HV Diagnostics

ENGLISH

Rev 2.6

EZ-Cable ID

User Manual

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North and South America

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Three Phase Cable and Phasing Identification System for Energized and De-Energized cables

Revisions

Revision	Change / Description	Firmware	
		RX	TX
2.6	Update to bypass verification mode with Threshold = 0% (off) and eliminate line mode change error.	2.6.5	1.6.7

Table of Contents

Forward

Purpose

This operating manual serves to ensure the proper and safe use of the EZ-Cable ID test instrument.

Regarding this Document

Target User

This operating manual is designed to inform various user groups. The scope and depth of the information provided may not be appropriate for all users. However, it is important that all users familiarize themselves with this document in full. The following is a guideline indicating the most significant information as a function of the user's responsibilities.

User	Responsibilities	Focus
EZ-Cable ID Operator	• To connect the equipment • To carry out the correct sequence • To verify validity of EZ-Cable ID application	**All** Sections Particular focus on all **safety** messages
Procurement, Management	• To assure that the workplace is safe and has all required equipment • To assure that the EZ-Cable ID operators are qualified technicians • To assure that the operators fulfil their responsibilites	Particular focus on safety messages and information regarding **general** product description.

Legal Considerations

Warranty

HV Diagnostics, Inc. provides a one year warranty from the original purchase date of the instrument for all necessary parts and labor. This warranty and our liability are limited to replacing or repairing, at our discretion, the defective equipment. Equipment that is returned to our company must be suitably packed and all shipped items must be prepaid and insured by the customer. This warranty does not include normal consumable items. No other warranties are expressed or implied. This warranty will be void in the event of abuse, incorrect operation and use, unauthorized modification or repairs or failure to perform the specified maintenance as indicated in this operation manual.

Contact Information

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Your opinion matters!

Your comments and suggestions are of value. We are dedicated to supporting your needs. Offering you optimal documentation is part of our promise of quality. Improvement suggestions regarding this manual may be sent to: sales@hvdiagnostics.com

Thank you for your feedback!

Safety Precautions and Prerequisites

Safety

Safety is a **priority**! Observe and adhere to all **safety information and regulations**; only use the EZ-Cable ID for **appropriate applications** and ensure that operators possess the required **operator qualifications and training**.

General Safety

NOTICE

Operation Manual

Before carrying out any test with this instrument, read and understand this Operating Manual in its entirety.

Work Safety

DANGER

Electric Shock Hazard

- Never assume that equipment is safe to handle without using the necessary safety equipment and grounding procedures.
- User should read and understand the entire operation manual before using the instrument.
- Always follow safety procedures defined by your company, or by national or international guidelines and regulations.
- Always treat exposed connectors and conductors as potential electric shock hazards.
- Cover up or barrier off neighboring energized parts using approved insulating materials.
- Ground connections must be made first and removed last!
- When working on a de-energized cable, both ends should be suitably grounded.
- DUT must be discharged and grounded before disconnecting the test lead.
- All cables and connectors must be inspected for damage before use. Damaged equipment must not be used.
- Avoid testing alone.
- **Always use an approved spiking gun/instrument and procedure when cutting into a cable.**
- **Never assume a cable to be de-energized, regardless of whether it has been positively identified or not.**
- Always confirm absence of voltage using an independent and approved instrument and procedure.
- Always protect against the re-energizing of a cable.

DANGER

Authorized Personnel Only

- Only well-trained personnel with an electrical background should use this equipment.
- **Never assume a cable to be de-energized, regardless of whether it has been positively identified or not.**

General Description/Technical Data

Technical Data for the EZ-Cable ID unit

Transmitter	Description
Input Supply Voltage	Integrated Battery: 12V SLA (Sealed Lead Acid), 2.9Ahr AC Shore Power: 85 ~ 264VAC, 47~440HZ / 120-370VDC Auxiliary DC: 12V DC auto type supply [9.6~15V DC reverse protected]
Output Pulse Voltage	125V peak
Output Pulse Cycling	Single Phase ~2 seconds, Multi Phase ~ 5 seconds
Output Pulse Current	100A max. Actual current dependent on loop impedance
Power Consumption	21W
Battery Status	LED indication: Full (Green), Medium (Amber), Low (Red), Critical (Blinking Red)
Battery Life	7 hrs (Single Phase)
Charging Time	4.5 hrs
Pulse Indication	LEDs with loop status indication and Audio
Environmental Protection	IP52
Operating Temperature	-10 ~ 55°C / 14 ~130°F
Dimensions	240 x 120 x 90 mm / 9.4" x 4.7" x 3.5"
Weight	2.1 kg / 4.6 lbs

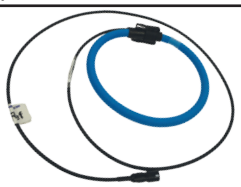
Receiver	Description
Input Supply Voltage	4 AA Batteries (6.0V nominal), Alkaline or rechargeable
Power Frequency Current	0 ~ 500A (50/60 Hz) +/- 2% at reading, Resolution: 0.1A (With Flexible Sensor)
Memory	Non-volatile storage of ID parameters
Display	Backlit 128 x 64 pixel, monochrome
Battery Life	16 hrs
Environmental Protection	IP62 with shock absorbing rubber holster and lanyard
Operating Temperature	-10 ~ 55°C / 14 ~130°F
Signal Detection Sensor	Flexible pickup coil, ID: 180mm/7.0” (CAT III 1000V) See also optional Hand Held Pickup Sensor “PUC” for twist method
Dimensions	240 x 120 x 55mm/ 9.4" x 4.7" x 2.2"
Weight	0.7kg / 1.6 lbs

Note: Due to continuous development, the information detailed in this document may change without notice.

Materials

Shipment Content

Items included with delivery of the base model EZ-Cable ID are listed below. The * marking specifies items that are country specific. For inquiries, please contact HV Diagnostics.

Part No.	Item	Description/Image	Quantity
EZ-ID-TX	**Transmitter: Tx** with integrated battery.		1
EZ-ID-RX	**Receiver: Rx** Including 4 AA batteries.		1
900 103	**Line output test leads** for Tx unit (L1, L2)		2
	Mains Cable/ AC power cable* *Not available in all countries		1
900 101	**DC Power Cable +12V Auto type** (Cigarette Lighter Adapter) for Tx unit		1
900 102	**EZ-Cable ID transport case**		1
900 109	**Red and Black alligator clip** (CAT III 1000V)		2 ea
	EZ Quick Start Guide	A quick setup guide.	1
	EZ-Cable ID manual	An operation manual.	1
900 110	**Rx Flexible Pickup Sensor** (CAT III 1000V) Can be used to detect ID signals AND measure RMS power frequency current on cables.		1

Optional Accessories

Optional equipment that is not included with the standard delivery of EZ-Cable ID.
These items are available to order through HV Diagnostics or one of our Distribtors.

Part No.	Item	Description/Image	Quantity
900 010	**Clamp-On CTs** (CAT III 600V) Used for the indirect method on potentially energized cables.		1
900 105	**CT Paralleling Test Leads** (Pair) used with Clamp-On CTs. 1 Red and 1 Black.		1
900 111	**Rx Handheld Pickup Sensor "PUC"** Useful for twist method and when testing 3 conductor cables. Can be used to detect ID signals, but cannot be used to measure RMS power frequency currents. Recommended for most ID applications in field.		1

Introduction

The EZ-Cable ID test instrument allows electrical testing personnel to accurately and effectively identify either one, two or three cables or cores anywhere along the length of the cable in one identification process. This can be done on both energized and de-energized cables. In addition to identifying the correct cable and phase, the resultant current and frequency (50/60 Hz) in a cable can also be measured by the instrument.

Correct identification of a cable is often required for many types of applications. This includes, but is not limited to, the “cutting in” of a new transformer, switch or splice into an existing cable, correct identification of cables in a trench, manhole, or cable tray, before spiking/cutting. The EZ-Cable ID unit offers enhanced identification of energized cable, even those that are carrying high load currents that often cause other ID units on the market to malfunction.

The instrument consists of 3 main items. A Transmitter (Tx), Receiver (Rx), Rx Pickup Sensor and inductive clamp/s (see options), all housed in a rugged injection molded carrying case.

The instrument is extremely easy to use in both day and night time environments. The transmitter Tx can be powered by either the internal battery, AC mains or from an Aux Auto 12V DC supply. The receiver Rx is battery operated, has a backlit LCD display, is housed in a rugged rubber case holster. The Rx can be connected to a variety of coupling pickup sensors that can either be wrapped around or can be placed directly on top of a cable that is being ID’d, even when working in congested locations.

Functionality

The EZ-Cable ID transmitter injects a special coded pulse sequence into the cables to be identified. The characteristics of these injected pulses are determined by the cable system that it is connected to. The ***verification process*** (VERIFY MODE) establishes and records these reference injected signals at a known reference location along the cable with the confirmation by the user/operator. Following operator ***verification*** at the known reference location, ***identification*** (ID MODE) at the unknown point along the cable can then be performed. The ***identification*** process then compares these detected signals at the unknown point along the cable, to those obtained during the verification process at the known reference location. Both ***Verification*** and ***Identification*** are performed by placing the pickup sensor that is connected to the Rx on or around the cable/core to be identified.

> **Note:** Under special circumstances, the user can opt to bypass the verification stage and move straight to the identification stage - see Preferences page.

Important Features

- Extremely simple, menu operated, automated, easy to use backlit user interface.
- Simultaneous Single and Multi Phase Identification of both energized and de-energized circuits (see options). There is no need to repeatedly go back and recalibrate the instrument after a single cable is identified.
- Can be used on single and multi-core cables.
- Non-Volatile Memory of stored parameters.
- Correct phasing and identification of a cable system without having to remove any grounds on the cable as required in many jurisdictions allowing safe operation for personnel.
- Operation even under high load current conditions when used in indirect mode.
- Prevention of user inadvertently changing gain/sensitivity settings to cause a possible wrong ID of a cable.
- User defined preferances for sensor direction orientation, power saving etc.

EZ-Cable ID Transmitter (Tx)

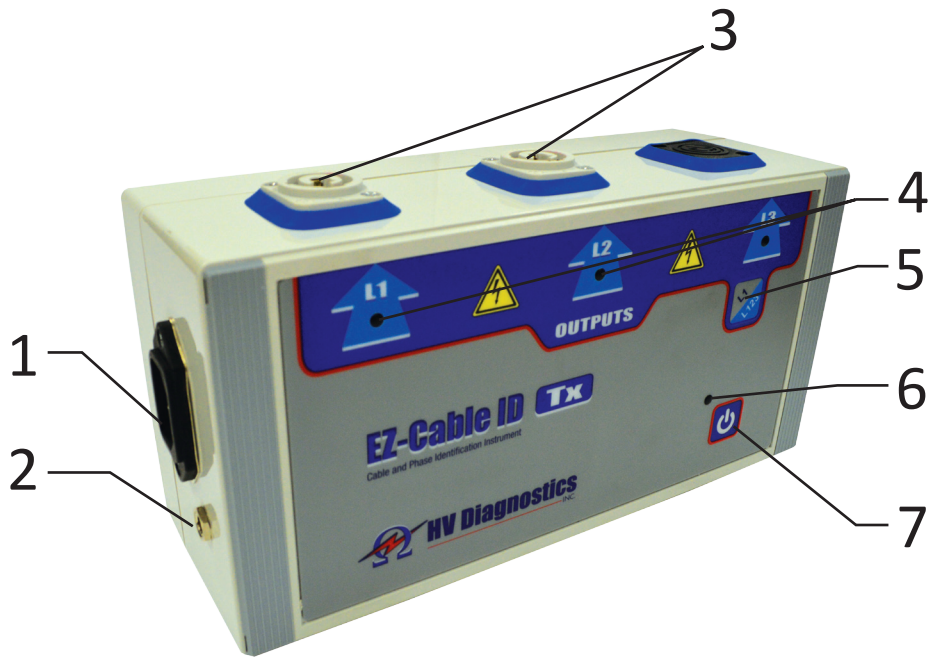


Table 1: Part of the EZ-Cable ID Transmitter

No.	Item	Description
1	AC Supply Power Input Socket	85-260V AC, 50/60Hz auto-sensing. Tx operation and recharges internal battery
2	External DC Power Input Jack	12V DC (use supplied cable only). Power source for normal Tx operation, but DOES NOT recharge internal battery.
3	Line Output Connectors	Connects the transmitter to output test leads (L1 and L2 are used - L3 is not used)
4	Line Pulse Indicator LEDs	**Green light** will illuminate when a pulse is output on L1 and/or L2 and the circuit loop impedance is good. **Red light** will illuminate when a pulse is output on either L1 and / or L2 but the loop circuit impedance on that channel is too high or there is a bad connection (>250 Ω approximately). Double Blink LED indicates Tx pulses on L1, L2, are synchronized to the power line frequency on that channel.
5	Phase selection switch	Toggles between single phase (L1) or multi phase mode (L123).
6	Internal battery power status indication LED	Green: Fully charged / Amber: medium charged Red: battery low / Blinking Red: Critically low (<10.5V DC)
7	Power On/Off switch	Toggles power ON or OFF for the transmitter. Press and hold to turn on or off Tx.

How to Use the Transmitter (Tx) Hardware

1. a) For DIRECT connection mode, connect the Line Output Test Leads provided to the supplied alligator clips (Figure 1 below). Red lead to red alligator clip, and black to black.
   b) For INDIRECT connection mode, connect Line Output Test Leads to the clamp-on CT's provided (optional. Figure 3).
2. Connect the other end of the Line output test lead to the transmitter Tx (Figure 2; Table 1, No. 3). Insert connector into socket and rotate clockwise slightly until it clicks and locks into position. **Note**: To remove the lead from the transmitter, slide down & hold the metal tab and then twist the connector.
3. Turn on the transmitter (Tx) by pressing and holding the I/O button (Table 1, No. 7) for about 2 seconds to turn ON or OFF.
4. Select either SINGLE phase (L1) or MULTI phase (L123) mode by pressing the L1/L123 phase selection switch (Table 1, No. 5).
5. Line Pulse Indicator LEDs (Table 1, No. 4) will inform operator if Tx is in Single phase (only L1 illuminates) or Multi Phase modes (L1 & L2 will illuminate in sequence). An audible beep will also be heard based on the output that is activated in both SINGLE PHASE and THREE PHASE mode.

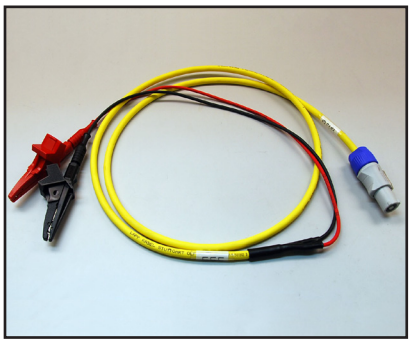


Figure 1: Main output test leads labeled L1 and L2 with alligator clips connected.

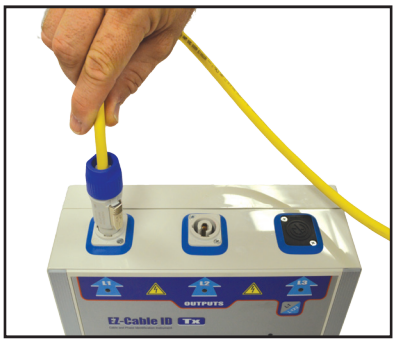


Figure 2: Male end being inserted into the transmitter. Insert then twist to lock. "Clicks" when locked.

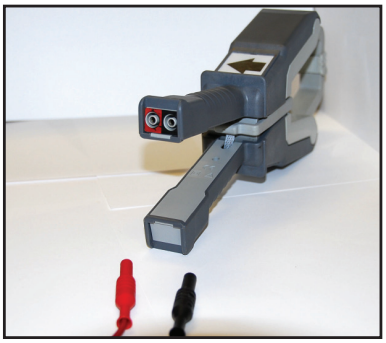


Figure 3: The end of the CT's handle has color coded inputs. Red to red; black to black.

