



Communications Test Design, Inc.

T1 ESF CSU Reference Manual

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Service and Warranty

For assistance with applications or technical questions, please contact CTDI technical support:

Phone: North America 1-888-444-9556

International: +1-615-884-7455

Email: NCservice@ctdi.com

To place an order, please contact CTDI sales:

Phone: 1-866-953-9030

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Should a product require repair or replacement, please contact CTDI Customer Service:

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Communications Test Design, Inc. warrants all CTDI products to be free of defects and to be fully functional for the time period beginning with shipment and ending as specified by the terms and conditions governing the sale of the product. Any attempt to repair or otherwise modify the product by anyone other than an authorized CTDI representative will void the warranty. A complete statement of the CTDI warranty policy is available upon request.

April 2009

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Compliance Information

Regulatory - Compliance and Agency approvals

EMC Emissions: FCC Part 15 Class A

Safety: UL 60950
CSA C22.2 N° 60950-0

Telecom: FCC Part 68

FCC Part 15 Statements

This digital equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his or her own expense. ***Shielded cables must be used to ensure compliance with the Class A FCC limits.***

FCC Part 68 statements

This equipment complies with Part 68 of the FCC rules.

On the product nameplate of this equipment (located on the underside of the product chassis) is a label that contains, among other information, the certification number for this equipment. If requested, this number must be provided to the telephone company.

Connection to Telephone line

The following instructions are provided to ensure compliance with FCC Rules, Part 68.

- 1 All equipment uses jacks for connection to the telephone line. You must, upon request, provide the following "USOC Jack type" to your local telephone company: *RJ48C*
- 2 Your telephone company may discontinue your service if your equipment causes harm to the telephone network. They will notify you in advance of disconnection, if possible. During notification, you will be informed of your right to file a complaint to the FCC
- 3 Occasionally your telephone company may make changes in its facilities, equipment, operation, or procedures that could affect the operation of your equipment. If so, you will be given advance notice of the change to give you an opportunity to maintain uninterrupted service
- 4 THE REGISTRATION NUMBER OF THE SYSTEM MUST BE PROVIDED SO THAT THE TELEPHONE COMPANY CAN ASCERTAIN INTENDED MODES OF OPERATION AND VERIFICATION OF REGISTRATION PORTS.
- 5 If a need arises in the future, the telephone company will call the user and request the following information for any equipment being connected to the Public Switched Telephone network.
 - Manufacturer: *Communications Test Design Inc*
 - Model Number: *Refer to the nameplate on the bottom of the unit*
 - FCC Registration #: *Refer to the nameplate (bottom of the unit)*

- Ringer Equivalence Number (REN): *Not applicable*
- Facility Interface Code (FIC):
 - *04DU9-BN* for 1.544 Mbps, D4
 - *04DU9-DN* for 1.544 Mbps, D4 and B8ZS
 - *04DU9-JKN* for 1.544 Mbps, ANSI ESF
 - *04DU9-1SN* for 1.544 Mbps, ANSI ESF and B8ZS
- Service Order Code (SOC): *6.0F*
- Telephone plug(s): *RJ48C*

6 **Problems Repair and Warranty:** should you experience trouble with this telephone equipment or for repair or warranty information, please contact CTDI (see *Technical Support* on page 2 in this manual) .

If an equipment is causing harm to the telephone network, the telephone company may request that you disconnect this equipment from the line network until the problem is connected.

7 The affidavit at the end of this manual must be completed by the installer.

Industry Canada Statements

This digital equipment does not exceed Class A limits for radio noise emissions for digital apparatus, set out in Radio Interference Regulation of the Industry Canada. Operation in a residential area may cause unacceptable interference to radio and TV reception requiring the owner or operator to take whatever steps necessary to correct the interference.

This product meets the applicable Industry Canada technical specifications.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.



Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

Notice d'Industry Canada

Cet équipement ne dépasse pas les limites de Classe A d'émission de bruits radioélectriques pour les appareils numériques, telles que prescrites par le Règlement sur le brouillage radioélectrique établi par l'Industrie Canada. L'exploitation faite en milieu résidentiel peut entraîner le brouillage des réceptions de radio et de télévision, ce qui obligerait le propriétaire ou l'opérateur à prendre les dispositions nécessaires pour en éliminer les causes.

