INIVEN

DIVISION OF CONOLOG CORP.

PTR-1500

AUDIO TONE TELEPROTECTION TERMINAL

APPLICATION GUIDE

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Purpose

The INIVEN PTR-1500 is a frequency shift keyed (FSK) programmable tone teleprotection transmitter/receiver terminal. It is capable of accommodating all protection schemes including direct transfer trip (DTT), permissive transfer trip (PTT) and blocking schemes. This document is intended for use in the commissioning of a PTR-1500 teleprotection terminal and is meant to allow for easy installation of a tone teleprotection terminal without spending a lot of time reading of the PTR-1500 instruction manual.

Scope

This document only focuses on the audio tone terminal installation, settings and periodic functional tests.

References & System Manuals

- PTR-1500 Audio Tone Teleprotection Terminal Instruction Manual
- Pulsar LPA50/LPA100 PLC Linear Amplifier Manual
- INIVEN Website: http://www.iniven.com

Test Equipment

The following test equipment is essential for PTR-1500 commissioning:

1. Digital multi-meter with dBm readout function or rms. Fluke or equivalent.
2. Flat-blade-screwdriver with 1/4-inch wide tip.
3. Flat-blade-screwdriver with 1/8-inch wide tip or potentiometer adjustment tool.

Revision History

Rev.	Description of Change(s)	By	Date	Approved
0	Original Issue			
1				
2				
3				
4				

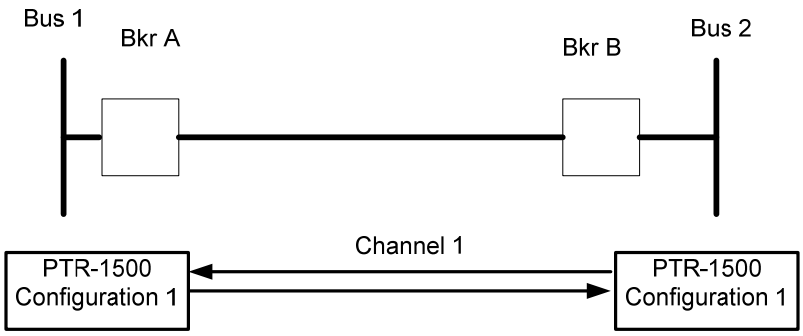
Initial System Checks Prior to PTR-1500 Field Settings/Testing

- ☑ Confirm which configuration is supplied, 1 or 2 (WD043 or WD045 respectively)
- ☑ Connect DC power to chassis
- ☑ Connect communication lines to chassis
- ☑ Verify DC Voltage on rear of the chassis
- ☑ Turn on Power Supply and confirm main green power indication LED illuminates
- ☑ Turn off Power Supply and follow instructions below

The INIVEN PTR-1500 is available in two configurations for use in different types of applications objectives.

Configuration 1

This single channel configuration provides a guard and trip frequency audio tone over a single telecommunications channel between two substations for the protection of a single line section.



Application 1

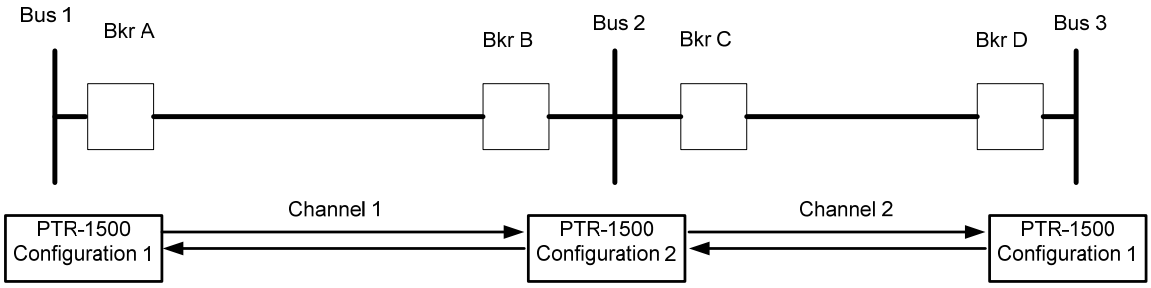
A single chassis is located at each end of the protected line section and contains the following modules:

- DC/DC power supply module
- Line Interface module
- Hybrid Splitter (4 wire) module
- Transmitter module
- Receiver module
- Logic module
- Contact Output module
- Solid State Output module

Configuration 2

This configuration provides dual independent channels, each having individual guard and trip frequencies and outputs. This unit may have either a 8 wire or 4 wire hybrid connection to the communication circuits to the remote terminal(s).

In Application 2, a configuration 2 chassis is located at the Bus 2 location and provides trip and guard signals to the configuration 1 chassis located at the Bus 1 location over the channel 1 transmitter. The same configuration 2 chassis provides separate trip and guard signals to the configuration 1 chassis at the Bus 3 location over the channel 2 transmitter. The inputs to the channel 1 and channel 2 transmitters are independent of one another. The outputs of the channel 1 and 2 receivers are also independent of one another.

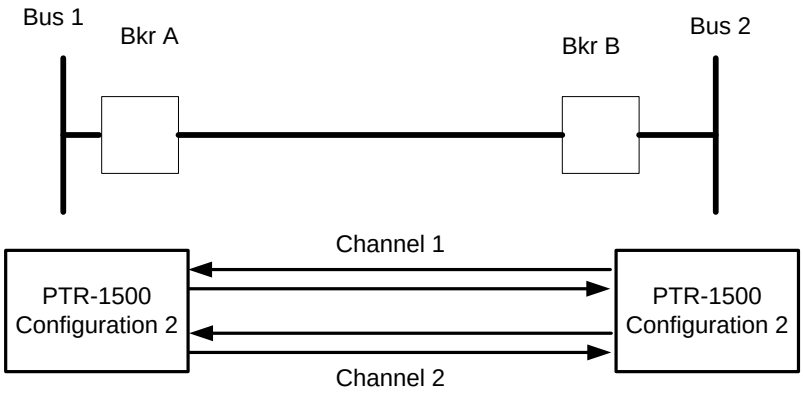


Application 2

For this application, a single Configuration 2 chassis is located at the Bus 2 location and contains the following modules:

- DC/DC power supply module
- Line Interface module
- Hybrid Splitter (8 wire) module
- Transmitter module
- 2 Receive modules
- 2 Logic modules
- 2 Contact Output modules
- 2 Solid State Output modules

In Application 3, a configuration 2 chassis is located at both Bus 1 and Bus 2 locations and provides 2 channels of trip and guard signals to the configuration 2 chassis located at the remote terminal. In this application the Channel 1 signals can be used for permissive transfer tripping while the Channel 2 signals can be used for direct transfer tripping. The inputs to the channel 1 and channel 2 transmitters are independent of one another. The outputs of the channel 1 and 2 receivers are also independent of one another.