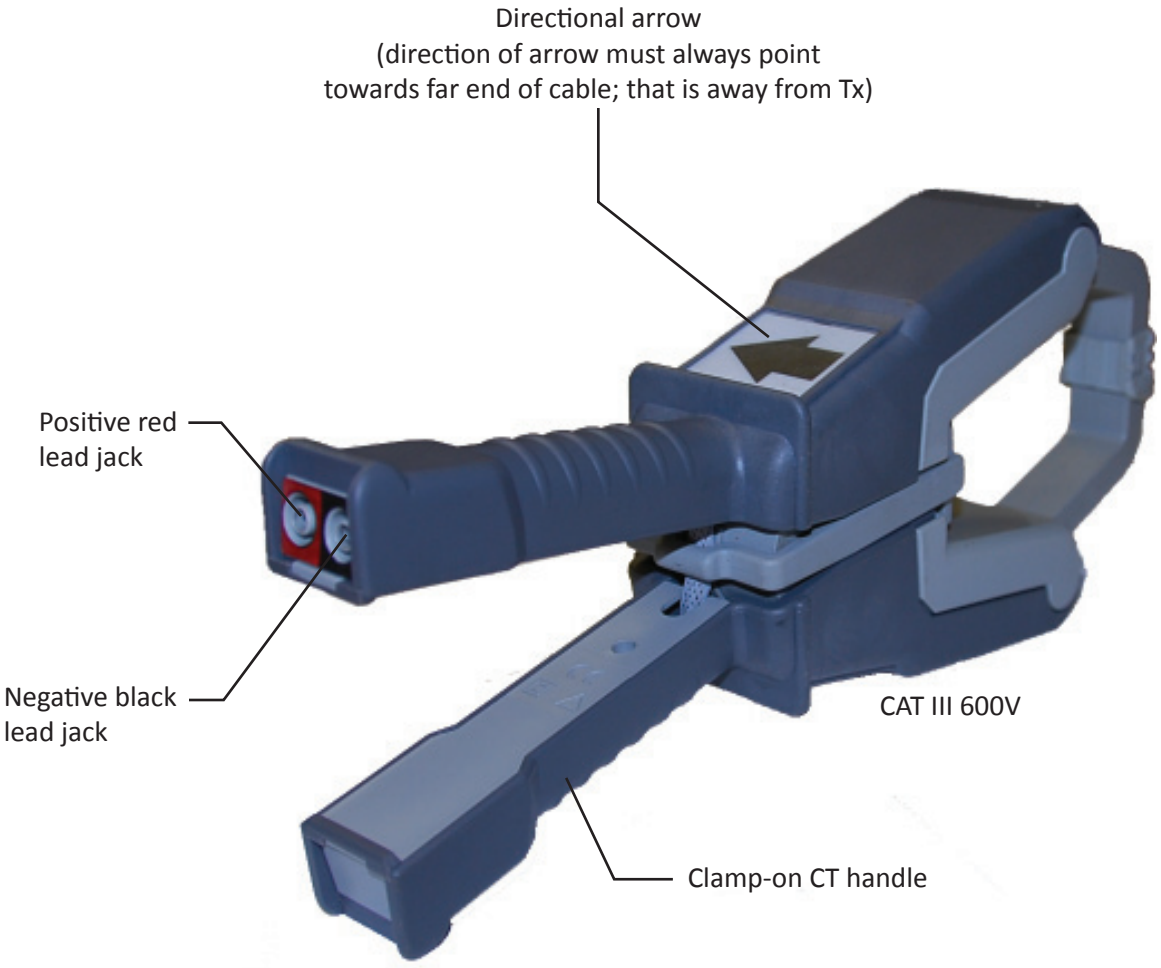
Line Synchronization

The Tx LEDs will double blink when they are synchronized to the power line frequency on that channel, when using the clamp-on CT's.

Loop Impedance Detection

If the Tx L1 / L2 Line Pulse Indicator LEDs are green, this indicates a good, low impedance current loop circuit. If any of these LEDs are red, this will indicate a poor current loop circuit. This could be due to an open circuit on the cable to be identified, a high impedance, an open test lead, a poor or bad connection and/or no grounding of the cable at the far end in direct mode. The user should always have green line pulse indicator LEDs when using the ID system on a cable.

Clamp-On CT (Optional)



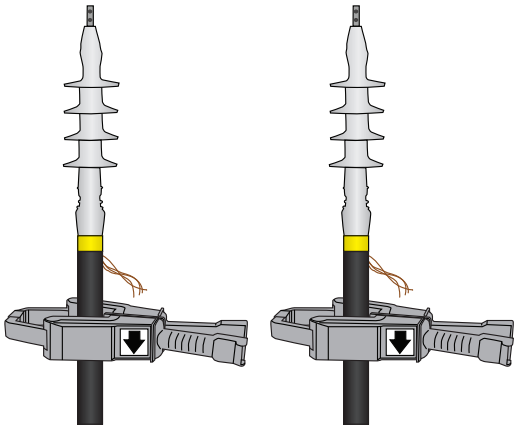
How to Use

1. Insert the banana connection of the line output test leads into the appropriate jack of the Clamp-On CT according to their color/polarity. Red to red and black to black.
2. Squeeze the handles together to open the clamp.
3. Close the clamp around the cable in question. Make sure the directional arrow is facing the far end of the cable.

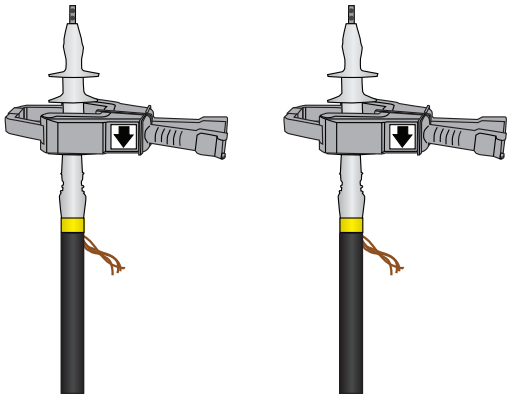
Note: When using the CT clamps, the Tx will always show a green LED on the line pulse indicators even if the circuit loop impedance is too high or there is a bad connection on the cable circuit being identified. This is because the secondary of the CT will always be a low impedance, irrespective of the primary circuit (which is the cable that is being tested).

Proper Clamp-on CT Placement

CORRECT PLACEMENT



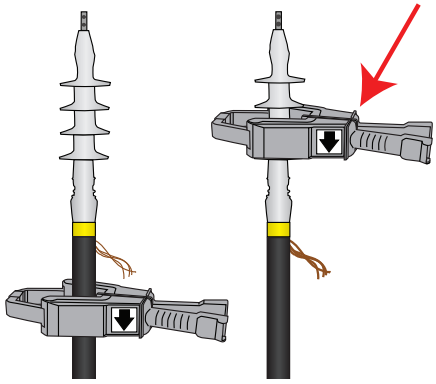
All clamps have the same polarity and each clamp is around the same location on the cable.
The direction of each clamp is facing towards the far end.



NOTE:The clamp position on the terminations shown here would only be acceptable for use on de-energized cables.

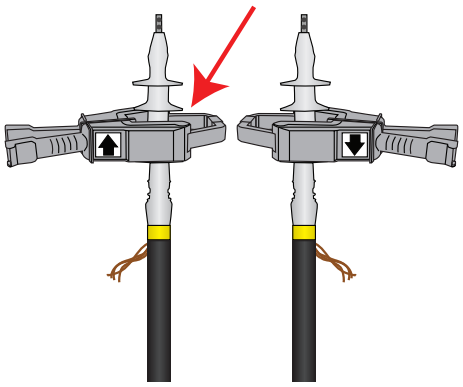
Each clamp is located on the same location on each cable.
The direction of each clamp is facing towards the far end.

INCORRECT PLACEMENT



The clamps are not all placed at the same location (around shield/neutral or main conductor) around the cable. This placement is therefore INCORRECT.

INCORRECT POLARITY



The clamps must be facing the same direction. In the above case the polarity is wrong on one phase. Each clamp must be facing towards the far end. This placement is therefore INCORRECT.

EZ-Cable ID Receiver (Rx)

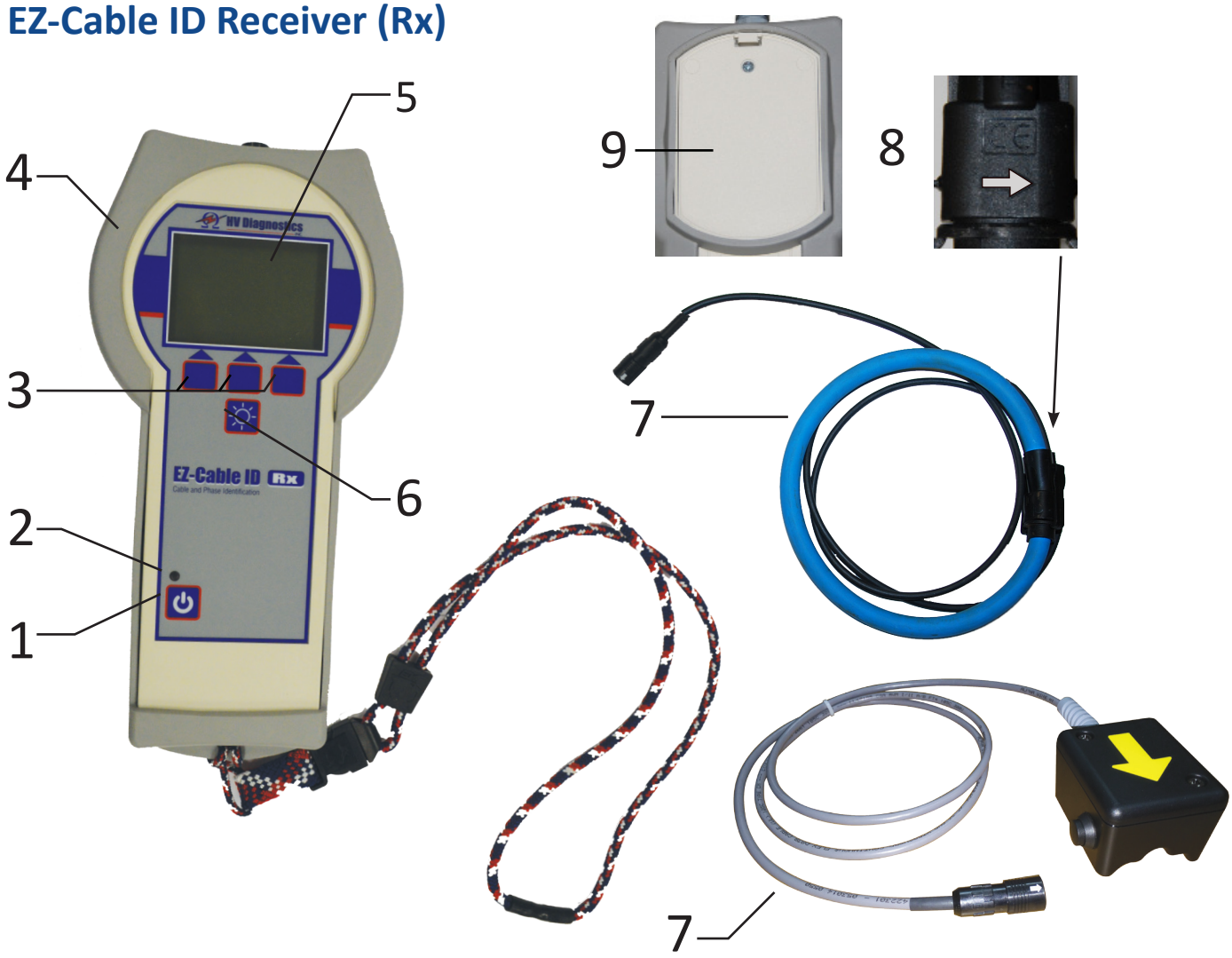


Table 2: Parts of the EZ-Cable ID Receiver

No.	Item	Description
1	Power On/Off switch	Toggles power On or Off
2	Power light indicator	Red light indicates the power is on
3	Selection buttons	Allow navigation through Rx prompts
4	Protective rubber holster/boot	Offers mechanical and environmental protection
5	LCD display	128x64 pixels
6	Backlight	Provides a backlight for dark environments
7	Flexible Pickup Sensor and optional Handheld Pickup Sensor “PUC”	Connect to the Rx unit using push-pull waterproof connector. Sensors detect pulses sent from the Tx. Note: Polarity is important. **Pull back** outer shell to unplug, and simply press on to connect.
8	Directional arrow and clamp	Flexible pickup sensor must be fully latched closed when in use. Note: Polarity is important. Keep the coupling connector of the flexible pickup sensor away from other potential current carrying conductors where possible.
9	Battery Compartment	Powered by four AA batteries (located in back of Rx)

Rx User Interface Screen Layout

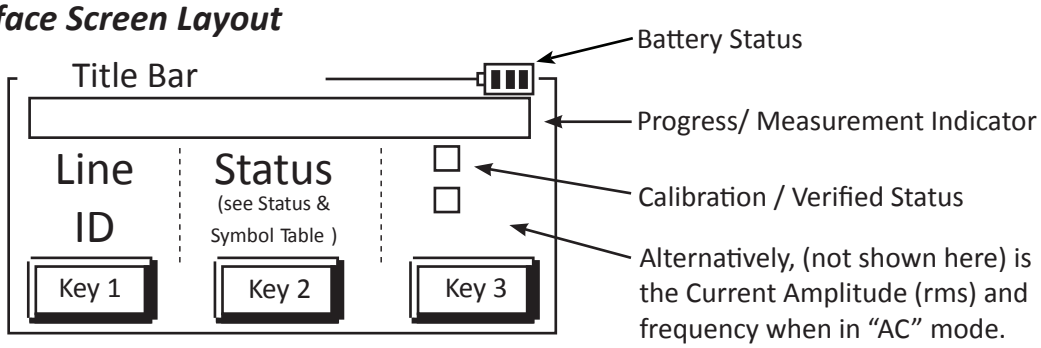
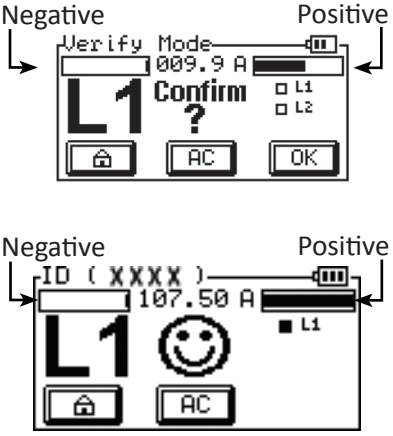
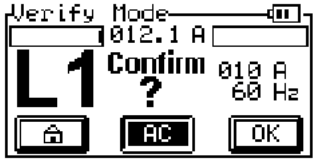
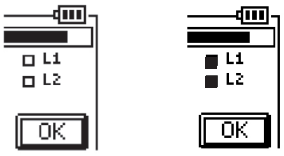


Table 3: Rx User Interface Screen Layout

	Description	Example Image
Title Bar	Varies depending which screen the Rx is on.	(intensionally left blank)
Line ID	Displays the line number detected when in ID mode or the line to be confirmed by the operator when in Verify mode: L1, L2. A negative "-" will appear when a negative signal is detected. This may be the return on the 3rd phase or another cable.	
Battery Status	High: 3 bars; Medium: 2 bars; Low: 1 bar; Critical: First bar blinking	
Progress Bar	Progress bar shows how much progress the receiver has made in processing information.	
Measurement Indicator	In **Verify Mode** this bar indicates the direction (positive or negative) and amplitude of the current pulse detected by the Rx's pickup sensor. In **ID Mode** this bar indicates the direction and amplitude of the current pulse detected by the Rx's pickup sensor. **NOTE:** In ID mode, the amplitude of the measurement indicator depends on if the Smiley Face Threshold is set to off (0%) or is active (>0%). If active, a verification was performed and the measurement indicator is relative to the amplitude obtained during the verification. If set to off, the amplitude is relative to 100Amps full scale.	
Current Amplitude	When in "AC" mode, the 50 or 60Hz current amplitude (rms) and frequency is displayed in area on the right hand side.	
Calibration Status	All lines (L1&L2) that have been VERIFIED by the operator during the VERIFY Mode are shown by a solid filled box. Lines not yet verified are shown by an empty box. All line boxes need to be filled to proceed to ID mode, when the Smiley Face threshhold is set above 0% (See Preferences Menu). If the Smiley Face is set to 0% unchecked boxes may appear indicating the Rx has detected either single or multi phase mode signals.	