Le présent matériel est conforme aux spécifications techniques applicables d'Industrie Canada.

Attention: L'utilisateur ne doit pas tenter de faire les raccordements lui-même, mais doit avoir recours à un service d'inspection d'installations électriques ou d'un électricien.



L'utilisateur ne doit pas tenter de faire les raccordements lui-même, mais doit avoir recours à un service d'inspection d'installations électriques ou d'un électricien.

**Safety Warnings
Precautions**

When handling this equipment, follow these basic safety precautions to reduce the risk of electric shock and injury:



For use only with a certified Class 2 power Supply. See "Power Source" in specifications at page 2.

Doit être utiliser seulement avec un module d'alimentation de Classe 2. Voir "Power Source" dans la reubrique specifications, page 2.



**Warning
Avertissement
Warnung**

<p>Access to the interior of this unit shall be made only by a qualified technician</p> <p>To ensure adequate cooling of the equipment, a 2.0-inch unobstructed space must be provided around all sides of the unit.</p> <p>The AC Power Socket shall be installed near the equipment and shall be easily accessible</p> <p>Remove power plug from the power socket before performing any service on the unit.</p> <p>Remove power plug from the power socket before performing any service on the unit.</p>	<p>Der Zugang ins Innere des Gerätes ist nur einem fachlich qualifizierten Techniker gestattet.</p> <p>Um die Kühlung des Gerätes nicht zu beeinträchtigen, ist es notwendig, an allen Seiten des Gerätes ca 5 cm Raum zu lassen</p> <p>Stellen Sie das Gerät in der Nähe eines geerdeten Schutzkontaktsteckers so auf, dass der Stecker leicht erreichbar und zugänglich ist.</p> <p>Vorm Öffnen des Gerätes muss der Netzstecker vom Stromnetz getrennt werden!</p>	<p>Seul un spécialiste devrait avoir accès à l'appareil</p> <p>Afin de ne pas nuire au processus de refroidissement, il est nécessaire de laisser un espace d'environ 5 cm de chaque côté de l'appareil.</p> <p>Placez l'appareil près d'une prise de courant facilement accessible</p> <p>Débranchez l'appareil avant de l'ouvrir</p>
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**Making changes
or Modifications**



Any changes and modifications not expressly approved by CTDI will void any compliance and regulatory approval, and will void the user's authority to operate the equipment.

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Affidavit for the Connection of Customer Premises Equipment to 1.544 Mbps and/or Subrate Digital Services

ABOUT THE T1 ESF CSU

About this Manual

This is a reference manual. It provides information about unit installation, configuration and testing. It is *not* a user's guide containing step-by-step procedures. This manual is designed to be used when you need specific information about a command, interface port, configuration parameter, etc. Unless otherwise noted, the information in this manual applies only to the T1 ESF CSU (also referred to as *the unit*.)



Manual Organization


The chapters and appendices in this manual are arranged for quick reference when you need it. You do not have to read previous chapters to understand the subsequent chapters.

- *Chapter 1, "General Information"* -- This chapter introduces the unit, lists the features, and provides specifications.
- *Chapter 2, "Installation and Configuration"* -- This chapter describes unit installation, port and power connections, and switch settings.
- *Chapter 3, "Testing"* -- This chapter describes the indicators, test switch, loopbacks, and test jacks.
- *"Affidavit for the Connection of Customer Premises Equipment to 1.544 Mbps and /or Subrate Digital Services"* -- Appended to the end of this manual, this affidavit may be required by your telco.

Typographic Conventions

The following table lists the conventions that are used throughout this guide.

Convention	Description
	A <i>Notice</i> calls attentions to important features or instructions.
	A <i>Caution</i> alerts you to serious risk of data loss or other results that may cause you or the unit trouble if the warning is not heeded.