Application 3

For this application, a single Configuration 2 chassis is located at the Bus 2 location and contains the following modules:

- DC/DC power supply module
- Line Interface module
- Hybrid Splitter (8 wire) module
- Transmitter module
- 2 Receive modules
- 2 Logic modules
- 2 Contact Output modules
- 2 Solid State Output modules

INSTALLATION

Unpacking

Two configurations of the PTR-1500 may be supplied. Both configurations are supplied as an individual chassis.

Each unit will be packed in its own shipping carton. Inspect the carton for possible damage in transit. Open each carton carefully and remove the chassis. Inspect the equipment for possible damage. Verify all items of value have been removed from the carton prior to discarding the packing material. Should transit damage be found, please notify INIVEN immediately. (1-800-526-3984)

NOTE: It is suggested the carton be retained for possible onward shipment.

Mounting

Two screws are required per mounting bracket (four total per chassis) and are not supplied with the unit. Install the chassis in the desired location and securely tighten all four screws. Spacing of the mounting holes is compliant with EIA and DIN standards.

NOTE: Adequate ventilation is required for reliable operation of electronic equipment. Temperatures within the equipment room should be kept between -30ºC and +70ºC to assure reliable operation.

Electrical Connections

User connections are made on the rear of the chassis through barrier and screw terminal blocks. Refer to the end of this section or to the drawings that come with the unit for specific wiring details. References made to terminal blocks are via terminal block numbers. Terminal block TB-1 terminal 1 is referred to as TB1-1. Terminal block TB-1 terminal 2 is referred to as TB1-2 and so on.

Various methods of making the connections to the terminal blocks may be used and are based on local practice. Lugs or bare wire may be used. Make sure to tighten all connections and insure exposed wires and/or lugs do not touch each other or the chassis.

To reduce the possibility of induced currents on the Trip input leads, it is recommended that shielded twisted pair wires are used with the shield grounded at the PTR-1500 end only. The Trip input leads and the communication cables should be bundled separately from each other and the other leads.

CAUTION: FOR SAFETY REASONS, ELECTRICAL POWER ON THE LEADS BEING CONNECTED TO THE UNIT SHOULD BE DE-ENERGIZED DURING INSTALLATION.

Inputs & Outputs

TRIP INPUT

The Trip input current is limited to 10 ma. A resistor in series with the optical isolator on each of the Trip inputs is used to limit the current. To produce a Trip, the battery voltage must be within 50% of the input battery voltage.

TRIP & GUARD OUTPUTS

Configuration 1

Four (2 Trip and 2 Guard) form C contact outputs are provided. Two (1 Trip and 1 Guard) solid state outputs are also provided.

Configuration 2

Eight (4 Trip and 4 Guard) form C contact outputs are provided. Four (2 Trip and 2 Guard) solid state outputs are also provided.

Please consult the factory when changes to a PTR-1500's factory configuration are being made.

STATUS RELAYS

Configuration 1

Four status relay alarms, each with a single set of SPDT (form C) contacts are provide the following:

- Alarm 1 (AL) – Master alarm indicating receiver failure to detect a signal, power failure (all other relays will also de-energize) and long term noise/interference on the incoming signal.
- Block 1(BL) – Detection of a corrupted signal
- Loss of Signal (LOS) – Indicates received signal level is below the set threshold.
- Transmitter Fail (Trans Fail) – Indicates the transmitted signal is below the setting threshold.

Configuration 2

Two sets of the four status relay alarms listed above are included. One set for each channel. Each relay is a single set of SPDT (form C) contacts.

NOTE: All of the status relays are energized during normal operation. Contacts are closed in their de-energized state.

AUDIO TONE LINES

Configuration 1

The unit is supplied for four-wire operation.

Configuration 2

The unit is supplied for eight-wire operation.

CAUTION: GROUNDING THE EQUIPMENT IS IMPORTANT FOR BOTH SAFETY REASONS AND RELIABLE OPERATION. CONNECT A 16 AWG OR LARGER WIRE BETWEEN CHASSIS GROUND AND EARTH GROUND UTILIZING THE SHORTEST PATH TO KEEP RESISITANCE AND INDUCTANCE TO A MINIMUM.

NOTE: Verify the battery voltage matches the input power requirements of the units.

NOTE: Double-check all connections for tightness and correctness, including polarity as applicable. Replace all protective covers supplied.

COMMISSIONING TESTS – Configuration 1

Initial Start-up

Each unit is checked and adjusted at the factory. Verify the electrical connections as described earlier. The following procedure will apply the settings for the logic required by the application, select the frequencies and signal levels for the transmitter and receiver, and verify proper operation of the unit. This procedure can be performed at any time to verify proper operation.