Status & Symbol Table (Rx)

Table 4: Status & Symbol Table (Rx)

Symbols	Description
	This indicates that the expected current pulse amplitude is correct, however the polarity is not correct. Check polarities of all connected equipment including pickup sensor, test leads, etc. This is only active during Verify mode.
	No signal detected by Pickup Sensor.
	Line has been verified by the user (during VERIFY mode).
	Home - Return to Home Menu
	Positive identification. If the signals detected by the RX at the unknown ID location, closely resemble those signals detected at the known verified location - that is direction/threshold/timing/pattern etc, then assuming the user setup is correct and the user preference is active and set to a certain threshold percentage, then this icon may appear. (see Verify and ID mode and Preferance Menu " Smiley Face")
	"Do you want to confirm?" User input required to confirm a action, setup and/or phase demarcation. If the ID or current signal detected is very small (<0.1A) then this icon will also appear.
	Egg-Timer: please wait. Information is being processed and/or saved.
Noise 	The noise icon may appear when the Rx pickup sensor detects the presence of electrical noise. This can occur when the pickup sensor is still in the process of been placed on or around a cable to be identified and stray electrical fields are inadvertently detected. It can also occur if there is a very low amplitude pulse been injected into a cable that has high electrical noise present causing a poor signal to noise ratio. The Rx will automatically make adjustments to attempt to reject this noise if present. Refer to Section "Indirect Connection in Noisy Environments".
	Negative polarity. Current being measured is going in the opposite direction to the arrow on the pickup sensor.
	Positive polarity. Current being measured is going in the same direction as the arrow on the pickup sensor.

How to Use the Receiver (Rx)

Every screen has a title, battery status, and key functions that change depending on the active screen. The user can also return to home screen by pressing the home button at any time.

To detect the current signals injected into the cable by the Tx, the Rx is connected to a polarity sensitive pickup sensor. There are two pickup sensors available. Either a flexible pickup sensor that comes standard with the system or a handheld pickup "PUC" sensor.

The flexible sensor needs to be wrapped around the cable in question. It has a quick release, latching coupling that needs to be engaged when wrapped around a cable. The handheld pickup coil "PUC" needs to be placed directly on the cable in question. The push button on the side of the handheld coil, resets/refreshes the Rx to acquire new signal data. This can be useful when moving the pickup coil to a new location.

The user should keep/hold the pickup sensor at any new location **for at least 15 seconds** before moving it to another ID location. This allows the Rx to acquire and process signal data at that location. **After 12 seconds** the Rx will either show

a) an egg-timer symbol, indicating that signals are being acquired and processed by the Rx - user to wait for further information.

or b) a progress bar indicating that pulse data is being processed and the RX is attempting to perform an ID - user to wait for the ID to appear.

or c) a "no signal" symbol is displayed at which point the user can move to another ID location.

When in **AC** Current measurement mode, direction (polarity of the pickup sensor) is not important. However, when in **ID** or **Verify mode**, the direction of the pickup sensor is important, noted by the direction of the arrow. The arrow must either face away from the Tx, towards the far end of the cable OR towards the Tx, depending on the setting in the user preferences menu - see Sensor Arrow.

When the Rx is first turned on, there are 3 options to select from. The option can be selected by pressing the one of the three selection buttons below each option icon.

Main Menu: Where you can view/change various preferences/settings such as power save mode, find system info, adjust the contrast.

AC Mode: Where user can measure AC 50/60 Hz rms currents (non-directional).

ID Mode: Press ID mode to start a **NEW** or Continue (**CONT**) an existing, ID session.

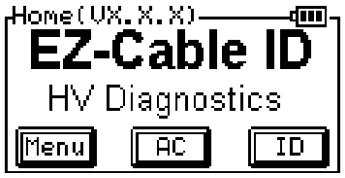


Figure 4: Rx Home menu screen.

Verify Mode Versus ID Mode

A new ID session consists of two important stages - the **Verify Mode** followed by the **ID Mode**.

During the **Verify mode**, the user confirms, at a known reference location along the length a cable (normally done at the near or far end), that the Rx and Tx are physically connected to a correct and known cable name/number/phase. The Rx then stores the measured signal data for that cable. This measured data includes the amplitude, direction and pattern. If this Verification phase is not performed, proper ID of a cable at the unknown location cannot be effectively performed.

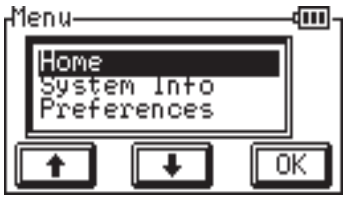
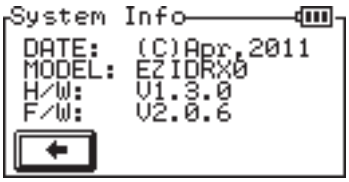
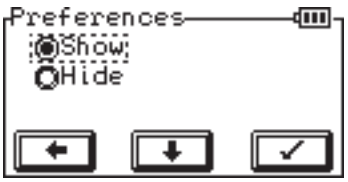
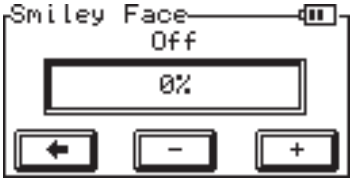
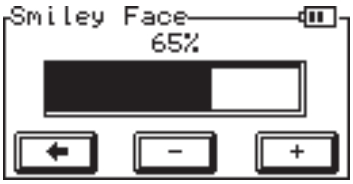
During the **ID mode**, typically performed at an unknown location along the length of the cable, the saved reference data collected during the Verification mode is compared to the measured signal data at the unknown location. The direction and magnitude are displayed. If the relative magnitude, pulse pattern and direction, closely correlate to the Verified data, the Rx will also display the phase line identified and, if selected in preferences, a Smiley face may appear.

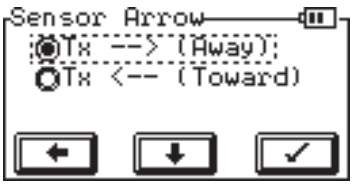
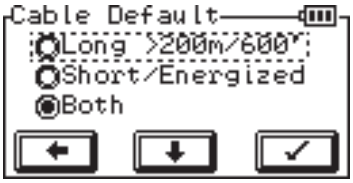
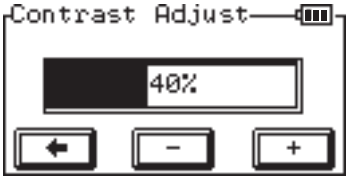
> **Note**: It is advisable to scan all cables in the vicinity before confirming a positive identification. The verification phase can be bypassed if the Smiley Face threshhold in the preference menu is set to 0%

EZ-Cable ID Receiver Menus

Main Menu

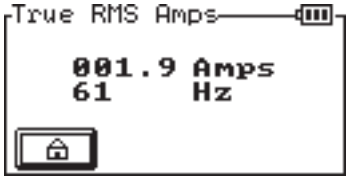
Table 5: Menu Screens

Menu	Description
	Press the **Menu** button, the contrast settings can be adjusted, the power save mode can be adjusted, the hardware and firmware versions are listed, and ID Mode can be turned to Automatic or Manual.
	If **System Info** is selected, the date of the most recent update, the model number is listed, the hardware version (H/W) is displayed, and the firmware version (F/W) is listed.
	If **Preference** is selected, this screenshot is displayed. By default the Preferences are hidden (“Hide” active). A Supervisor is required to activate the Preferences by entering a code. They are listed as P1 to P3 and need to be configured by the user/supervisor. If “Show” is activated, they are shown below the “Preferences” Menu item and seen by merely scrolling down.
	**Preference items P1 to P3:** **P1: Smiley Face** **P2: Sensor Arrow** **P3: Cable Length**
 	The **Smiley Face threshhold** Menu. If the relative percentage amplitude of the measured pulse/s at the unknown ID location, closely correlates (meets or exceeds a threshhold set by user) to the measured signal data at the known verified reference location, then a Smiley Face will be displayed. ☺ For example lets consider a setting of 65%. Then if a 10 amp pulse was detected at the known verified reference location and then 7 amps was detected at the unknown ID location, the smiley face would appear. Now if only 5 amps was measured, the smiley face would not appear based on this setting of 65%. A setting of 65% in this example also means that only signals > 65% or < 135% (that is 35% above or below 100%) will be produce a smiley face result. The setting can be made more conservative or liberal or completely turned off by setting this number to 0%. If set to zero %, the smiley would never be displayed and the verify stage can be bypassed and the user can go straight to the ID stage. **Note**: The Smiley face is to provide the user with a quick and easy to understand positive ID of the cable. Careful consideration should therefore be exercised by the user when adjusting or setting this threshold.

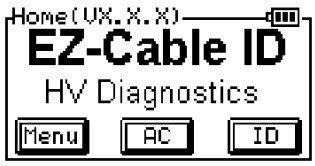
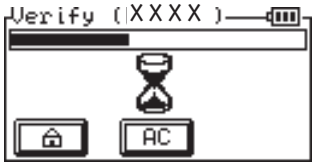
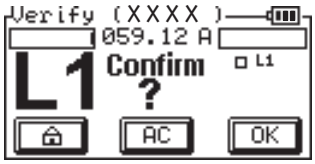
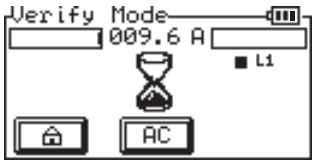
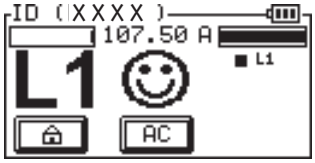
	**Sensor Arrow:** The sensor arrow allows the user to define the polarity of the arrow for the Rx Pickup Sensor. This can either be conventional or non conventional depending on the practices and norms that the user is familar with. Rx Pickup sensor arrow can either be set to face away or towards the Tx location on the cable being identified.
	**Method Used:** Allow the user to select the default line length that the ID unit will be used on. User will set it to "long" if cable under test is generally > 200m or 600ft. User will set it to "short" if all cables to be tested are short in length. That is <200m/600ft. This is also the setting to be selected if the Clamp-on CT is used (regardless of cable length). "Both" (the default recommended setting) should be selected if the user will be testing both long and short cables. If both is selected a menu screen will prompt the user to select long or short every time a new ID performed. **NOTE:** This selection effects the way in which the current pulses are acquired by the instrument and can affect the operation if the wrong mode is selected.
	The **Contrast Adjust** of the display can be set from 0 to 100% by using the - or + buttons.
	The **Power Save Mode** can be adjusted from high (highest battery conservation) to none. **High Mode** Backlight: 20 seconds to backlight off User Inactivity: 1 minute to power off Measurement no change time out: 10 minutes **Low Mode** Backlight: 300 seconds to backlight off User Inactivity: 10 minutes to power off Measurement no change time out: 30 minutes

AC Mode

Table 6: AC Display Screen

AC	Description
	From the Home page, press the **AC** button. This displays the current (in Amps) and the frequency (in Hertz). Press the home icon to return to the home page. **Note:** This is the resultant current of both the current on the conductor itself and the current flowing on the outer shield/ neutral of the cable. For example, if 10 Amps is flowing in the main conductor and 2 Amps is flowing in the opposite direction on neutral, the resultant current detected by the Rx pick up sensor will be 8 Amps.

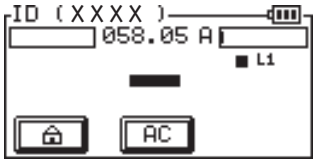
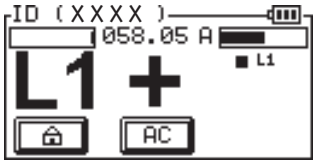
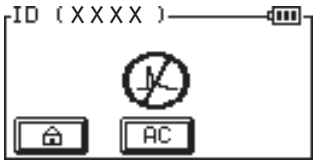
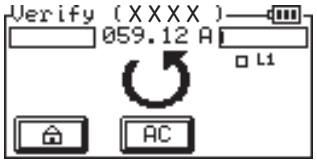
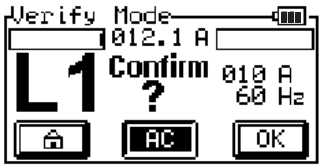
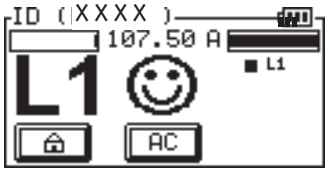
ID Mode: *Single Phase (L1) Walkthrough*

ID		
Step	**Screen Shot**	**Description**
1		From home menu, press ID to start the process.
2		"**NEW**" session: erases any previous saved data and starts a new ID session, starting with the **verify** mode. "**CONT**" Continue/s an existing ID session using pre-existing saved verification data.
3		The user is asked to either select 1. Long or 2. Short cable. If the Clamp-on CT is being used, select option 2. too. Option 1. Long is used for any cable > 200m/600ft. **Note:** If this screen does not appear - see preferences section.
PLACE PICKUP SENSOR ON OR AROUND TO CABLE TO BE VERIFIED (this verify section only applies if smiley face threshhold preference is active).		
4		**VERIFY MODE:** Wait for progress bar to complete. Rx is detecting and processing signal data. The Mode of operation is shown in brackets. (NOTE: Direct Mode shown here - but similarly for Indirect Mode).
5		Please check, verify and confirm this is, in fact, "L1"? Press **OK** to confirm. If not, user needs to recheck all connections and setup.
6		Saving the information to Rx. Wait for the small checkbox to go solid as shown. Do not remove pickup sensor until checkbox is solid/filled.
7		Once L1 data is saved to the RX (checkbox L1 solid), the Rx will automatically go to the **ID MODE.** See Title Bar signifying this change in mode. Since the user will initially still be at the reference location where the verification was done, a Smiley face should appear (if the this option is chosen in preferences).
THE USER NOW PROCEEDS TO THE UNKNOWN LOCATION TO PERFORM THE ID PROCESS.		

(XXXX) Indicates "Long" or "Short" cable mode is active.

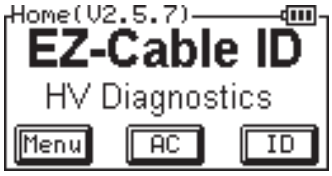
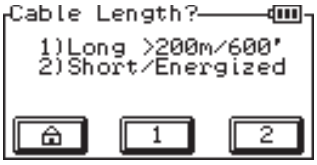
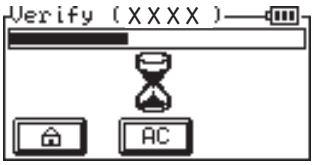
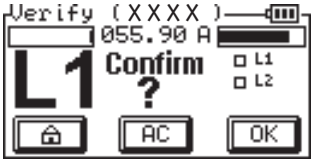
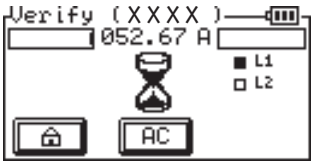
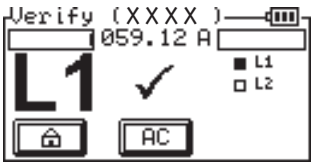
Single Phase (L1) ID Mode: Possible Outcomes

Table 7: Single Phase Possible Outcomes

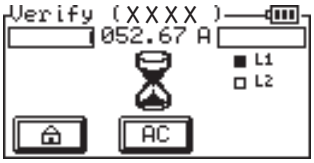
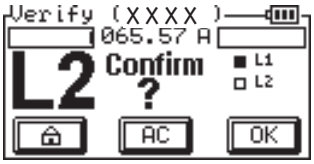
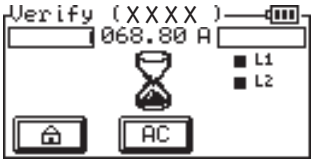
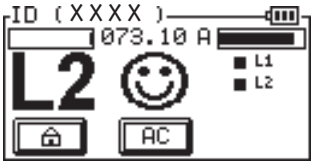
Screen Shot	Description
	In “ID Mode” the Rx sensor has detected a signal of a certain amplituide and polarity which is shown here to be negative. In this case the negative polariy indicated a returning signal pulse.
	In “ID Mode” the signal detected is in the positive direction. Amplitude is also shown and should be compared to the amplitude detected at the reference location during the Verify mode and/or to the amplitude detected on other cables in the vicinity. The cable with the **highest magnitude reading in the positive direction**, is the likely to be the corresponding phase identified.
	No Signal detected by the pickup coil connected to the Rx.
	If during the “Verify Mode” a current pulse is detected in the opposite direction to the polarity selected, this symbol is displayed. Check polarities/directional arrows of Sensor etc or possibly sensor is on the wrong cable. Check also preferences menu.
	On pressing “AC” menu button, the resultant 50/60Hz current detected by Rx pickup sensor is displayed. In this example, 10 amps at 60 Hz is being measured by the pickup sensor.
	If Smiley option is selected in preferences and the signal detected closely correlates to the Verified data for a Line, then that line number and the smiley face may appear as shown. In this case Line 1 (L1) is shown.