Convention	Description
	A <i>Warning</i> alerts you to the risk of serious damage to the unit or injury and possible death to the end user.
“Enter” vs. “Type”	When the word <i>enter</i> is used in this guide, it means type something, then press the Return or Enter key. Do not press the Return or Enter key when an instruction simply says <i>type</i> .
<i>Italics</i>	Refers you to other sections of this manual.

1

GENERAL INFORMATION

Introduction

The T1 ESF CSU provides an economical solution for providing the T1 interface between customer premises equipment and T1 facilities (telco or private). Each unit is compatible with all T1 carrier transmission equipment and is designed to comply with all industry-standard specifications. Both the transmitted and received 1.544 Mbps signals are conditioned.

The T1 ESF CSU is an industry standard T1 channel service unit. It detects and activates network initiated loopbacks, monitors bipolar violations, and maintains pulse density of the transmitted signal. The unit is capable of interfacing to both B8ZS and AMI circuits and can convert signal formats or line coding to integrate older equipment. Automatic transmission of ESF performance report messages (PRM) is also supported by the T1 ESF CSU.

The unit is designed to be wallmounted using hook-and-loop fasteners or “T” openings on the base (like a telephone). The unit can also be set on a desktop.

The unit provides ALBO circuitry on the network receive path. The network ALBO supports a receive range from +1 to –30 decibels. The DTE supports DSX1 signal ranges up to 655 feet. The unit also provides line build out (LBO) circuitry on both network and DTE. The network transmit LBO is user selectable in four increments (from 0 to –22.5 decibels). The DTE transmit LBO is user selectable in five increments from 0 to 655 feet.

The T1 ESF CSU operates from an external power source. Network and DTE connections are made through RJ-48C connectors. The units have primary and secondary surge protection on both the network and DTE side (meeting the UL 1950 requirements).

Features

- Provides T1 facility interface and jitter tolerance per ANSI T1.102, T1.403, and AT&T TR 62411
- Supports B8ZS or AMI formats
- Conversion for signal formats and line coding
- Supports PRM in ESF mode
- Space-saving design can be desktop or wall mounted

Specifications

Network Interface

Line Rate:	1.544 Mbps (± 50 ppm)
Line Framing:	D4 or ESF
Line Code:	AMI or B8ZS
Line Impedance:	balanced 100 Ω ($\pm 5\%$)
Input Signal:	DS1, +1 to -30 dB (ALBO)
Output Signal:	3.0 V, $\pm 15\%$, base-peak into 100 Ω
Line Build Out:	0, -7.5, -15, and -22.5 dB attenuation
Line Protection:	1000 V lightning, fused input and output
Jitter Control:	per TR 62411 and T1.403
Pulse Density:	per TR 62411

Equipment Interface

Line Rate:	1.544 Mbps (± 50 ppm)
Line Framing:	D4 or ESF
Line Code:	AMI or B8ZS
Line Impedance:	balanced 100 Ω ($\pm 5\%$)
Input Signal:	DSX1 to 655 feet
Output Signal:	Selectable DSX1 signal level from 0 to 655 feet
Line Protection:	1000 V lightning, input and output

Mechanical

Mounting:	desktop or wallmount
Dimensions:	1.25" H, 3.5" W, 5.75" D
Weight:	1 pound

Power Source

External:	Input: 115 VAC Output: 9 VDC, 1.2 A
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Environmental

Operating Temp:	0° to 50°C (32° to 122°F)
Storage Temp:	-20° to 70°C (-4° to 158°F)
Humidity:	95% max (non-condensing)

2

INSTALLATION AND CONFIGURATION

Introduction

This chapter contains information and instructions required to prepare the T1 ESF CSU for use. Included are initial inspection procedures, mounting instructions, configuration guidelines, connection and powering information.

Safety Summary

This manual contains information and warnings that must be followed to ensure safe operation and retain the equipment in a safe condition.



This WARNING sign denotes a potential hazard to the operator. It calls attention to a procedure or practice that, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.



Units are susceptible to damage caused by static electricity. Use ESD (electrostatic discharge) precautionary measures, such as wearing electrostatic grounding straps.