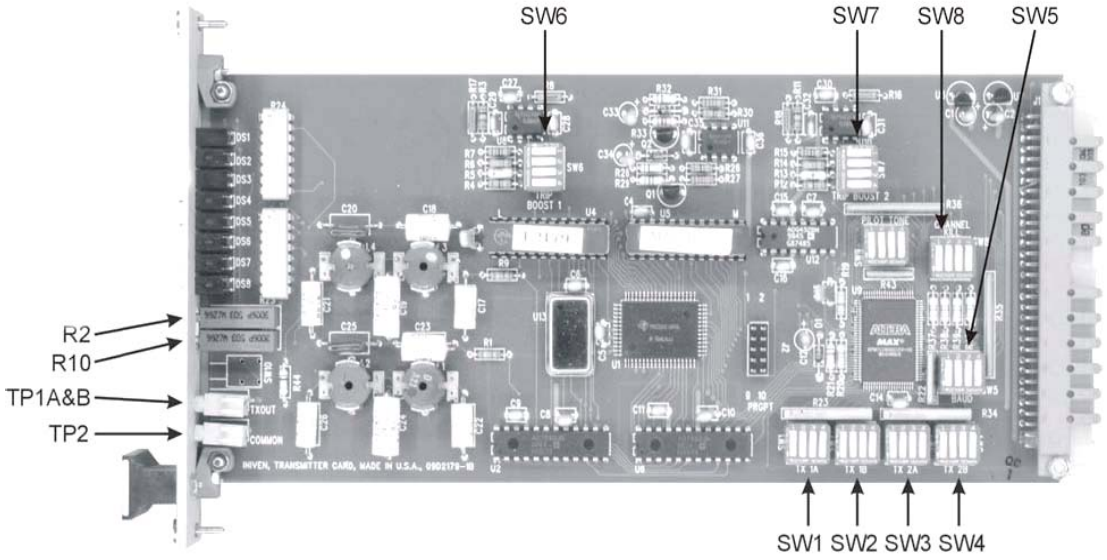
Input and output settings

Unless otherwise directed, follow the steps in the order presented. Comments and typical results will appear in ***italic***.

1. Verify that the MAIN POWER switch, located on the front of the LINE INT module, is OFF.

Transmitter

2. Using a flat-blade screwdriver, loosen the two captive screws securing the TRANS module to the chassis. Remove the TRANS module from chassis by pulling on the handle.



Transmitter Module

3. Set DIP switch SW1 for desired frequency of Channel 1A (see DIP switch settings, Table 1 for 340 Hz sub-channel spacing, or Table 2 for 680 Hz sub-channel spacing). Appendix A provides specific frequency characteristics of each Group and Sub-Channel with 340 Hz spacing. Appendix B provides specific frequency characteristics of each Group and Sub-Channel with 680 Hz spacing.

4. Set DIP switch SW2 for desired frequency of Channel 1B (see DIP switch settings, Table 1 or 2).

5. Set all positions of DIP switches SW3 and SW4 to a valid setting from Table 1 or 2.

6. Set DIP switch SW5 for desired bandwidth of all channels (see DIP switch settings, Table 3). Both channels need to be set even though only one is used in this application.

SW1 - SW4 Frequency - 340 Hz Groups					
Group	**Sub-Channel**	**Switch Positions to "ON"**			
		TX 1A	**TX 1B**	**TX 2A**	**TX 2B**
		SW1	**SW2**	**SW3**	**SW4**
1	A	1	1	1	1
1	B	2	2	2	2
2	A	1,2	1,2	1,2	1,2
2	B	3	3	3	3
3	A	1,3	1,3	1,3	1,3
3	B	2,3	2,3	2,3	2,3
4	A	1,2,3	1,2,3	1,2,3	1,2,3
4	B	4	4	4	4
5	A	1,4	1,4	1,4	1,4
5	B	2,4	2,4	2,4	2,4
6	A	1,2,4	1,2,4	1,2,4	1,2,4
6	B	3,4	3,4	3,4	3,4
7	A	1,3,4	1,3,4	1,3,4	1,3,4
7	B	2,3,4	2,3,4	2,3,4	2,3,4

Table 1 DIP Switch Settings for 340 Hz Frequency Groups (SW1 – SW4)

SW1 - SW4 Frequency - 680 Hz Groups					
Group	**Sub-Channel**	**Switch Positions to "ON"**			
		TX 1A	**TX 1B**	**TX 2A**	**TX 2B**
		SW1	**SW2**	**SW3**	**SW4**
8	A	1	1	1	1
8	B	2	2	2	2
9	A	1,2	1,2	1,2	1,2
9	B	3	3	3	3
10	A	1,3	1,3	1,3	1,3
10	B	2,3	2,3	2,3	2,3

Table 2 DIP Switch Settings for 680 Hz Frequency Groups (SW1 – SW4)

SW5 Bandwidth		
Channel	**Bandwidth**	**Switch Position to "ON"**
TX 1	340 Hz	1
TX 1	680 Hz	2
TX 2	340 Hz	3
TX 2	680 Hz	4

Table 3 DIP Switch Settings for Bandwidth

7. Set DIP switch SW6 for desired Trip boost level of Channel 1A & 1B Set all positions of SW7 to OFF.(see DIP switch settings, Table 4)

8. Set DIP-switch SW8 for the desired choice of Transmitter Channel operation (see DIP switch settings, Table 5).

SW6 -SW7 Trip Boost Output Level		
Boost Level	**Switch Position to "ON"**	**Switch Position to "ON"**
	TX 1	**TX 2**
	SW6	**SW7**
0 dB	None	None
3 dB	1	None
6 dB	2	None
9 dB	3	None
12 dB	4	None

Table 4 DIP Switch Settings for Trip Boost Output Level

SW8 **Channel Kill**		
Channel	**Status**	**Switch Position to "ON"**
TX 1A	OFF	1
TX 1B	OFF	2
TX 2A	OFF	3
TX 2B	OFF	4

Table 5 DIP Switch Settings for the desired operational channels

9. Verify **all** the DIP switches on SW9 are in the “OFF” position. *(The pilot tone function is not used in this application.).*

10. Reinsert the TRANS module into the chassis and secure it in place by tightening the two captive *screws with a flat*-blade screwdriver.