(XXXX) Indicates “Long” or “Short” cable mode is active.

ID Mode: *Three phase (L123) Walkthrough*

ID		
Step	**Display**	**Description**
1		From home menu, press ID to start the process.
2		"**NEW**" session: erases any previous saved data and starts a new ID session, starting with the **verify** mode. "**CONT**" Continue/s an existing ID session using pre-existing saved verification data.
3		The user is asked to either select 1. Long or 2. Short cable. If the Clamp-on CT is being used, select option 2. too. Option 1. Long is used for any cable > 200m/600ft. **Note:** If this screen does not appear - see preferences section.
PLACE PICKUP SENSOR ON OR AROUND TO CABLE or PHASE TO BE VERIFIED (this verify section only applies if smiley face threshhold preference is active).		
4		**VERIFY MODE:** Wait for progress bar to complete. Rx is detecting and processing signal data. The Mode of operation is shown in brackets. (NOTE: Direct Mode shown here - but similarly for Indirect Mode).
5		Please check, verify and confirm this is, in fact, "L1"? Press **OK** to confirm. If not, user needs to recheck all connections and setup.
6		Saving the information to Rx. Wait for the small checkbox to go solid as shown. Do not remove pickup sensor until checkbox is solid/filled.
7		Once L1 data is saved to the RX - checkbox L1 is now solid and a check mark appears). The user now need to move pickup sensor to phase L2 to verify it. NOTE: L1 and L2 can be Verified in any order.

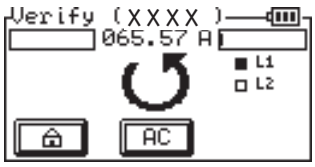
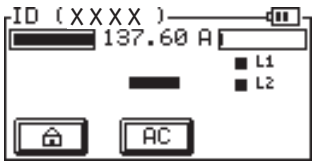
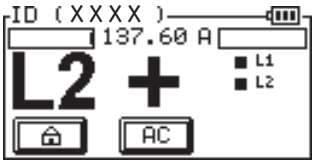
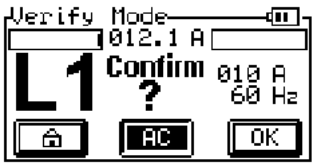
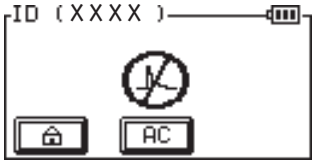
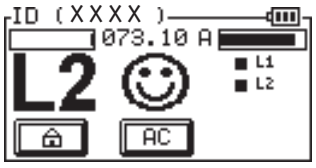
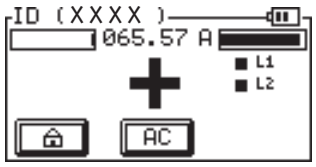
(XXXX) Indicates "Long" or "Short" cable mode is active.

Step	Display	Description
PLACE PICKUP SENSOR ON OR AROUND TO CABLE or PHASE TO BE VERIFIED.		
8		**VERIFY MODE: Phase L2** Wait for progress bar to complete. Rx is detecting and processing signal data. The Mode of operation is shown in brackets. (NOTE: Direct Mode shown here - but similarly for Indirect Mode).
9		Please check, verify and confirm this is, in fact, “L2”? Press **OK** to confirm. If not, user needs to recheck all connections and setup.
10		Saving the information to Rx. Wait for the small checkbox to go solid as shown. Do not remove pickup sensor until checkbox is solid/filled.
11		Once L2 data is saved to the RX (checkboxes L1 and L2 should now be solid), the Rx will automatically go to the **ID MODE.** See Title Bar signifying this change in mode. Since the user will initially still be at the reference location where the verification was done, a Smiley face should appear (if the this option is chosen in preferences).
THE USER NOW PROCEEDS TO THE UNKNOWN LOCATION TO PERFORM THE ID PROCESS.		

(XXXX) Indicates “Long” or “Short” cable mode is active.

Three Phase (L123) ID Mode: Possible Outcomes

Table 8: Three Phase, Possible Outcomes

Screen Shot	Description
	If during the “Verify Mode” a current pulse is detected in the opposite direction to the polarity selected, this symbol is displayed. Check polarities/directional arrows of Sensor etc or possibly sensor is on the wrong cable. Check also preferences menu.
	In “ID Mode” the Rx sensor has detected a signal of a certain amplituide and polarity which is shown here to be negative. In this case the negative polariy indicates a returning signal pulse/pulses. Make sure sensor arrow polarity is correct. This could be as a result of going around a return conductor.
	In “ID Mode” the signal detected is in the positive direction and indicates L2 phase. Amplitude is also shown and should be compared to the amplitde detected at the reference location during the Verify mode for that phase and/or to other amplitudes detected on other cables in the vicinity.
	On pressing “AC” menu button, the resultant 50/60Hz current detected by Rx pickup sensor is displayed. In this example, 10 amps at 60 Hz is being measured by the pickup sensor.
	No Signal detected by the pickup coil connected to the Rx. Wait a few seconds and if no change, then move to next cable.
	If Smiley option is selected in preferences and the signal detected closely correlates to the Verified data for a Line, then that line number and the smiley face may appear as shown. In this case Line 1 (L2) is shown.
	A positive “+” symbol with no associated Line # indicates that all signals detected are in a positive direction and of similar amplitude. Possible Cause: Pickup Sensor arrow is placed with arrow incorrectly on cable based on direction chosen (See Preferences). Further investigation required.

(XXXX) Indicates “Long” or “Short” cable mode is active.

Principle of Operation

Direct Connection (Only to be used on De-energized cables)

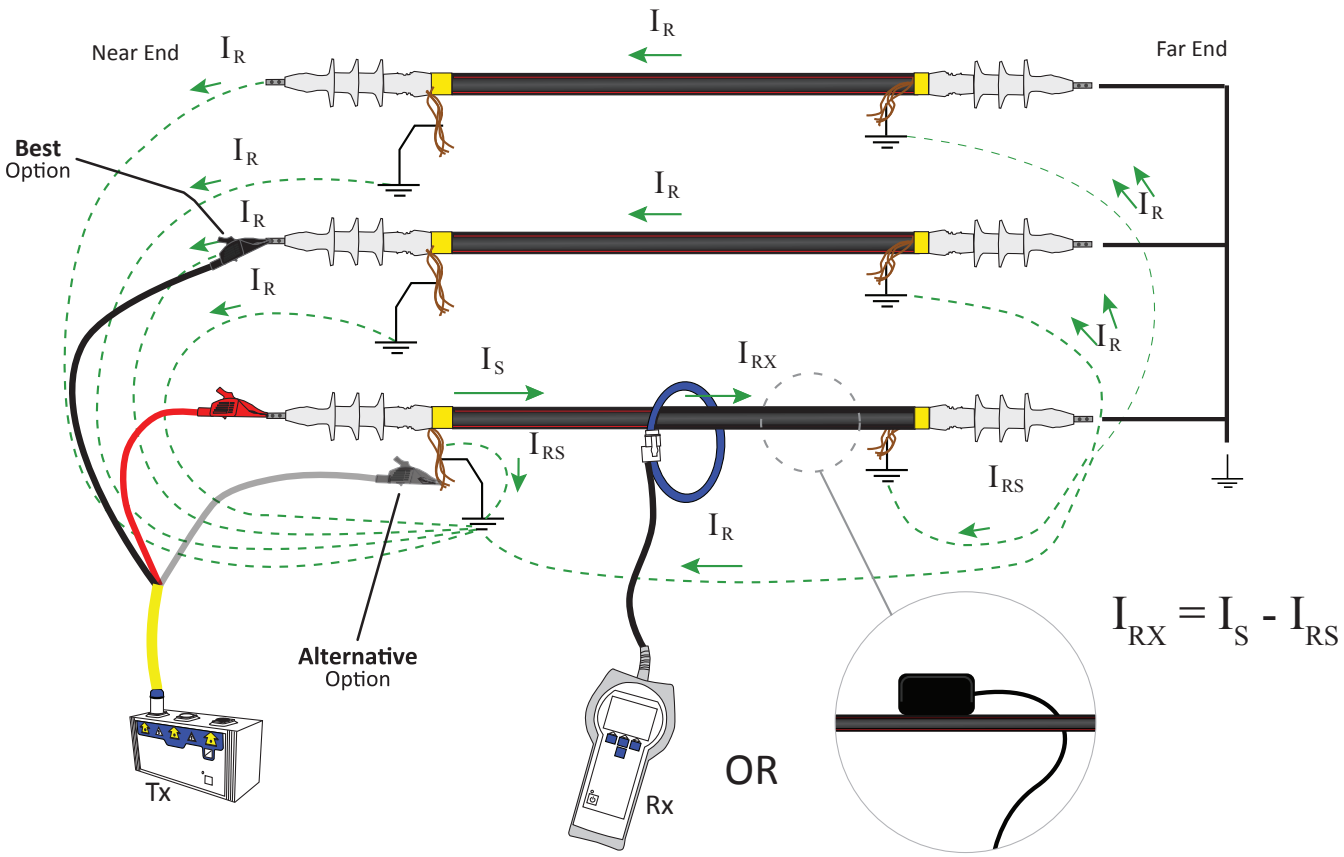


Figure 5: Single phase mode, direct connection. Example of current flow through the cables.

The output current pulse "I_S" is sent from the Tx down the conductor of the cable to be identified. The current pulse then splits and divides and returns to the Tx negative (black) terminal via the multiple ground loops as shown above by I_R. One of these ground loops can include the shield/ neutral of the cable to be identified I_{RS}.

The resultant current magnitude and direction is detected by the Rx pickup sensor. This current "I_{RX}" is the result of I_S - I_{RS}. The current flowing down the conductor less the current flowing back along the shield of that cable being identified.

The polarity (direction) and magnitude of the pulse going down the cable to be identified is unique to that cable. The other phases or other ground loops will have current signals that are generally in opposite direction and at reduced magnitudes.

Note: The Flexible pickup sensor or Hand held pickup sensor "PUC" can be used interchangeably with the RX unit.

Indirect Connection (Can be used on energized cables)

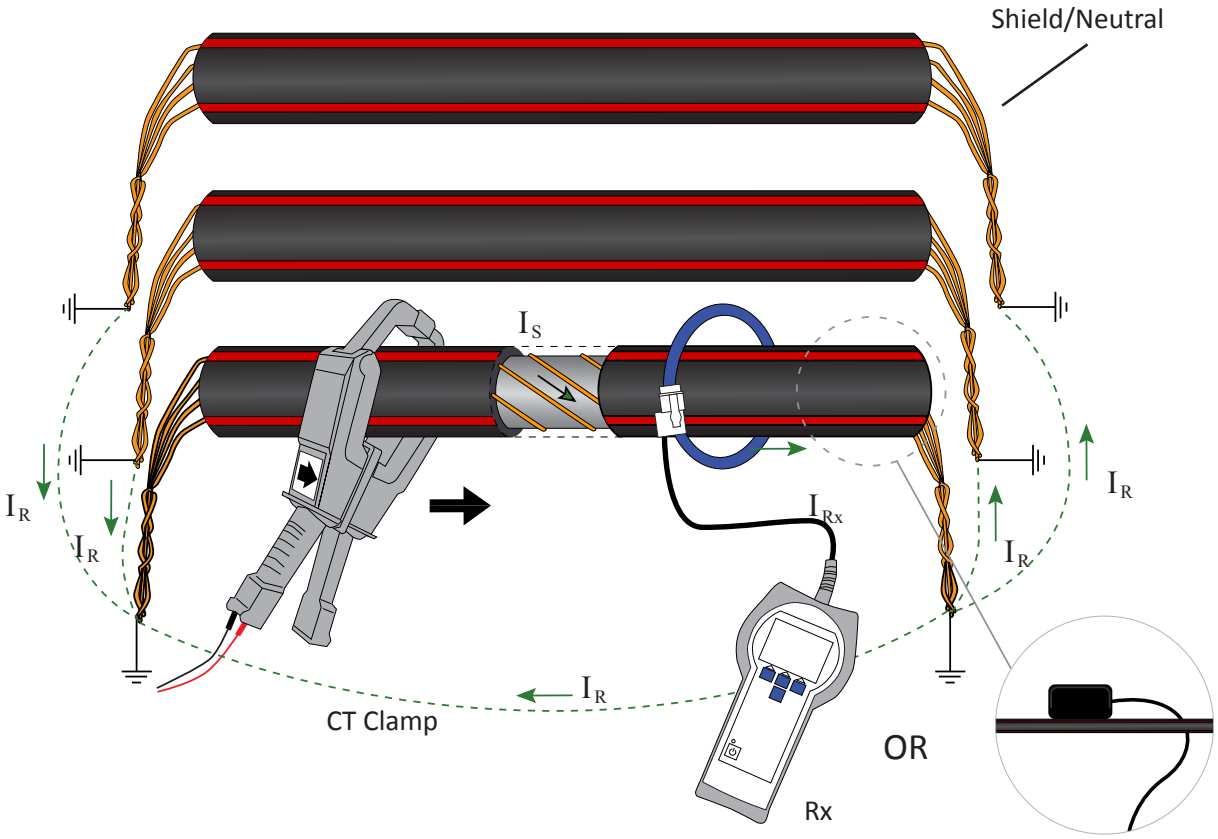


Figure 6: Single phase mode, indirect connection. Example of current flow through the cables.

With the indirect connection setup, the Tx pulse is induced into the cable's shield/neutral by the optional clamp-on CT. Note: Using this method, the signal injected into the cable is generally less in amplitude than using the direct connection setup, particularly if the ground loop impedance of the circuit is high.

The current pulse "I_S" is injected down the shield/neutral of the cable to be identified. The current pulse then splits and divides and returns via the multiple ground loops as shown above by I_R.

The Rx pickup sensor will detect I_S (assuming no return current on the conductor of the cable is present).

The polarity (direction) and magnitude of the pulse going down the cable to be identified is unique to that cable. The other phases or other ground loops will have current signals that are generally in opposite direction and at reduced magnitudes.

Methods of Connection

There are two methods of connecting the TX onto a cable: Direct and Indirect. Shielded cables shown.

Direct Connection Method

This method can only be used on de-energized cables. Line output test leads are used to connect directly to the conductor. The main current pulse travels down the cable conductor. It is important that the far end of the conductor is grounded as shown. *Helpful Hint*: Try not to directly connect the conductor of the cable in question to its own shield/neutral, but rather ground the conductor to a different ground location if possible. This will help force the signal back along different ground paths.

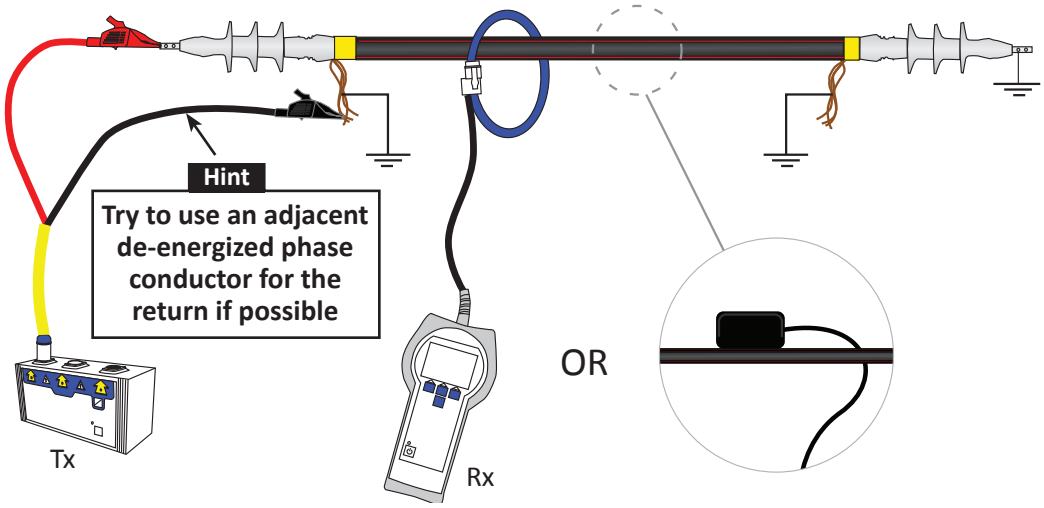


Figure 7: Direct connection to a de-energized cable.