Unpacking and Inspection

This unit is carefully packaged to prevent damage in shipment. Upon receipt, inspect the shipping container for damage. If the shipping container or cushioning material is damaged, notify the carrier immediately and make a notation on the delivery receipt that the container was damaged (if possible, obtain the signature and name of the person making delivery). Retain the packaging material until verifying the contents of the shipment are complete and the unit has been checked both mechanically and electrically.

If the contents of the shipment are incomplete or, if there is mechanical damage or defect, notify CTDI. If the shipping container is also damaged, or the cushioning material shows signs of stress, notify the carrier of the damage as well as CTDI. Keep the shipping materials for the carrier's inspection. CTDI will arrange for repair or replacement without waiting for claim settlement.

Supplied Materials

The T1 ESF CSU is shipped from the factory with the following standard equipment:

- external DC power supply
- reference manual
- adhesive strips
- two 9-foot RJ48-to-RJ48 cables (part number 9-1544-619-009)

Wall-mount Installation

Using Adhesive Strips

- 1 Select a place close to an 115 VAC outlet with clearance for the signal and power cables as well as for bantam test cables. The indicators and switches should be easily accessible.
- 2 Verify the mounting surface is clean.
- 3 Cut the adhesive strip to the desired length and affix the backing of one piece to the underside of the unit.
- 4 Attach the other adhesive strip to the piece on the underside of the unit.
- 5 Remove the backing to expose the sticky surface.
- 6 Press the underside of the unit firmly against the selected place.

Using Screws

- 1 Select a place close to an 115 VAC outlet with clearance for the signal and power cables as well as for bantam test cables. The indicators and switches should be easily accessible.
- 2 Vertically place two #6 screws 3-13/32 inches apart at the selected place. Leave the screws out about an eighth of an inch.
- 3 Place the upright unit over the screws until the holes engage and slide the unit down until it locks.

Connections

The T1 ESF CSU has RJ-48C connectors for the network and equipment interfaces and a terminal strip for the power connection. The following paragraphs describe these connections.

Equipment and Network Connections

The interface for these connectors is an RJ-48C jack.

Table 2-1 Pinout for Network/Equipment Connectors

Pin	NET	Equipment
1	R1 (ring, receive from network)	R1 (ring, transmit to equipment)
2	T1 (tip, receive from network)	T1 (tip, transmit to equipment)
4	R (ring, transmit to network)	R (ring, receive from network)
5	T (tip, transmit to network)	T (tip, receive from network)
3, 6-8	not used	not used

Power Connection

Plug the connector from the power supply into the unit. Plug the transformer into an appropriate grounded outlet. This will apply power to the unit.

Configuration

This section describes the configuration of the T1 ESF CSU. This unit is configured using DIP switches. Refer to Figure 2-1 for switch locations.



NOTICE: *On power up, each unit is configured to the settings of the option switches. Changes to the NET LBO and EQ LBO switches do not take effect until the unit is reset. Reset the unit by removing power from the unit and then reapplying power. The loopback switches activate as soon as they are thrown.*

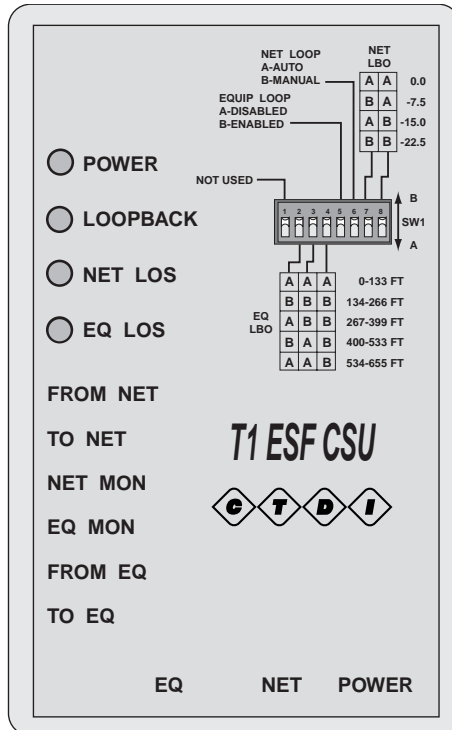


Figure 2-1 T1 ESF CSU

Configuration Switch SW1

Switch SW1 is located on the CSU cover. This eight-position dip switch provides the following configuration parameters. (Underlined text indicates default settings.)