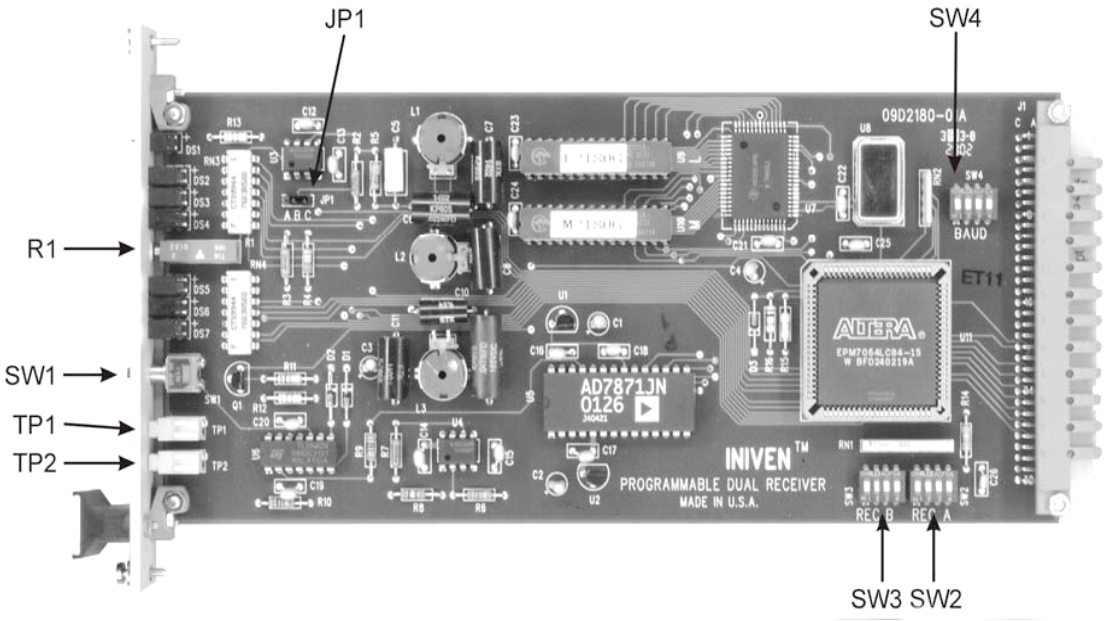
Receiver

11. Using a flat-blade screwdriver, loosen the two captive screws securing one of the REC modules to the chassis. Remove the REC module from the chassis by pulling on the handle.

12. Verify JP1 is in the High-gain position (A-B).

13. Set DIP switch SW2 for desired frequency of Channel A (see DIP switch settings, Table 6 for 340 Hz sub-channel spacing, or Table 7 for 680 Hz sub-channel spacing). Appendix A provides specific frequency characteristics of each Group and Sub-Channel with 340 Hz spacing. Appendix B provides specific frequency characteristics of each Group and Sub-Channel with 680 Hz spacing.

14. Set DIP switch SW3 for desired frequency of Channel B (see DIP switch settings, Table 6 or 7).



Receiver Module

SW2 - SW3 Frequency - 340 Hz Groups			
Group	**Sub-Channel**	**Switch Positions to "ON"**	
		Rec A	**Rec B**
		SW2	**SW3**
1	A	1	1
1	B	2	2
2	A	1,2	1,2
2	B	3	3
3	A	1,3	1,3
3	B	2,3	2,3
4	A	1,2,3	1,2,3
4	B	4	4
5	A	1,4	1,4
5	B	2,4	2,4
6	A	1,2,4	1,2,4
6	B	3,4	3,4
7	A	1,3,4	1,3,4
7	B	2,3,4	2,3,4

Table 6 Receiver Switch Settings – 340 Hz Groups

SW2 - SW3 Frequency - 680 Hz Groups			
Group	**Sub-Channel**	**Switch Positions to "ON"**	
		Rec A	**Rec B**
		SW2	**SW3**
8	A	1	1
8	B	2	2
9	A	1,2	1,2
9	B	3	3
10	A	1,3	1,3
10	B	2,3	2,3

Table 7 Receiver Switch Settings – 680 Hz Groups

15. Set DIP switch SW4 for desired bandwidth of all channels (see DIP switch settings, Table 8).

SW4 Bandwidth	
Sub-Channel Spacing (A &B)	**Switch Positions to "ON"**
340 Hz	1
680 Hz	2

Table 8 Bandwidth Settings

SW4 Mode & Security Settings	
Mode & Security	**Switch Positions to "ON"**
Single Channel	3
Dual Channel	4
Dual Channel, Hi Security	3,4

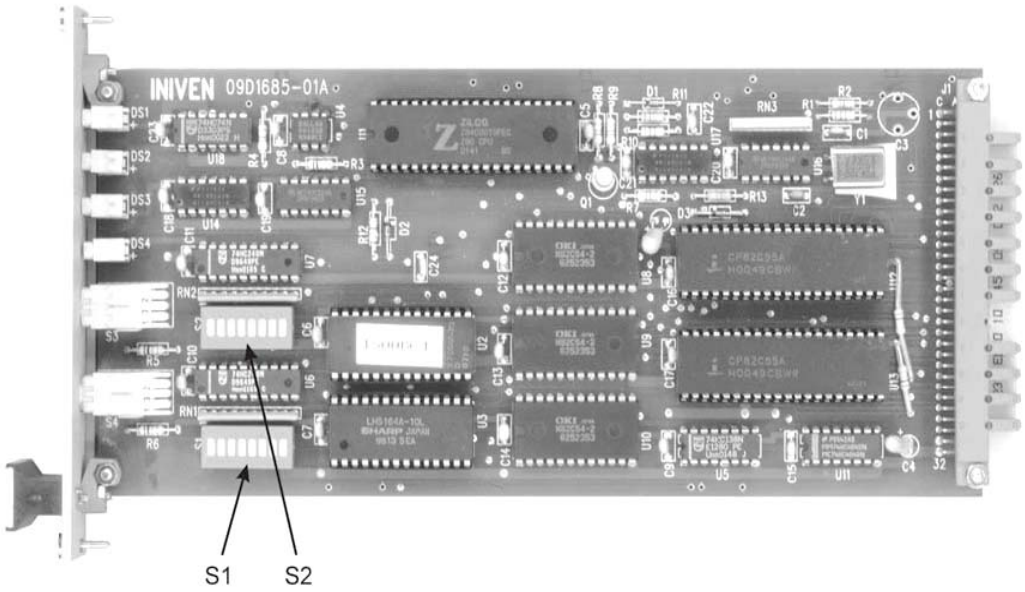
Table 9 Mode and Security Settings

16. Set DIP switch SW4 for desired receive security logic (single, dual, or dual high security, see DIP switch settings, Table 9).

17. Reinsert the REC module into the chassis and secure it in place by tightening the two captive screws with a flat-blade screwdriver.

Logic Module

18. Using a flat-blade screwdriver, loosen the two captive screws securing the LOGIC module to the chassis. Remove the module from the chassis by pulling on the handle.



Logic Module

19. Set DIP switch S1 to program: Single or Dual channel, Trip Boost, the Pre-Trip timer, the Transmit Flasher, the Trip Hold timer, and the Guard before Trip options (see Tables 10-13, Logic, for DIP switch settings and descriptions).