Indirect Connection Method

Clamp-on CT is used on energized or de-energized cables. Both ends of the cable shields need to be grounded for this method as shown. The current pulse is induced into the shield/neutral conductor of the cable and travels down this conductor. It is important that both ends of the cable have their shields/neutrals grounded. There should be no other ground points of the shields/neutrals between the two outer end grounding points. The VERIFY and ID modes should take place between the two ground end points of the shield/neutral as shown.

Note: If the shield is grounded at one point only, a temporary ground should be used on the other end to ground the shield. Do not place Rx pickup sensor too close to Clamp-on CT. Try to keep at least 20cm/8" away from each other.

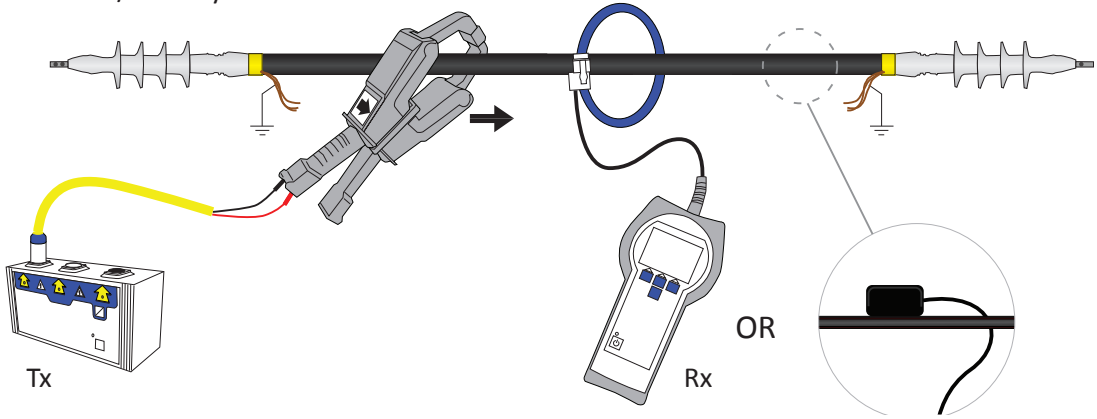


Figure 8: Indirect connection to a cable using a clamp-on CT.

Direct Connection Setup: Single Phase Mode L1

Preconditions for this method to work:

- Cable needs to be de-energized.
- Far end of cable must be able to be grounded at one point only.

1. Cable to be ID'ed must be de-energized, isolated from the power grid system, discharged and grounded. Follow approved switching and safety guidelines and procedures to ensure this is done correctly and verified. The cable neutral/shields can remain grounded.
2. The conductor of the far end of the cable being identified needs to remain grounded for the duration of the ID using a suitable ground jumper and clamps and tied to the station ground. See Figure below.
3. Insert L1 line output test leads to the L1 output connector on Tx.
4. Connect red tail of the test lead to the red alligator clamp and connect this clamp to the conductor of the reference cable. Connect the **black** tail of the test lead to the **black** alligator clamp and connect this clamp to the station ground. **Note**: The shield/neutral of the reference cable should be grounded to the station ground.
5. Remove the temporary ground connected to the conductor at the test end, leaving the alligator clamp connected from the Tx at the test end. **Note:** The conductor being identified needs to remain grounded at the far end for the duration of the test – this must not be removed.
6. Turn ON the Tx unit and ensure that it is in L1 mode. You can verify this by the LED flashing only on L1 output. Check connections before continuing. Ensure a green light is shown. If this L1 LED is red, there is a connection issue causing a high loop resistance. A single audio beep sequence will be heard when in L1 mode.

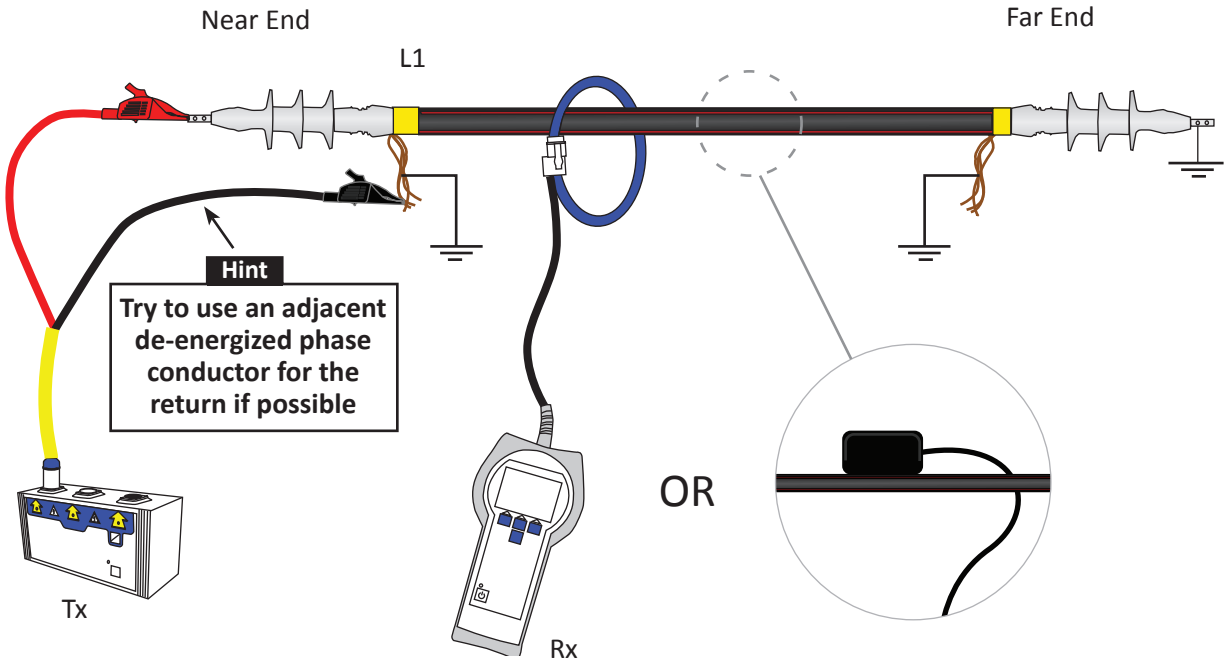


Figure 9: Direct connection setup to a cable in single phase ID mode.

Direct Connection Setup: Multi Phase Mode L123 (Preferred Method)

Preconditions for this method to work:

- Cable needs to be de-energized.
- Far end on cable must be able to be grounded at one common point for all phases. See image below.

1. Cable to be ID'ed must be de-energized, isolated from the power grid system, discharged and grounded. Follow approved switching and safety guidelines and procedure to ensure this is done correctly and verified. The cable shield/neutral can remain grounded.
2. The 3 conductors of the far end of the cable being identified needs to remain grounded for the duration of the ID using a suitable ground jumpers and clamps and tied to the station ground. See Figure below.
3. Insert L1, L2 line output test leads into associated L1, L2, output connectors on Tx.
   Note: Do not mix up the test leads – L1 Test lead to L1 port, L2 test lead to L2 port, etc.
4. Connect red tail of the test lead L1 to the red alligator clamp supplied and connect this clamp to the conductor of the L1 reference cable. Connect black tail of the test lead L1 to the black alligator clamp supplied and connect this clamp to L3 of the reference cable. **Note:** The shield/neutral of the reference cable should remain grounded to the station ground at this the test end, and far end as per normal (as shown).
5. Repeat steps 1 - 4 for L2 as per the Figure below. **Note:** black tail of test lead L2 also connects to L3 of reference cable.
6. Remove any temporary grounds connected to conductor phases at the near test end, leaving the alligator clamps connected from the Tx. **Note:** The conductors of all 3 phases being identified need to remain grounded at the far end for the duration of the test – these must not be removed. **Note:** Only one set of grounds should be on this circuit at this stage.
7. Turn On the Tx unit and ensure that it is in L123 mode. You can verify this by the LED flashing in cycle sequence L1 then L2. In addition an audio beep will generate a 3 pulse train beep (versus a single beep for single phase L1 mode). Ensure green LEDs are shown for L1 and L2 line pulse indicators.

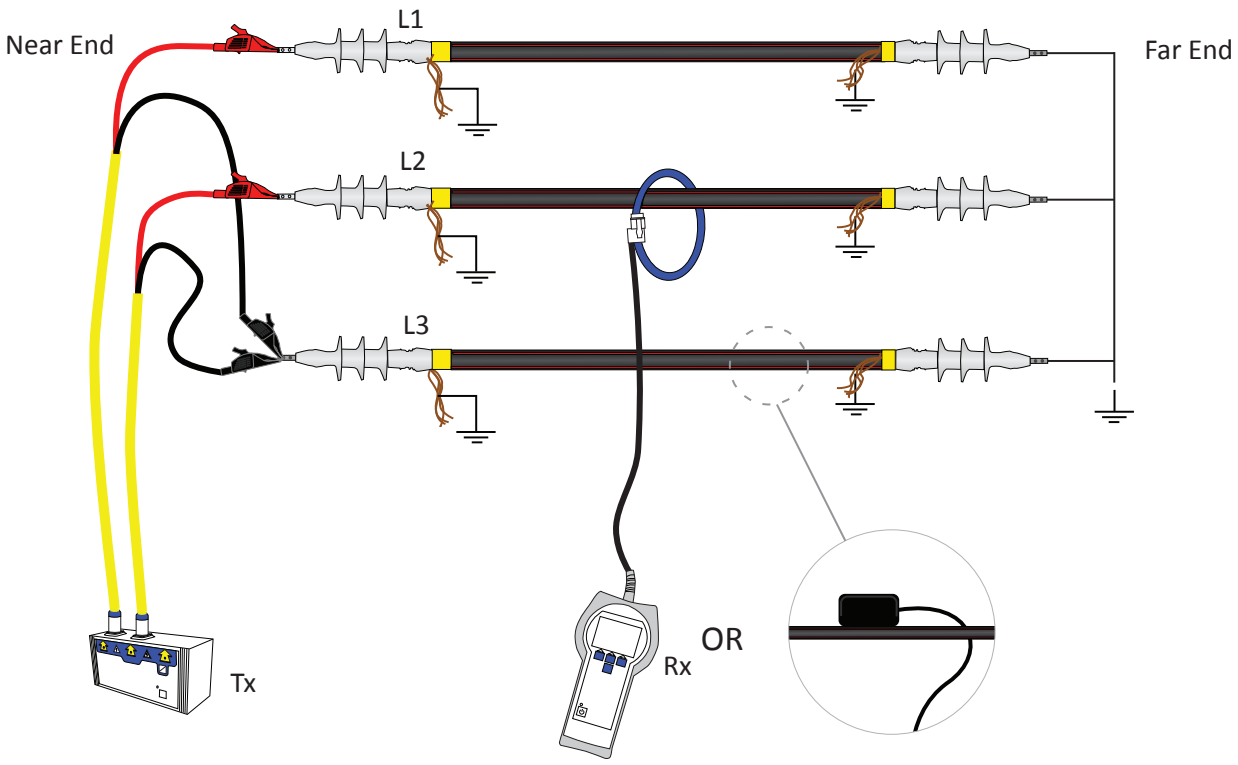


Figure 10: Direct connection setup to a cable in three phase ID mode.

"Indirect Connection" Setup: Single Phase Mode L1

Preconditions for this method to work:

- Cable must have an insulated jacket throughout its length.
- Cable must be shielded and shields grounded on both ends of the cable.
- No ground points of shield/neutral other than at ends of the cable should be present.
- Cables need to have a known reference point.
- Can be used on energized or de-energized cables.
- VERIFY and ID mode should be done between ground points on cable shield/neutral.

Introduction: This method uses an optional, inductive clamp (clamp-on CT) to induce a current pulse into the cable shield of a shielded power cable or the conductor of an unshielded power cable. This pulse and its characteristics are then verified at a known reference point along the cable.

1. Insert L1 line output test lead into the L1 output connector of Tx.
   Note: Do not mix up the test lead – L1 Test lead to L1 port.
2. Insert red tail of the test lead L1 into the red port on the back of a clamp-on CT. Insert black tail of the test lead L1 into the black port on the back of the clamp-on CT.
3. Power On the Tx unit and ensure that it is in L1 mode. You can verify this by the LED lighting in sequence on L1. In addition, an audio beep will be heard when a pulse is sent.
4. Ensure polarity of the arrows on the clamp and the pickup sensor of the Rx.

The cable neutrals/shields need to be grounded on both ends of the cable to be identified. No ground point should exist along the rest of the cable length. Do not connect clamp-on CT to conductors on energized cable! Only use clamp-on CT around the outside of shielded section of cable.

Note: If the Rx is getting a small or no signal, refer to page "Indirect Connection in Noisy Environments".

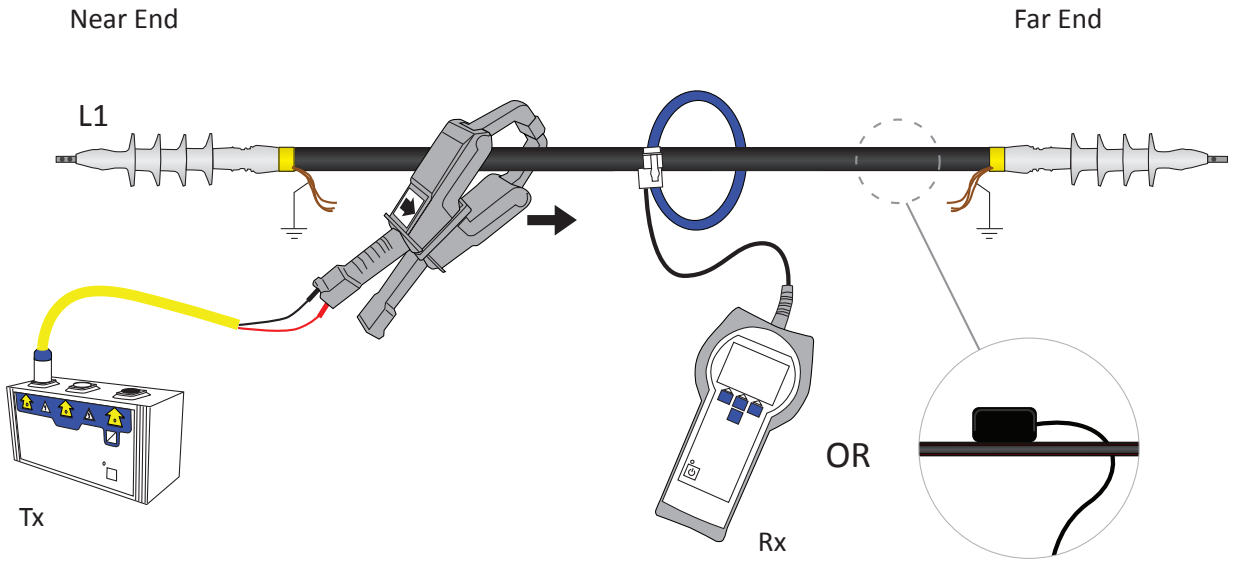


Figure 11: Indirect, single phase connection using clamp-on CT.

"Indirect connection" Setup: Multi Phase Mode L123

Preconditions for this method to work:

- Cable must have an insulated jacket throughout its length.
- Cable must be shielded and shields grounded on both ends of the cable.
- No ground points of shield/neutral other than at ends of the cable should be present.
- Cables need to have a known reference point.
- Can be used on energized or de-energized cables.
- VERIFY and ID mode should be done between ground points on cable shield/neutral.

Introduction: This method uses optional, inductive clamps (clamp-on CT) to induce a current pulse into the cable shield of a shielded power cable or the conductor of an unshielded power cable. This pulse and its characteristics are then verified at a known reference point along the cable.

1. Insert L1, L2 line output test leads into associated L1, L2, output connectors on Tx.
   Note: do not mix up the test leads – L1 Test lead to L1 port, L2 test lead to L2 port etc.
2. Insert red tail of the test lead L1 into the red port on the back of a clamp-on CT. Insert black tail of the test lead L1 into the black port on the back of the clamp-on CT.
3. Repeat steps 1-2 for L2 as per the Figure below.
4. Power On the Tx unit and ensure that it is in L123 mode. You can verify this by the LED lighting in sequence on L1 then L2. In addition an audio beep will generate a 3 pulse train beep (versus a single beep for single phase L1 mode).
5. Ensure polarity of the arrows on the clamp and the pickup sensor of the Rx.

The cable neutrals/shields need to be grounded on both ends of the cable to be identified. No ground point should exist along the rest of the cable length. Do not connect clamp-on CT to conductors on energized cable! Only use clamp-on CT around the outside of shielded section of cable.