NOTICE: *Position SW1-1 is not enabled for use.*

EQ LBO Positions SW1-2, SW1-3, and SW1-4 set the EQ LBO (line build out) transmit signal value towards the customer equipment. The value should match the cable length from the EQ port to the attached equipment. The default is 0 to 133 feet (AAA).

Equipment Loop Position SW1-5 sets equipment loopback functions. When the switch is set to Enabled (B), the unit is placed into an equipment loopback where the equipment receives all the data it sends. The unit remains in equipment loopback until the switch is set to Disabled (A). The unit sends an unframed all ones pattern to the network.

Network Loop Position SW1-6 sets network loopback functions. NET LOOP can be set to Auto or Manual. Auto (A) enables the unit to respond to network loop requests. Setting the switch to Manual (B) forces the unit into a manual network loopback. During loop, the unit sends an unframed all ones pattern to the equipment. It responds to inband CSU loop (1-in-5 pattern) and unloop (1-in-3 pattern), ESF out-of-band line loopback/payload loopback, and loop up/loop down codes, and responds to the universal loopdown code even if the switch is in the "Manual" position.

Network LBO Positions SW1-7 and SW1-8 set the network line build out signal level transmitted towards the T1 facility. The default output level is 0 dB (AA). Change the signal level to -7.5 dB, -15 dB, or -22.5 dB as necessary. The telco can provide the proper setting. If unsure of the setting, leave it at 0 dB.

3

TESTING

Introduction

This chapter describes the diagnostic and test features of the T1 ESF CSU. The unit is controlled manually using front panel DIP switches (the DIP switches are discussed on page 5). The front panel indicators and side bantam jacks are described below.

Indicators

The unit indicators convey major alarm conditions and looping status.

- POWER** This green indicator lights when power is applied to the unit.
- LOOPBACK** This amber indicator lights under the following conditions: the NET LOOP switch is set to Manual; the EQUIP LOOP is placed in the Enabled position; or the unit receives an inband (or out-of-band) loop code from the network.
- NET LOS** This red indicator lights if the internal alarm circuitry detects a loss of signal condition for ≥ 175 bit times or if it detects an unframed error from the network. The indicator stays lit until the unit detects ≥ 4 pulses in 32 bit times.
- EQ LOS** This red indicator lights if the internal alarm circuitry detects a loss of signal condition for ≥ 175 bit times or if it detects an unframed error from the DTE. The indicator stays lit until the unit detects ≥ 4 pulses in 32 bit times.

Loopbacks

Equipment

Position SW1-5 sets equipment loopback functions. When the switch is set to Enabled, the unit is placed into an equipment loopback where the DTE receives all the data it sends. The unit sends an unframed all ones pattern to the network end. The unit remains in equipment loopback until the switch is set to Disabled.



Figure 3-1 Local Loopback

Network

Position SW1-6 sets network loopback functions. NET LOOP can be set to Auto or Manual. “Auto” enables the unit to respond to network loop requests (a 1-in-5 pattern) and remain looped until it receives a 1-in-3 pattern. Setting the switch to “Manual” forces the unit into a manual network loopback until the switch is returned to Auto or loopdown code is received from the network. The unit sends an unframed all ones pattern to the equipment end unless the equipment is also in loopback.

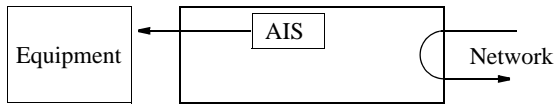


Figure 3-2 Line or CSU Loopback

The following paragraphs describe other loops that may be initiated on the unit. Refer to the looping diagrams below for further information.