Pre-Trip Timer, based on Logic and Switch setting			
Logic Mode	**Switch 1-4 Position**	**680 Hz Shift**	**340 Hz Shift**
Dual Channel/Single	ON	10 ms	12 ms
Dual Channel/Single	OFF	2.4 ms	3.5 ms

Table 10 Pre-Trip Timer Settings

S1 Options - Single Channel		
	Switch Positions to "ON" for:	**Switch Positions to "OFF" for:**
S1-1	Dual Tone Channel	Single Tone Channel
S1-2	Enable TRIP Boost	Disable TRIP Boost
S1-3	Trip Boost Duration 200 ms	Trip Boost Duration 100 ms
S1-4	Approx 12 ms Pre-Trip Timer (see Table 8)	Approx 4 ms Pre-Trip Timer (see Table 8)

S1-5	Transmit Flasher Enabled	Transmit Flasher Disabled
S1-6	Guard before Trip (see Table 10)	Guard before Trip (see Table 10)
S1-7	Guard before Trip (see Table 10)	Guard before Trip (see Table 10)
S1-8	50 ms Trip Hold Timer Enabled	50 ms Trip Hold Timer Disabled

Table 11 Switch S1 Settings – Options

S1 Guard before Trip - Single Channel		
Description of Action	**Switch Positions to "ON"**	**Switch Positions to "OFF"**
Guard before Trip "Off"	N/A	6,7
100 ms of Guard is required by the Receiver before the Channel will Trip. Protection is restored when TRIP ceases.	7	6
100 ms of Guard is required by the Receiver before the Channel will Trip. Once 500 ms of TRIP is detected by the Receiver, protection will not be restored until 500 ms of Guard is again detected.	6	7

Table 12 Guard before Trip Settings

20. Set DIP switch S2 for desired Mode and Bandwidth

S2 Mode and Bandwidth		
S2-1	**S2-2**	**Mode and Bandwidth Select**
OFF	OFF	Dual Sub-Channel, 340 Hz Spacing
ON	OFF	Independent Dual Channel, 340 Hz Spacing
OFF	ON	Dual Sub-Channel, 680 Hz Spacing
ON	ON	Independent Dual Channel, 680 Hz Spacing

Table 13 Mode and Bandwidth Settings

21. Reinsert the LOGIC module into the chassis and secure it in place by tightening the two captive screws with a flat-blade screwdriver.

The unit is now ready for testing.

TESTING – Configuration 1

Testing requires both the local and remote terminals to be set the same and powered up.

1. Place the MAIN POWER switch, on the front of the LINE INT module, to the ON position.

Transmitter

2. Set the multimeter for dBm measurement.

3. Connect the positive multimeter lead to the TX OUT 1 test point on the front of the TRANS module, and connect the negative lead to the COMMON test point.

4. Note the indication on the multimeter. *This is the output of Channel 1. Set to +2dBm (this will result in 0dBm at the output)*.

5. Connect the positive multimeter lead to the TX OUT 2 test point on the front of the TRANS module, and connect the negative lead to the COMMON test point.

6. Note the indication on the multimeter. *This is the output of Channel 2. Set to +2dBm (this will result in 0dBm at the output)*.

7. Disconnect the multimeter test leads from the TRANS module.

Receiver

8. Connect the positive multimeter lead to the REC OUT test jack on the front of the REC module. Connect the negative lead to the COMMON test point on the same card. The meter will read the incoming signal.

9. Verify that the unit is receiving a steady incoming Guard signal (no Trip or line noise).

10. Press and hold SENS SET switch on the REC module front panel.

11. Using a small screwdriver or potentiometer adjustment wand, slowly turn SENS potentiometer counterclockwise until the GUARD LO indicator begins to flicker.

12. Release the SENS SET switch.

NOTE: The above procedure will set your Receiver for a 20db dynamic range.

If the above procedure was successfully completed, the terminal is working properly. If the procedure could not be completed, or if a malfunction is suspected, refer to the Instruction Manual maintenance information in Section 7 and the information on the individual cards in Section 4 to determine the source of the problem. Once the problem is located and corrected, repeat the initial startup procedure to assure that the unit is functioning properly.

COMMISSIONING TESTS – Configuration 2

Initial Start-up

Each unit is checked and adjusted at the factory. Verify the electrical connections as described earlier. The following procedure will apply the settings for the logic required by the application, select the frequencies and signal levels for the transmitter and receiver, and verify proper operation of the unit. This procedure can be performed at any time to verify proper operation.

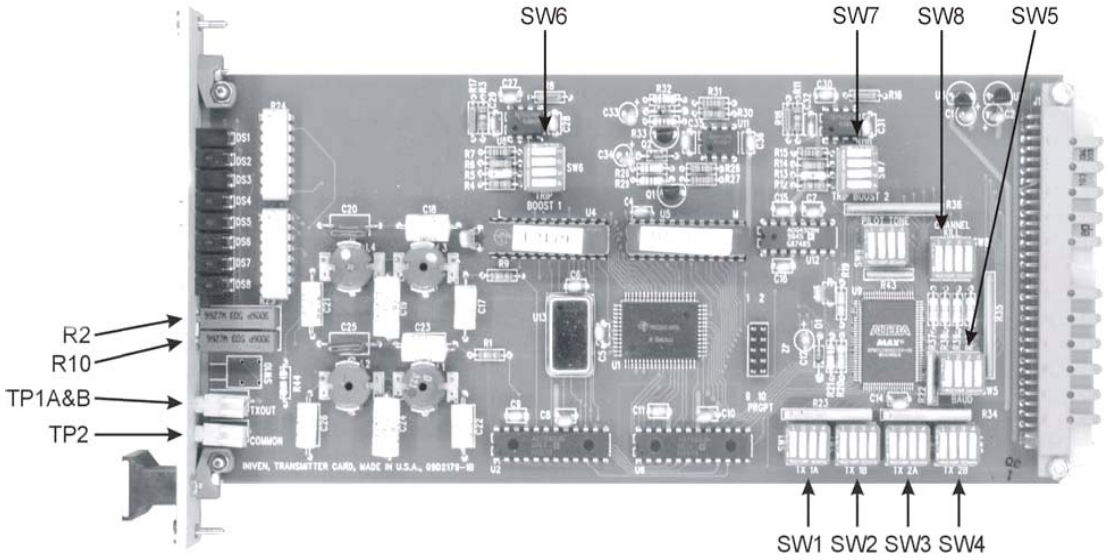
Input and output settings

Unless otherwise directed, follow the steps in the order presented. Comments and typical results will appear in ***italic***.