Note: If the Rx is getting a small or no signal, refer to page "Indirect Connection in Noisy Environments". You can only ID a maximum of two cables at a time using this indirect method.

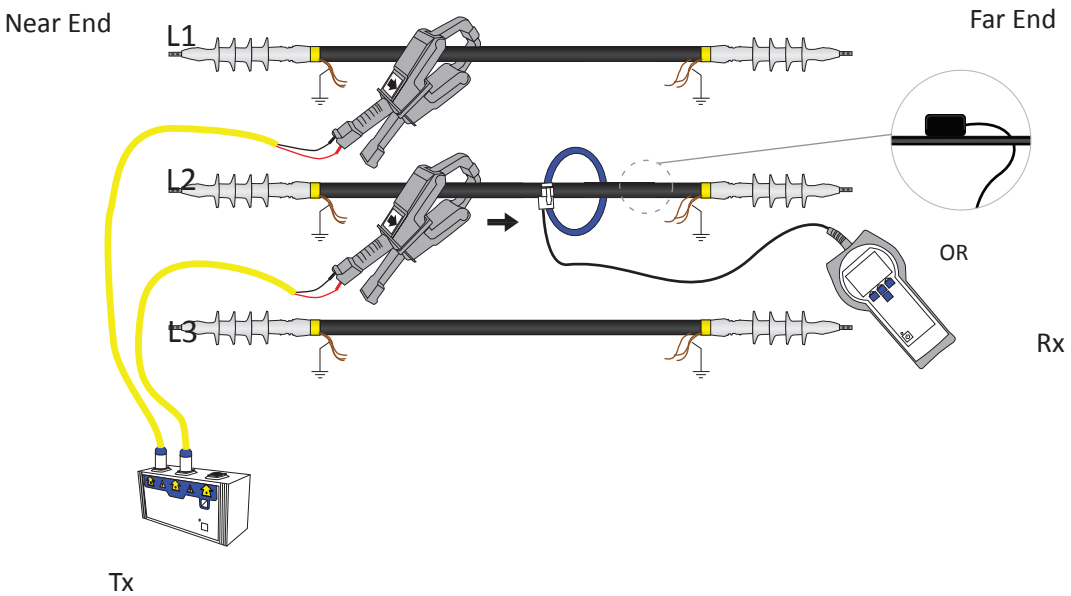


Figure 12: Indirect, Multi Phase connection using clamp-on CTs.

Field Application & Troubleshooting

Indirect Connection in Noisy Environments

In certain circumstances, there may be very low pulse signatures injected onto the cable making the ID process difficult to perform. This can be due to high resistance ground loops or electrically noisey environments causing a low signal to noise ratio. In these situations it may be useful to connect additional clamp-on Cts to the Tx in parallel as shown below. First try 2 in parallel and then, if required, 3 in parallel. Tx should be in single phase mode. The clamp-on CTs must be as close together as possible.

There may be instances where using the indirect method simply does not work. In these cases, it is recommended to ensure cable is de-energized and the Direct Connection Setup is used.

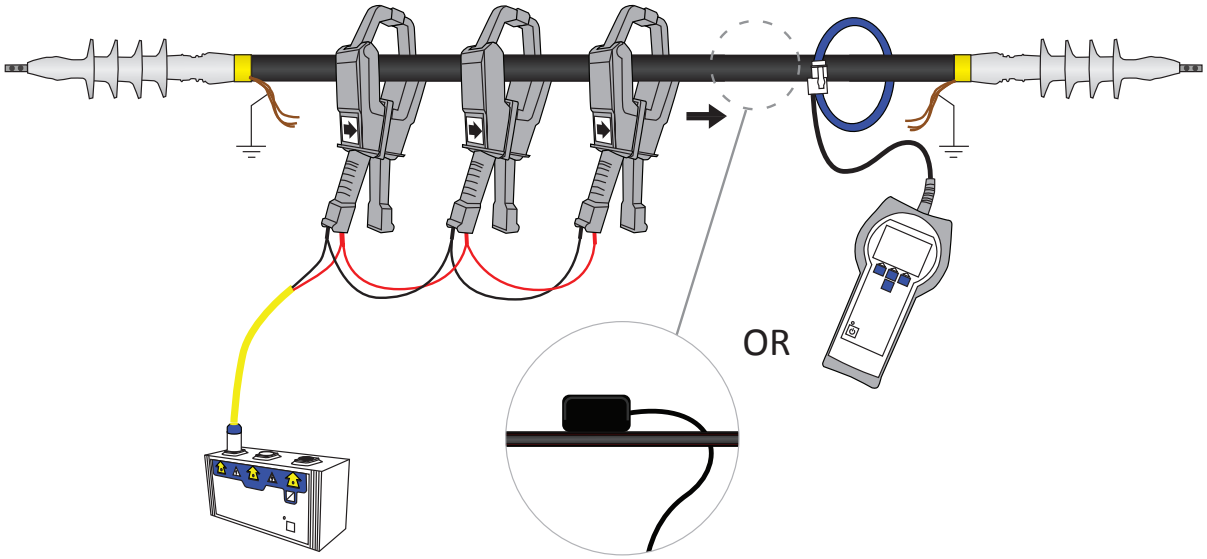


Figure 13: 3 Clamp-on CTs in parallel.

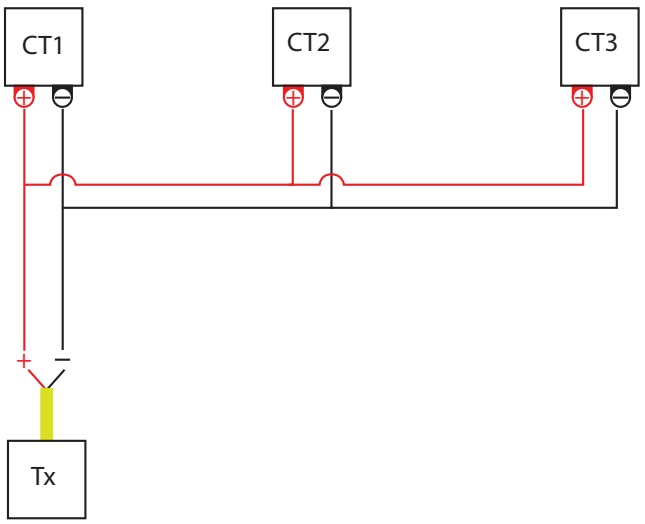


Figure 14: Circuit diagram of the clamp-on CTs in parallel.

"Like for Like"

It is important that if the VERIFY MODE is done around the cable main conductor and shield/neutral conductors combined as shown below, then ID MODE should be done, likewise, around the main conductor and shield/neutral conductors.

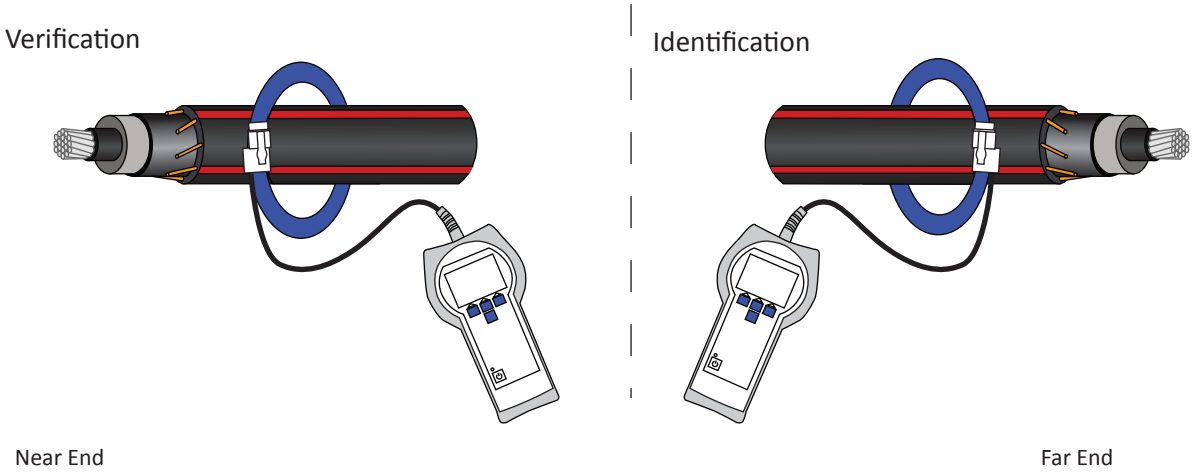


Figure 15: "Like for Like" around complete cable (main conductor and shield/neutral conductor).

Similarly, if VERIFY MODE is done around the main conductor only, then ID MODE should be done around the main conductor only.

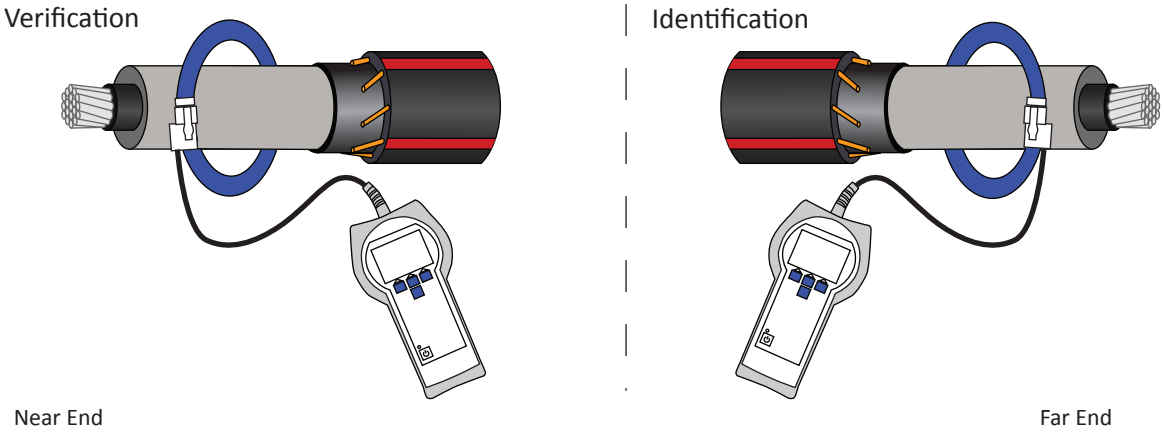


Figure 16: "Like for Like" around main conductor only.

Dealing With Intermediate Grounded Shields/Neutrals

In general, most cable installations have the cable neutral/shield conductor grounded at one end or both ends of the cable (Figure directly below). A consistent current pulse amplitude can, therefore, be detected along the full length of the cable (between these two outer shield ground points).

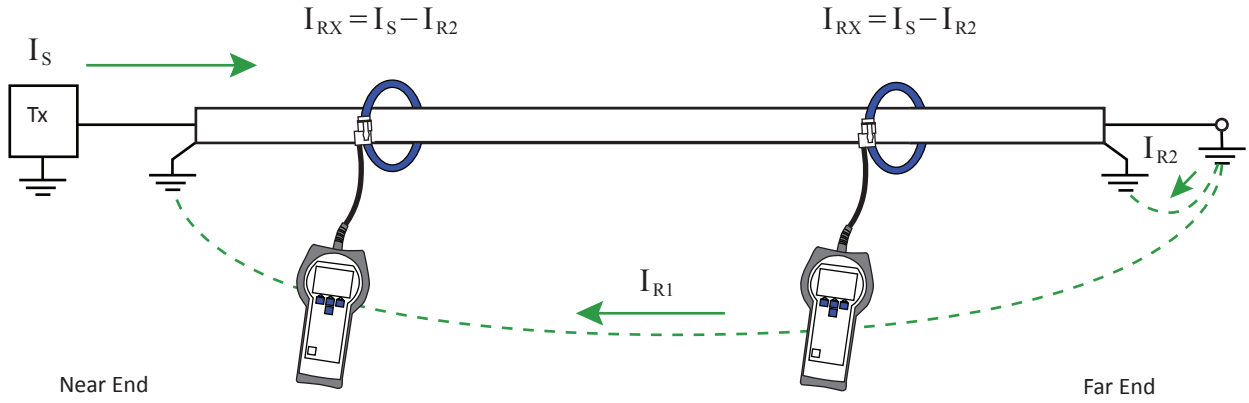


Figure 17: Current detected by RX pickup sensor on cable without intermittent grounds along cable length.

Inconsistent magnitudes of the ID pulse may arise when there are shield/neutral grounds between the near and far end terminations as shown below. This can be due to grounding the neutrals at the splice location or intermittent grounding on a cable neutral conductor. The receiver expects a specific amount of current from the Tx in order to give an automatic ID of the correct cable. If there are grounds between the points being measured, then this current may be partially or completely diverted at these ground points along the cable. In addition, these ground points might also pick up some of the returning currents (I_R) from the far end. In these cases it is recommended to use the Manual ID mode as the amplitude thresholds required for the Automatic ID mode to ID the correct cable may not be met.

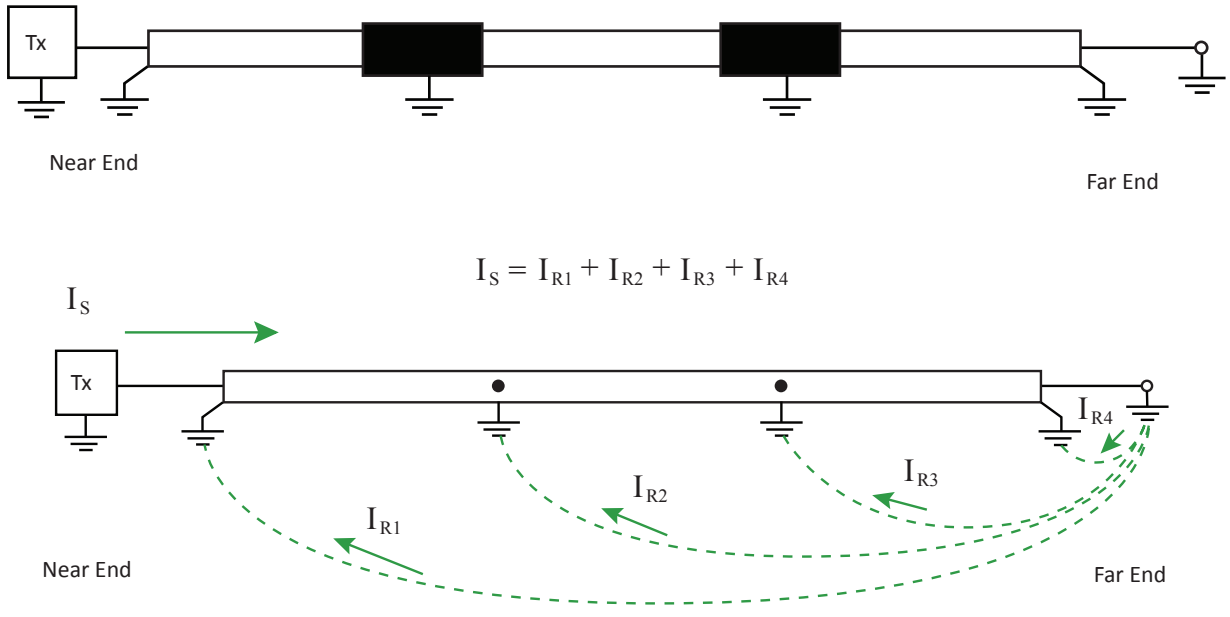


Figure 18: Current behavior on a cable with multiple grounds in between end terminations (above)

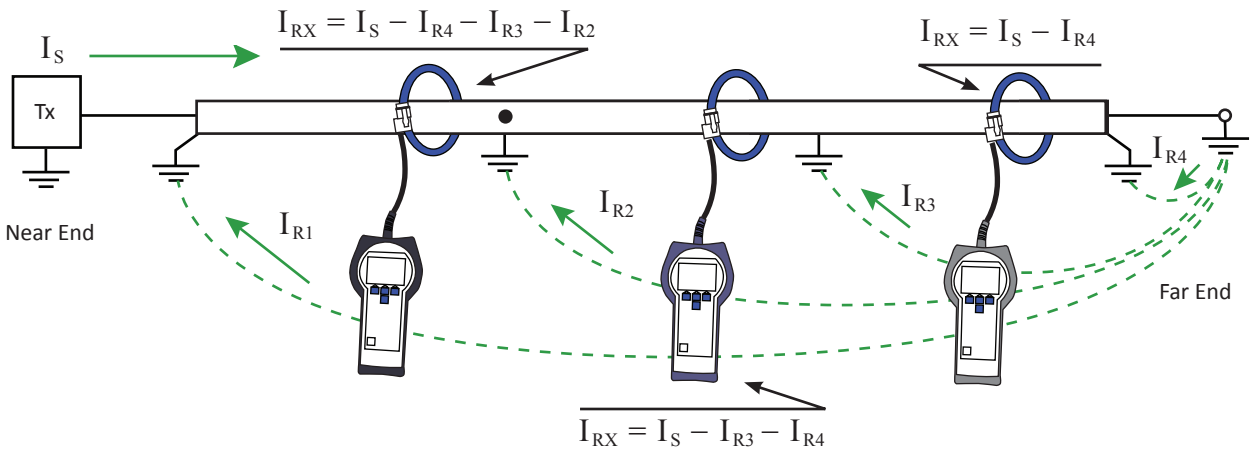


Figure 19: Current detected by Rx can vary depending on location along cable length.