CSU Inband LLB: Each unit can be looped remotely by generating towards it a standard CSU line loopback code (00001 repeating for ≥ 5 seconds, framed or unframed). Once looped, the received signal from the T1 facility (NET IN) is regenerated and transmitted back to the T1 facility (NET OUT).

CSU Inband Unloop: Each unit can be unlooped remotely by generating towards it a standard CSU line unloop code (001 repeating for ≥ 5 seconds, framed or unframed).

T1.403 LLB: The unit supports the T1.403 line loopback command (the FDL LLB format is 00001110 11111111). Once looped, the received signal from the T1 facility (NET IN) is regenerated and transmitted back to the T1 facility (NET OUT).

T1.403 LLB Unloop: The unit supports T1.403 FDL line loopback unloop command messages (00111000 11111111 repeating).

T1.403 / 54016 PLB: The unit supports T1.403 FDL payload loopback command messages (00010100 11111111 repeating).

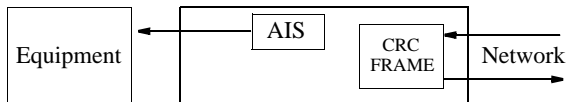


Figure 3-3 Payload Loopback (with Frame and CRC regeneration)

T1.403 / 54016 PLB Unloop: The unit supports T1.403 FDL payload loopback unloop command messages (00110010 11111111 repeating).

Test Jacks

The bantam jacks located on the left side of the unit provide signal access as follows:

The FROM NET and TO NET jacks can be used to break the network connection to the T1 ESF CSU internal circuitry and connect the network to a piece of test equipment.

The NET MON and EQ MON jacks are used for passively monitoring received signals passing through the unit (between the DTE and the network).

The FROM EQ and TO EQ jacks can be used to break the equipment connection to the T1 ESF CSU internal circuitry and connect the equipment to a piece of test equipment



NOTICE: *When connected to the TO EQ and FROM EQ jacks, the EQ LOS indicator lights. This is due to the test connection and is not an indication of signal loss from the equipment.*

AFFIDAVIT FOR THE CONNECTION OF CUSTOMER PREMISES EQUIPMENT TO 1.544 MBPS AND/OR SUBRATE DIGITAL SERVICES

For work to be performed in the certified territory of

Telco's Name: _____

State of _____

County of _____

I, _____, of _____,
(Authorized Representative Name) (Customer Name)

_____, _____,
(Customer Address) (Telephone Number)

being duly sworn, state:

I have responsibility for the operation and maintenance of the terminal equipment to be connected to _____ 1.544 Mbps and/or _____ subrate digital services. The terminal equipment to be connected complies with Part 68 of the Commission's rules except for the encoded analog content, and billing protection specifications. With respect to encoded analog content and billing protection:

- I attest that all operations associated with the establishment, maintenance, and adjustment of the digital CPE with respect to encoded analog content and encoded billing information continuously complies with Part 68 of the FCC's Rules and Regulations.
- The digital CPE does not transmit digital signals containing encoded analog content or billing information which is intended to be decoded within the telecommunications network.
- The encoded analog and billing protection is factory set and is not under the control of the customer.

I attest that the operator(s) maintainer(s) of the digital CPE responsible for the establishment, maintenance, and adjustment of the encoded analog content and billing information has (have) been trained to perform these functions by successfully completing one of the following: Check appropriate ones(s).

- A. Training course provided by the manufacturer/grantee of the equipment used to encode analog signals; or
- B. Training course provided by the customer or authorized representative, using training materials and instructions provided by the manufacturer/grantee of the equipment used to encode analog signals; or
- C. Independent training course (e.g., trade school or technical institution) recognized by the manufacturer/grantee of the equipment used to encode analog signals; or
- D. In lieu of the proceeding training requirements, the operator(s) maintainer(s) is (are) under the control of a supervisor trained in accordance with _____ above.

I agree to provide _____ with proper documentation to
(Telco's Name)
demonstrate compliance with the information as provided in the proceeding paragraph, if so requested.

_____ (Signature)

_____ (Title)

_____ (Date)

Subscribed and Sworn to before me this _____ day of _____, 19____.

Notary Public

My Commission expires _____.