1. Verify that the MAIN POWER switch, located on the front of the LINE INT module, is OFF.

Transmitter

2. Using a flat-blade screwdriver, loosen the two captive screws securing the TRANS module to the chassis. Remove TRANS module from chassis by pulling on the handle.



Transmitter Module

3. Set DIP switch SW1 for desired frequency of Channel 1A (see DIP switch settings, Table 1 for 340 Hz sub-channel spacing, or Table 2 for 680 Hz sub-channel spacing). Appendix A provides specific frequency characteristics of each Group and Sub-Channel with 340 Hz spacing. Appendix B provides specific frequency characteristics of each Group and Sub-Channel with 680 Hz spacing.

4. Set DIP switch SW2 for desired frequency of Channel 1B (see DIP switch settings, Table 1 or 2).

5. Set DIP switch SW3 for desired frequency of Channel 2A (see DIP switch settings, Table 1 or 2).

6. Set DIP switch SW4 for desired frequency of Channel 2B (see DIP switch settings, Table 1 or 2).

SW1 – SW4 Frequency – 340 Hz Groups					
Group	**Sub-Channel**	**Switch Positions to "ON"**			
		TX 1A	**TX 1B**	**TX 2A**	**TX 2B**
		SW1	**SW2**	**SW3**	**SW4**
1	A	1	1	1	1
1	B	2	2	2	2
2	A	1,2	1,2	1,2	1,2
2	B	3	3	3	3
3	A	1,3	1,3	1,3	1,3
3	B	2,3	2,3	2,3	2,3
4	A	1,2,3	1,2,3	1,2,3	1,2,3
4	B	4	4	4	4
5	A	1,4	1,4	1,4	1,4
5	B	2,4	2,4	2,4	2,4
6	A	1,2,4	1,2,4	1,2,4	1,2,4
6	B	3,4	3,4	3,4	3,4
7	A	1,3,4	1,3,4	1,3,4	1,3,4
7	B	2,3,4	2,3,4	2,3,4	2,3,4

Table 1 DIP Switch Settings for 340 Hz Frequency Groups (SW1 – SW4)

SW1 – SW4 Frequency – 680 Hz Groups					
Group	**Sub-Channel**	**Switch Positions to "ON"**			
		TX 1A	**TX 1B**	**TX 2A**	**TX 2B**
		SW1	**SW2**	**SW3**	**SW4**
8	A	1	1	1	1
8	B	2	2	2	2
9	A	1,2	1,2	1,2	1,2
9	B	3	3	3	3
10	A	1,3	1,3	1,3	1,3
10	B	2,3	2,3	2,3	2,3

Table 2 DIP Switch Settings for 680 Hz Frequency Groups (SW1 – SW4)

SW5 Bandwidth		
Channel	**Bandwidth**	**Switch Position to "ON"**
TX 1	340 Hz	1
TX 1	680 Hz	2
TX 2	340 Hz	3
TX 2	680 Hz	4

Table 3 DIP Switch Settings for Bandwidth

7. Set DIP switch SW5 for desired bandwidth of all channels (see DIP switch settings, Table 3).

8. Set DIP switch SW6 for desired Trip boost level of Channel 1A & 1B (see DIP switch settings, Table 4).

SW6 –SW7 Trip Boost Output Level		
Boost Level	**Switch Position to "ON"**	**Switch Position to "ON"**
	TX 1	**TX 2**
	SW6	**SW7**
0 dB	None	None
3 dB	1	1
6 dB	2	2
9 dB	3	3
12 dB	4	4

Table 4 DIP Switch Settings for Trip Boost Output Level

9. Set DIP-switch SW7 for desired Trip boost level of Channel 2A & 2B (see DIP switch settings, Table 4).

10. Set DIP-switch SW8 for the desired choice of Transmitter Channel operation (see DIP switch settings, Table 5).

SW8 **Channel Kill**		
Channel	**Status**	**Switch Position to "ON"**
TX 1A	OFF	1
TX 1B	OFF	2
TX 2A	OFF	3
TX 2B	OFF	4

Table 5 DIP Switch Settings for the desired operational channels

11. Set **all** the DIP switches on SW9 in the “OFF” position to turn off the pilot tone function.

12. Reinsert the TRANS module into the chassis and secure it in place by tightening the two captive screws with a flat-blade screwdriver.

Receivers 1 and 2

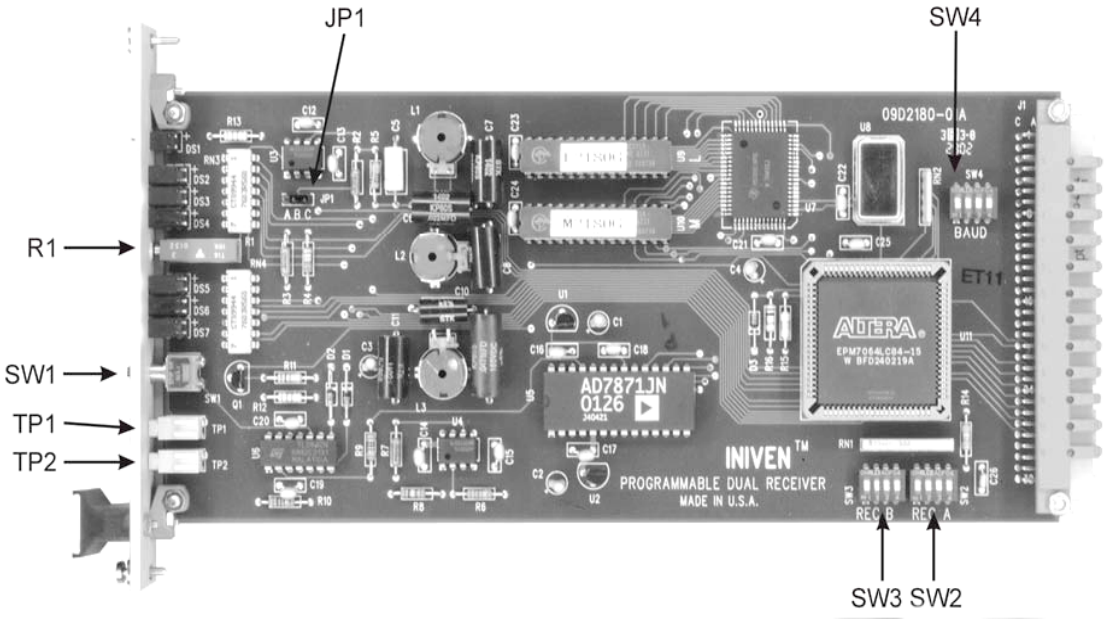
Note: ***There are two receiver modules in this configuration. Their frequency and bandwidth setting should match their respective remote terminals.***

13. Using a flat-blade screwdriver, loosen the two captive screws securing one of the REC modules to the chassis. Remove the receiver module from the chassis by pulling on the handle.