A possible solution is to VERIFY and IDENTIFY between each ground (Figure below).

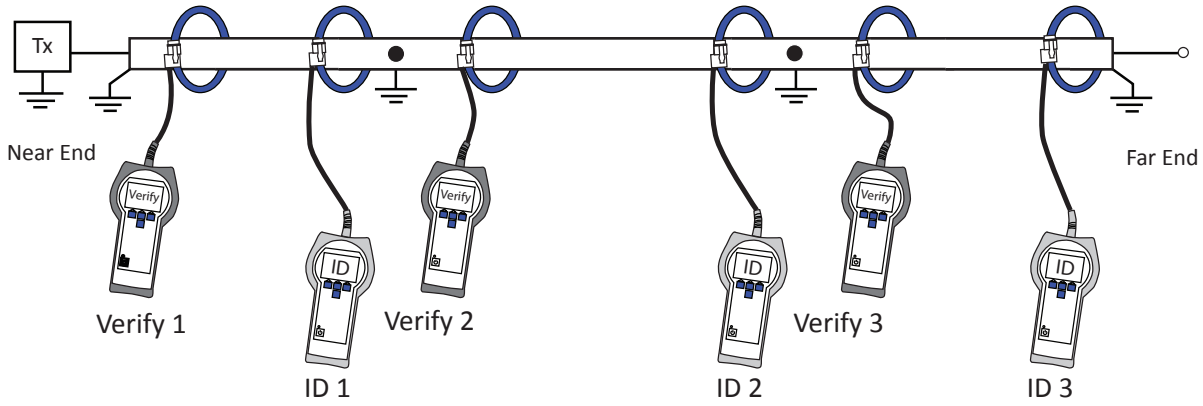
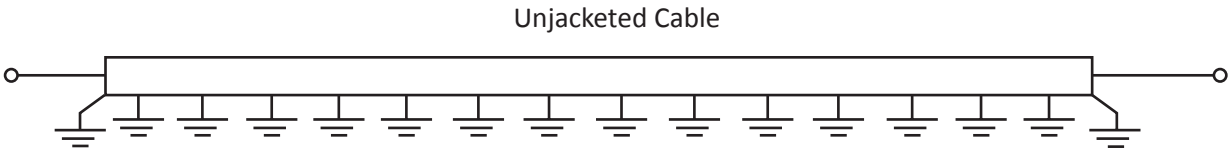


Figure 20: Cable being verified and identified between each ground.

Single Phase Unjacketed Cable ID



Unjacketed single phase cables do not have an insulation layer between the neutral conductors and mother earth/ground. In effect, you can have multiple ground points along the cable as shown above where the neutral wires are in contact with earth/ground. Examples are unjacketed or bare concentric neutral cables. When performing an ID on these cables, note the following:

- Use direct method only
- Only use single phase L1 mode.
- Test all cables in area/vicinity
- Look for highest amplitude, positive polarity for a positive ID
- If possible and allowed, try to VERIFY and ID inside the concentric neutral wire around the outside of the cable insulation semi-con with the pickup sensor. Remember “Like for Like”.

Hint: In some cases, with single phase cable runs, it may be very difficult to sucessfully ID the cable due to the high impedance returns. This can be due to the grounding conditions, corrosion of the neutral or others related issues. In these cases, it is recommended, if available, to use an adjacent de-energized cable conductor or phase as a return. If this is not available, a temporary shunt (insulated cable) can be run from the end of the cable being ID’d back to the TX’s return input. The cable can still be grounded at the far end.

Three Conductor Cable ID

When performing a ID process on 3 conductor cable (that is a cable that has three phases enclosed in one common sheath or jacket), it is recommended to use the Handheld Pickup Sensor. The operator should set the Tx to three phase mode (L123) and connect the cable using the Direct Connection Setup for de-energized circuits. (See Direct Connection Setup).

Generally the three conductors twist gradually inside the body of the cable along the length of the cable. Using the handheld pickup coil, the user will be able to detect the varying amplitudes of the signals in the cable as per the figure 21. Also see figure 22. This is sometimes referred to as the “Twist method”

With this method the user can ID the cable in question, but can also ID the phases below the sheath/jacket of the cable at a point along the cable. When ID’ing a 3 conductor cable with the twist method, the user should ID the 2 phases connected to L1 and L2 and also the return “-” on the third phase. This aids in reconfirming that the user has ID’d the correct cable.

NOTE: The flexible pickup sensor **cannot** be used for 3 conductor cable as the injected currents will all be inside the coil and will cancel each other out. For 3 Conductor cable applications use the handheld pickup coil “PUC”

Hint: For 3 Phase circuits that consist of 3 **individual** single phase cables, it is recommended to use the 3 Phase Direct mode on the Tx and to use the Flexible pickup coil that can wrap around the individual cables. This flexible pickup sensor also eliminates external environmental fields and focuses only on the field enclosed by the coil. This can be very useful in electrically noisy environments.

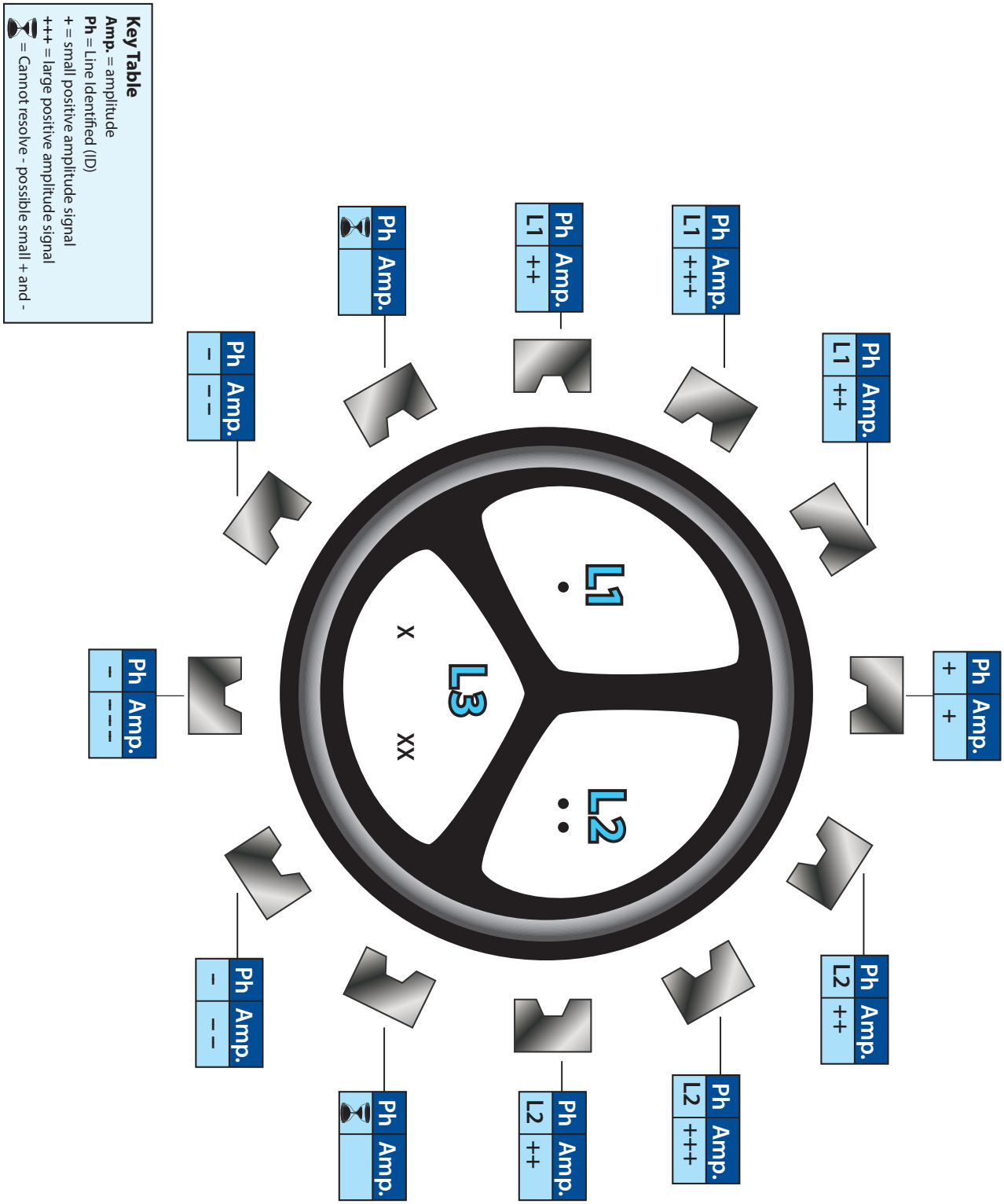


Figure 21: Three Phase Cable. Phase & Cable ID of a Three Conductor Cable using the Handheld Pickup Sensor. "Twist Method"

Three Conductor Network Cable (multi-tapped)

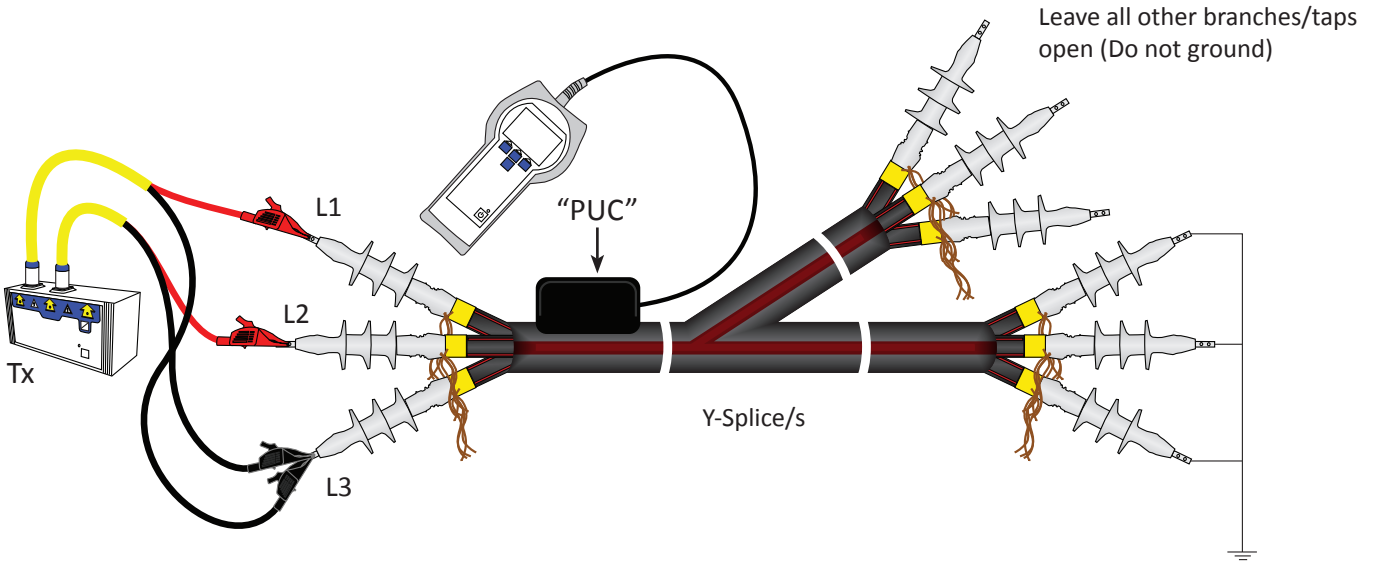


Figure 22: Typical setup for a three conductor cable ID.

Connecting with Elbows

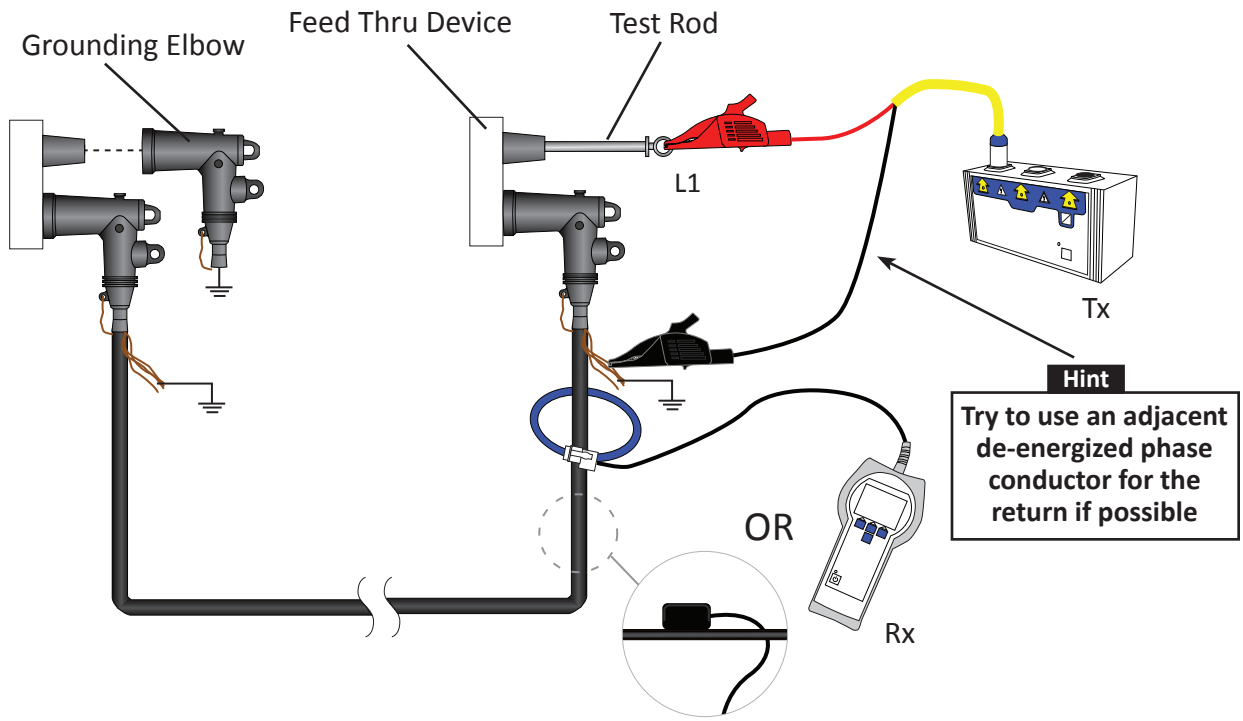


Figure 23: Direct connection setup to a cable with elbows in single phase ID mode.

1. Ground the shield/neutral on both side and ground the conductor on the far end.
2. Connect red alligator clamp to the test rod as shown which connects to the conductor of the cable.
3. Connect the **black** alligator clamp to the neutral/shield of the cable.
4. Below where the neutral wires exit the cable, wrap the Rx pickup sensor around the cable to perform verification and, later, identification.

