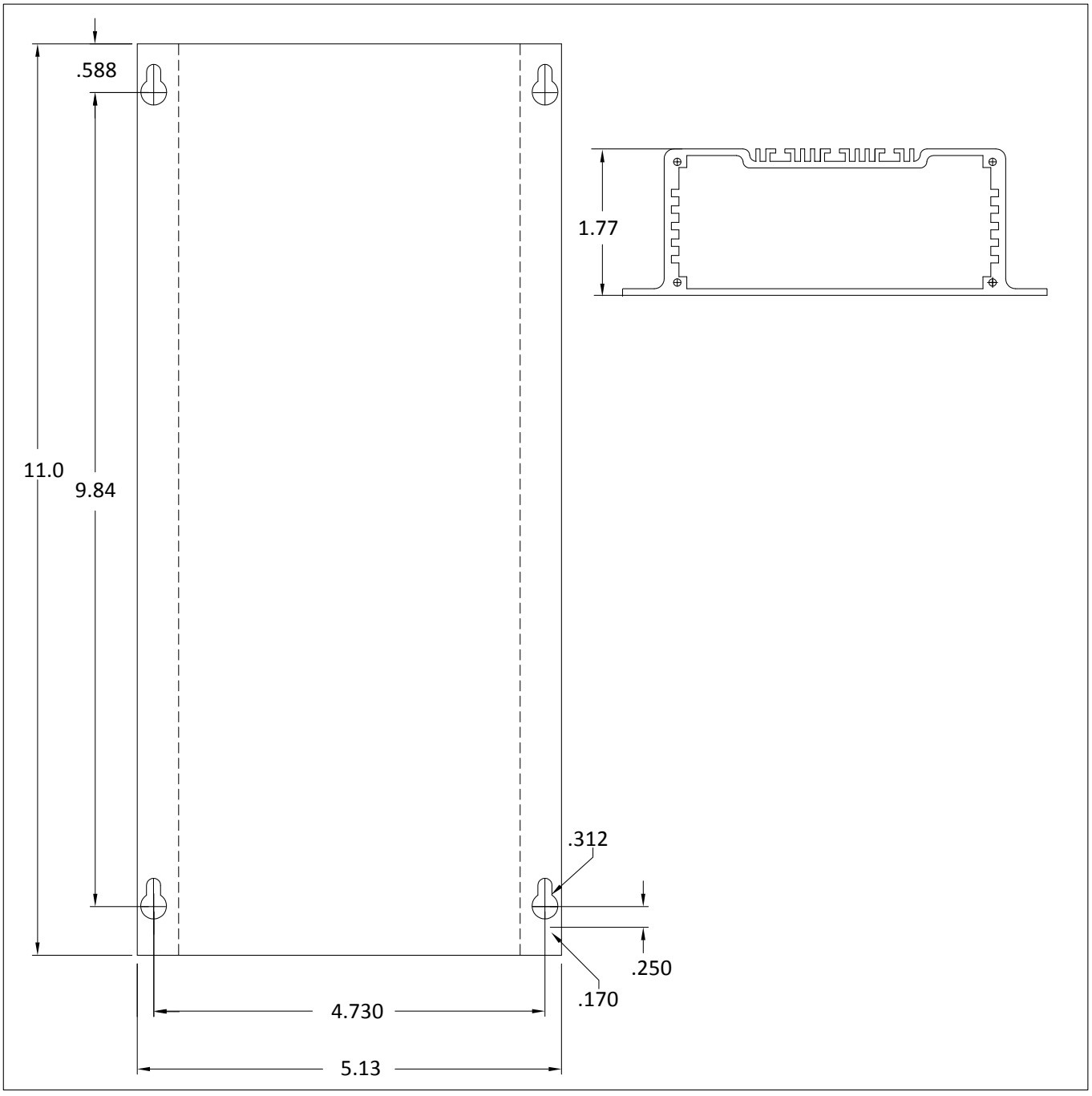


Figure 10 Wall-Mount FSU Mounting Dimensions (107560-1 and 107560-2)

The rackmount FSU fits in a standard 19 inch rack as show by the dimensions in the following figure.

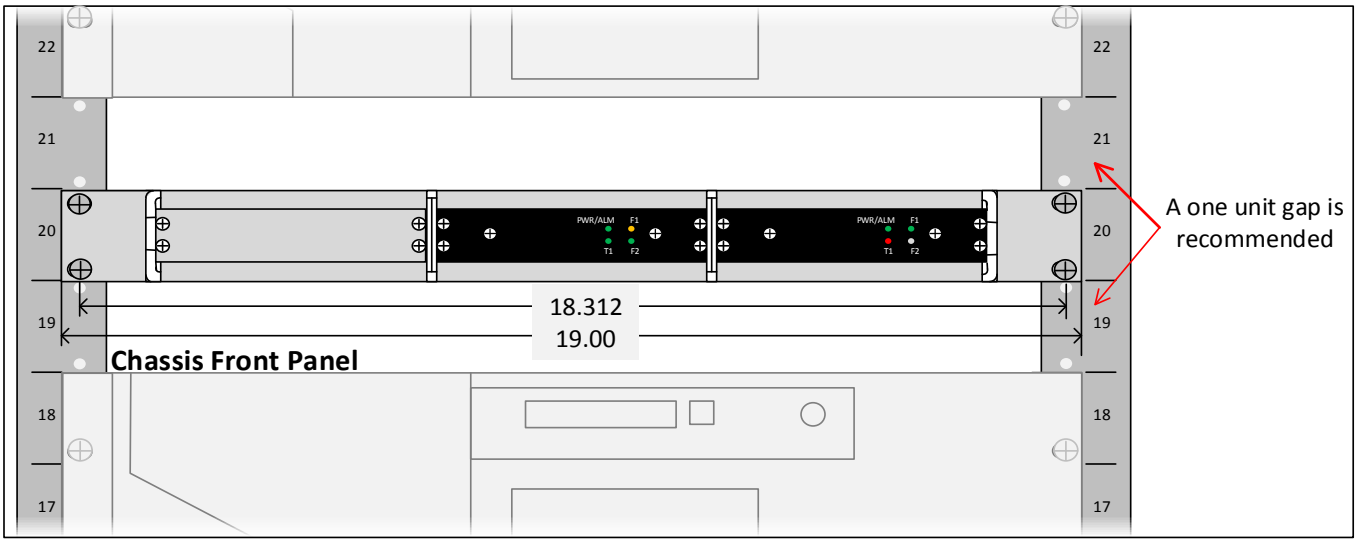


Figure 11 Rackmount FSU Mounting Dimensions (107580-1 through 107580-4)

Notice

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Disposal

When disposing of the equipment, it should be done in strict accordance with all local and national regulations for the disposal of electrical and electronic equipment.

Hubbell Power Systems, Inc. – RFL® Products
353 Powerville Road ● Boonton Twp., NJ 07005-9151 USA
Tel: 973.334.3100 ● Fax: 973.334.3863
Email: Customer.Service@RFLelect.com ● www.rflelect.com