14. Verify all the DIP switches on SW9 are in the "OFF" position. *(The pilot tone function is not used in this application.)*

15. Set DIP switch SW2 for desired frequency of Channel A (see DIP switch settings, Table 6 or 7).

16. Set DIP switch SW3 for desired frequency of Channel B (see DIP switch settings, Table 6 or 7).



Receiver Module

SW2 - SW3 Frequency - 340 Hz Groups			
Group	**Sub-Channel**	**Switch Positions to "ON"**	
		Rec A	**Rec B**
		SW2	**SW3**
1	A	1	1
1	B	2	2
2	A	1,2	1,2
2	B	3	3
3	A	1,3	1,3
3	B	2,3	2,3
4	A	1,2,3	1,2,3
4	B	4	4
5	A	1,4	1,4
5	B	2,4	2,4
6	A	1,2,4	1,2,4
6	B	3,4	3,4
7	A	1,3,4	1,3,4
7	B	2,3,4	2,3,4

Table 6 Receiver Switch Settings – 340 Hz Groups

SW2 - SW3 Frequency - 680 Hz Groups			
Group	**Sub-Channel**	**Switch Positions to "ON"**	
		Rec A	**Rec B**
		SW2	**SW3**
8	A	1	1
8	B	2	2
9	A	1,2	1,2
9	B	3	3
10	A	1,3	1,3
10	B	2,3	2,3

Table 7 Receiver Switch Settings – 680 Hz Groups

17. Set DIP switch SW4 for desired bandwidth of all channels (see DIP switch settings, Table 8).

SW4 Bandwidth	
Sub-Channel Spacing (A &B)	**Switch Positions to "ON"**
340 Hz	1
680 Hz	2
240 Hz	1,2

Table 8 Bandwidth Settings

18. Set DIP switch SW4 for desired receive security logic (single, dual, or dual high security, see DIP switch settings, Table 9)

SW4 Mode & Security Settings	
Mode & Security	**Switch Positions to "ON"**
Single Channel	3
Dual Channel	4
Dual Channel, Hi Security	3,4

Table 9 Mode and Security Settings

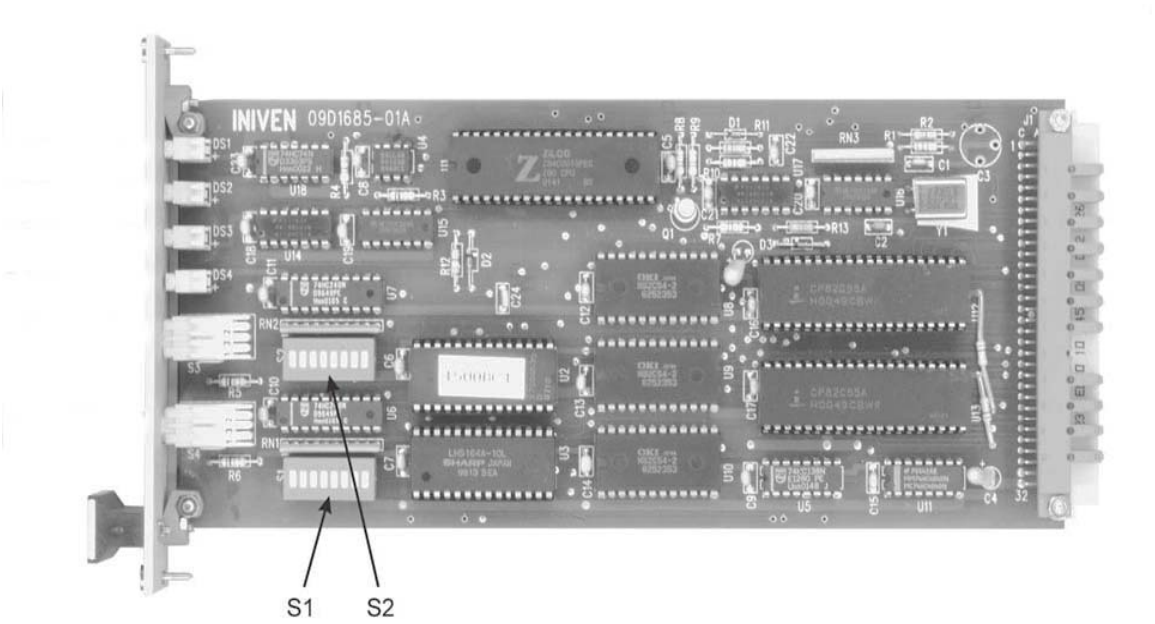
19. Reinsert the REC module into the chassis and secure it in place by tightening the two captive screws with a flat-blade screwdriver.

20. Repeat steps 13 to 19 for the second receiver module. These settings should differ in terms of frequency. The bandwidth and Security settings may be the same, based on the application requirements of the installation.

Logic Modules

Note: ***There are two logic modules in this configuration. Their settings could be different within the chassis depending on the application requirements. However the logic card for a Channel must match the respective remote terminal logic card.***

21. Using a flat-blade screwdriver, loosen the two captive screws securing the LOGIC module to the chassis. Remove the module from the chassis by pulling on the handle.



22. Set DIP switch S1 to program: Single or Dual channel, Trip Boost, the Pre-Trip timer, the Transmit Flasher, the Trip Hold timer, and the Guard before Trip options (see Table 10-13, Logic, for DIP switch settings and descriptions).

Pre-Trip Timer, based on Logic and Switch setting			
Logic Mode	**Switch 1-4 Position**	**680 Hz Shift**	**340 Hz Shift**
Dual Channel/Single	ON	10 ms	12 ms
Dual Channel/Single	OFF	2.4 ms	3.5 ms
Independent Dual	ON	11 ms	13 ms
Independent Dual	OFF	2.4 ms	3.5 ms

Table 10 Pre-Trip Timer Settings

S1 Options - Dual Independent		
	Switch Positions to "ON" for:	**Switch Positions to "OFF" for:**
S1-1	Unused for this application	Must be in "OFF" for this application
S1-2	Unused for this application	Unused for this application
S1-3	Unused for this application	Unused for this application
S1-4	Approx 11 ms Pre-Trip Timer (see Table 10)	Approx 3 ms Pre-Trip Timer (see Table 10)
S1-5	Unused for this application	Unused for this application
S1-6	Enable Guard before Trip Out 1: 100 ms of Guard is required by the receiver before Channel 1 will TRIP. Protection is restored when TRIP ceases.	Disable Guard before Trip
S1-7	Enable Guard before Trip Out 2: 100 ms of Guard is required by the receiver before Channel 2 will TRIP. Protection is restored when TRIP ceases.	Disable Guard before Trip
S1-8	Unused for this application	Unused for this application

Table 11 Switch S1 Settings – Options

S1 Guard before Trip - Single or Dual Channel		
Description of Action	**Switch Positions to "ON"**	**Switch Positions to "OFF"**
Guard before Trip "Off"	N/A	6,7
100 ms of Guard is required by the Receiver before the Channel will Trip. Protection is restored when TRIP ceases.	7	6
100 ms of Guard is required by the Receiver before the Channel will Trip. Once 500 ms of TRIP is detected by the Receiver, protection will not be restored until 500 ms of Guard is again detected.	6	7

Table 12 Guard before Trip Settings

23. Set DIP switch S2 for desired Mode and Bandwidth

S2 Mode and Bandwidth		
S2-1	**S2-2**	**Mode and Bandwidth Select**
OFF	OFF	Dual Sub-Channel, 340 Hz Spacing
ON	OFF	Independent Dual Channel, 340 Hz Spacing
OFF	ON	Dual Sub-Channel, 680 Hz Spacing
ON	ON	Independent Dual Channel, 680 Hz Spacing

Table 13 Mode and Bandwidth Settings

24. Reinsert the LOGIC module into the chassis and secure it in place by tightening the two captive screws with a flat-blade screwdriver.

25. Repeat steps 21 to 24 for the second logic module.

TESTING – Configuration 2

1. Place the MAIN POWER switch, on the front of the LINE INT module, to the ON position.

Transmitter

2. Set the multimeter for dBm measurement.

3. Connect the positive multimeter lead to the TX OUT 1 test point on the front of the TRANS module, and connect the negative lead to the COMMON test point.

4. Note the indication on the multimeter. *This is the output of Channel 1. Set to +2dBm (this will result in 0dBm at the output)*.

5. Connect the positive multimeter lead to the TX OUT 2 test point on the front of the TRANS module, and connect the negative lead to the COMMON test point.

6. Note the indication on the multimeter. *This is the output of Channel 2. Set to +2dBm (this will result in 0dBm at the output)*.

7. Disconnect the multimeter test leads from the TRANS module.

Receiver 1

8. Connect the positive multimeter lead to the REC OUT test jack on the front of the REC module 1. Connect the negative lead to the COMMON test point on the same card. The meter will read the incoming signal.

9. Verify that the unit is receiving a steady incoming Guard signal (no Trip or line noise).

10. Press and hold SENS SET switch on the REC module front panel.

11. Using a small screwdriver or potentiometer adjustment wand, slowly turn SENS potentiometer counterclockwise until the GUARD LO indicator begins to flicker.

12. Release the SENS SET switch.

Receiver 2

13. Repeat steps 8 through 12 for the REC module 2.

NOTE: The above procedure will set your Receivers for a 20db dynamic range.

If the above procedure was successfully completed, the terminal is working properly. If the procedure could not be completed, or if a malfunction is suspected, refer to the Instruction Manual maintenance information in Section 7 and the information on the individual cards in Section 4 to determine the source of the problem. Once the problem is located and corrected, repeat the initial startup procedure to assure that the unit is functioning properly.

APPENDIX A

CHANNEL FREQUENCIES

Standard Frequency Groups

RECOMMENDED TONE FREQUENCIES				
340 Hz SUB-CHANNEL SPACING - 170 Hz NOMINAL BANDWIDTH				
GROUP	**SUB-CHANNEL**	**FREQUENCY**	**MODE**	**SUB-CHANNEL CENTER FREQUENCY**
1	A	860	Trip	935 Hz
		1010	Guard	
	B	1200	Guard	1275 Hz
		1350	Trip	
2	A	1200	Trip	1275 Hz
		1350	Guard	
	B	1540	Guard	1615 Hz
		1690	Trip	
3*	A	1540	Trip	1615 Hz
		1690	Guard	
	B	1880	Guard	1955 Hz
		2030	Trip	
4*	A	1880	Trip	1955 Hz
		2030	Guard	
	B	2220	Guard	2295 Hz
		2370	Trip	
5*	A	2220	Trip	2295 Hz
		2370	Guard	
	B	2560	Guard	2635 Hz
		2710	Trip	
6	A	2560	Trip	2635 Hz
		2710	Guard	
	B	2900	Guard	2975 Hz
		3050	Trip	
7	A	2900	Trip	2975 Hz
		3050	Guard	
	B	3240	Guard	3315 Hz
		3390	Trip	
* Preferred Groups for minimum noise and to avoid roll-off at lower or upper end of communication channel. CCITT frequencies and spacing are available on request.				

APPENDIX B

CHANNEL FREQUENCIES

Standard Frequency Groups

RECOMMENDED TONE FREQUENCIES				
680 Hz SUB-CHANNEL SPACING - 340 Hz NOMINAL BANDWIDTH				
GROUP	**SUB-CHANNEL**	**FREQUENCY**	**MODE**	**SUB-CHANNEL CENTER FREQUENCY**
8	A	785	Trip	935 Hz
		1085	Guard	
	B	1465	Guard	1615 Hz
		1765	Trip	
9*	A	1465	Trip	1615 Hz
		1765	Guard	
	B	2145	Guard	2295 Hz
		2445	Trip	
10	A	2145	Trip	2295 Hz
		2445	Guard	
	B	2825	Guard	2975 Hz
		3125	Trip	
* Preferred Groups for minimum noise and to avoid roll-off at lower or upper end of communication channel. CCITT frequencies and spacing are available on request.				