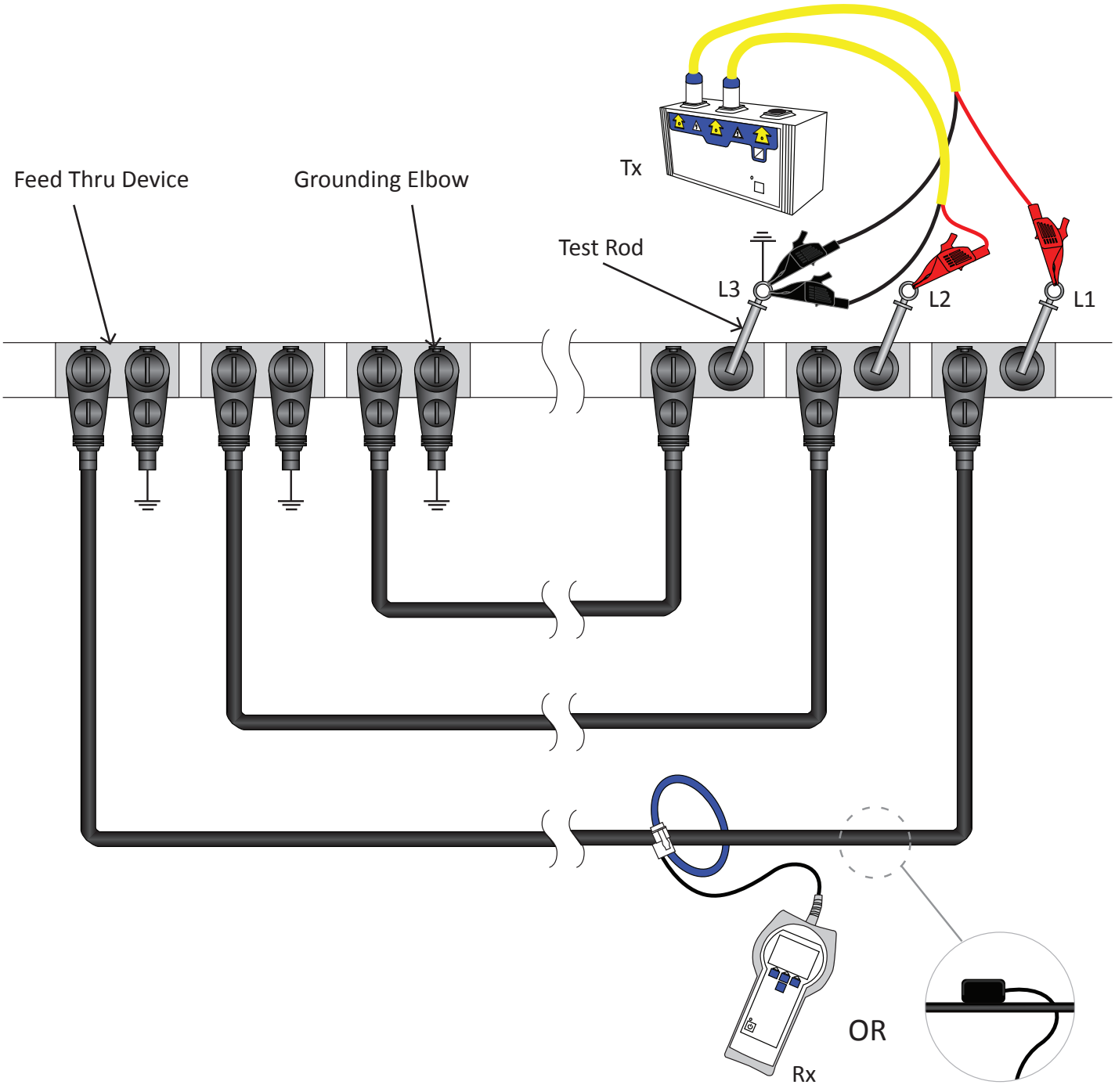


Figure 24: Direct connection setup to a cable with elbows in three phase ID mode.

Phasing

Example 1

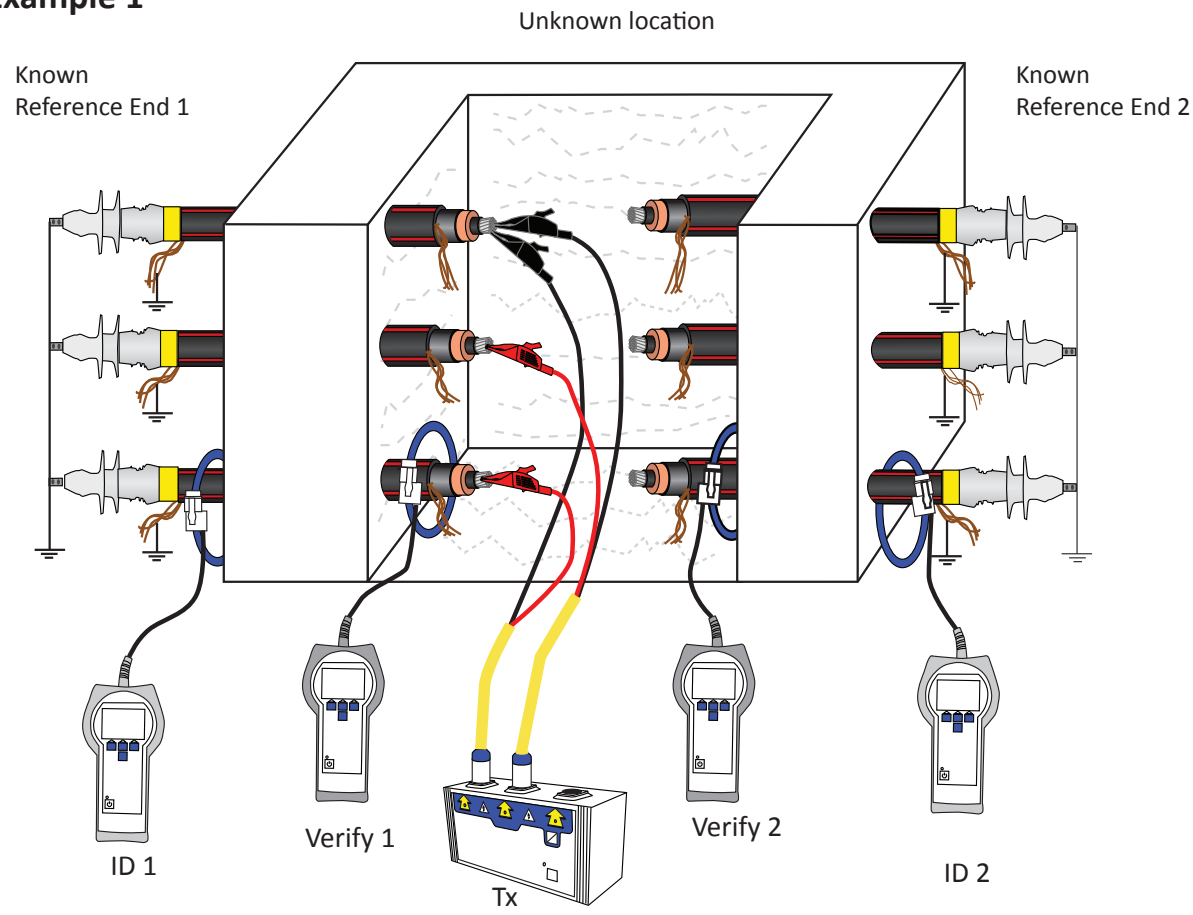


Figure 25: Setup on phasing cables.

Note: Rx is used around cable conductor and shield/neutral conductor in both VERIFY and ID mode.

1. Connect the far ends of each cable conductor to ground as shown. This is often a safety requirement employed by cable owners.
2. Connect the Tx to the cable at the unknown point to be phased out by randomly connecting “L1”, “L2”. **Red** lead to conductors, **black** leads to 3rd remaining conductor phase as shown.
3. Perform VERIFICATION (Verify 1) on each cable before going to other known reference end of the cable (ID 1).
4. Now Identify (“L1”, “L2”, “L3”) cable at the Known Reference End 1.
5. Make a map of the “L1”, “L2”, and “L3” to relate it to the known actual phase name.
   For example: L1 = phase B
   L2 = phase A
   L3 = phase C
   Note: L1 may not equal A phase, etc.
6. Now label each cable at the unknown Verify 1 location with the correct phase name, such as phase A, phase B, and phase C based on the mapping above. **Note**: Take care not to make any mistakes. Misidentification can be crucial.
7. For the other half, follow the same procedure for Verify 2 and ID2 location, as above.
8. Correct phasing of all 6 cables A-A, B-B, and C-C should then be possible.

Example 2

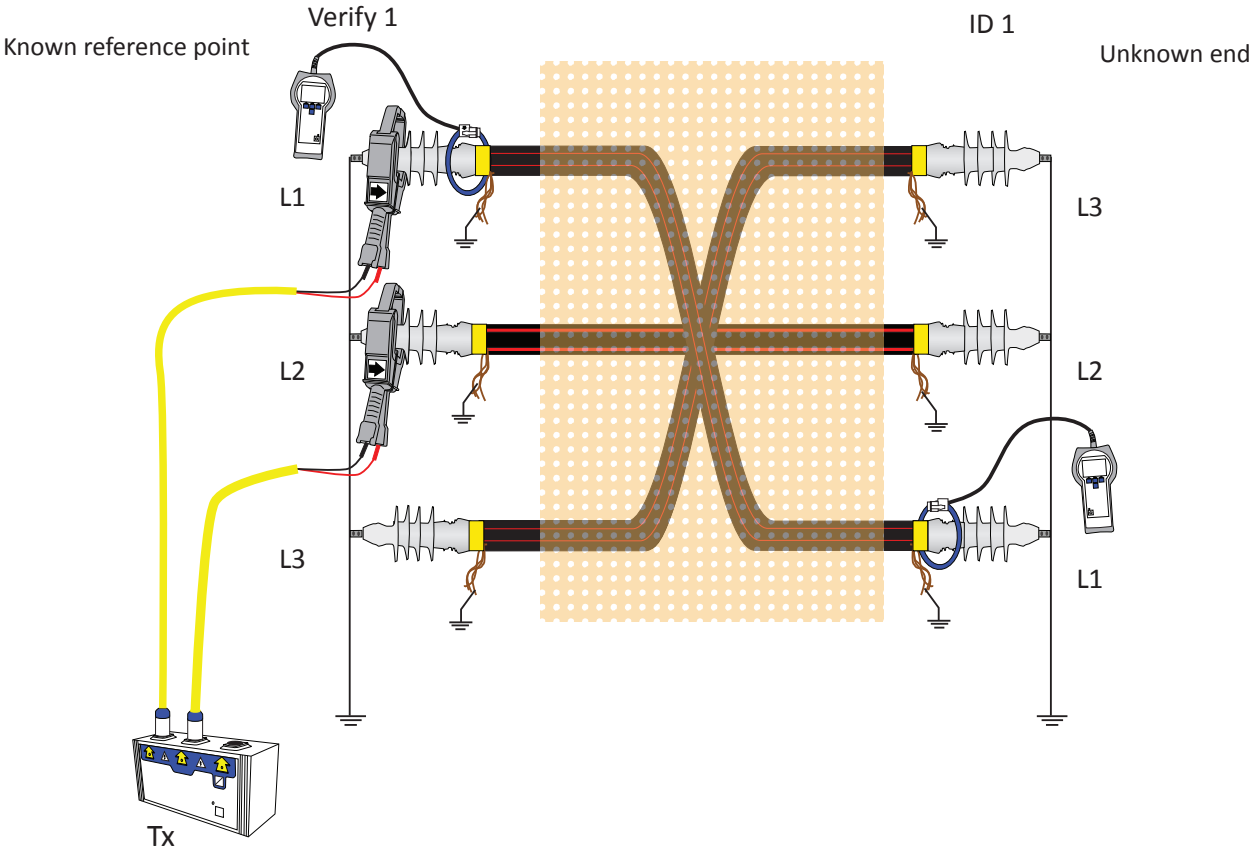


Figure 26: Identifying cables that were rearranged underground.

Note: Rx is used around cable conductor only in both VERIFY and ID mode.

1. Connect the far ends of each cable conductor to ground as shown. This is often a safety requirement employed by cable owners.
2. Connect the Tx to the cable at the known reference point by connecting L1 and L2 using clamp-on CTs as shown.
3. Perform VERIFICATION (Verify 1) on each cable at the known reference location before going to the unknown end of the cable (ID 1).
4. Identify (L1, L2,) cable at the unknown end.
5. The user may then need to ID the third remaining phase either by using single phase L1 and L123 mode following the same process.

Maintenance

Rx Battery Replacement

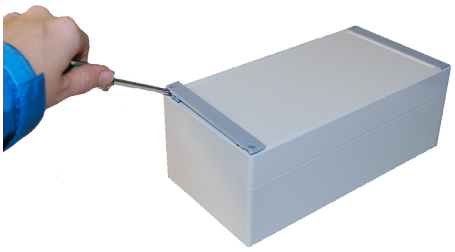
1. Remove the screw on the back of the receiver.

2. Replace batteries in the receiver. The polarity of the batteries is noted inside the battery compartment. **Note**: Use **AA** batteries.

Note: Use AA batteries

Tx Battery Replacement

1. Disconnect any external AC or DC supply.
2. Turn off Tx.
3. On the back of the transmitter, there are thin slits on both ends of the gray panels. Insert a flathead screwdriver into these slits to remove each gray panel.



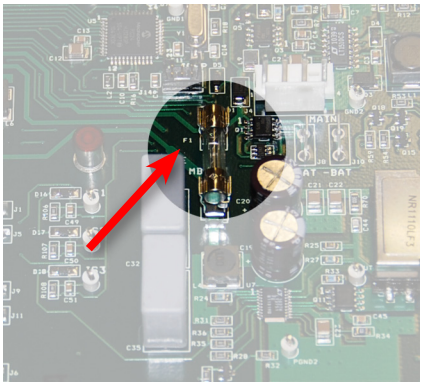
4. Unscrew each corner.

5. Remove the **black** and **red** wires from the battery. Remove screws to the clear, plastic bar that holds down the battery.

   Note: When replacing the wires to the battery, the polarity is important. If the polarity is wrong, the circuit board can be damaged and the unit will no longer be powered just by the battery. The **red** wired connection goes to the **positive** side on the battery, and the **black** wired connection goes on the **negative** side on the battery.

Tx Fuse Replacement

1. Follow steps 1 through 5 from the Tx Battery Instructions.
2. Remove the fuse from the printed circuit board housed in the Tx and replace with a new **2A** fuse (Ø5 x 20 mm).



Firmware and Hardware Version on the Tx

To find the firmware and hardware version of the transmitter, hold down the "L1/L123" button for 1 second and, while still holding the "L1/L123" button, press the power on button. All three **GREEN** LEDs will light up at the same time and will be followed by a 1 second pause. After this, each **GREEN** LED will light up a certain number of times under the each line (L1, L2, L3) according to the firmware version. There is a 1 second pause before changing over to the next line (L1 and L2; L2 and L3).

Ex. The firmware version is 1.4.2
First, the **GREEN** LED under **L1 blinks *1* time**.
Then the **GREEN** LED under **L2 blinks *4* times**.
Then the **GREEN** LED under **L3 blinks *2* times**.
Therefore, the firmware version is 1.4.2

After the firmware version displays, all three **RED** LEDs will light up at the same time and turn off for 1 second. This means the *hardware* version is about to be displayed. Each **RED** LED will light up a certain number of times under the each line according to the *hardware* version. There is a 1 second pause before changing over to the next line.

Ex. The hardware version is 1.5.3
First, the **RED** LED under **L1 blinks *1* time**.
Then the **RED** LED under **L2 blinks *5* times.**
Then the **RED** LED under **L3 blinks *3* times**.
Therefore, the hardware version is 1.5.3

If there is a zero in the firmware or hardware version, that specific LED does not light up.
Ex. The firmware version is 1.0.5
First, the **GREEN** LED under **L1 blinks *1* time**.
Then the **GREEN** LED under **L2 *does not* blink**.
Then the **GREEN** LED under **L3 blinks *5* times**.
Therefore, the firmware version is 1.0.5

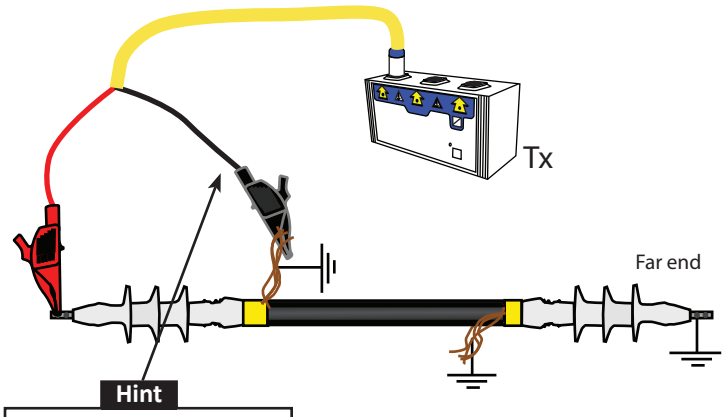
Quick Start Guide: EZ-Cable ID in 3 Steps

Direct Method
(De-Energized cables)

Indirect Method
(Energized and De-Energized cables)

1 Setup

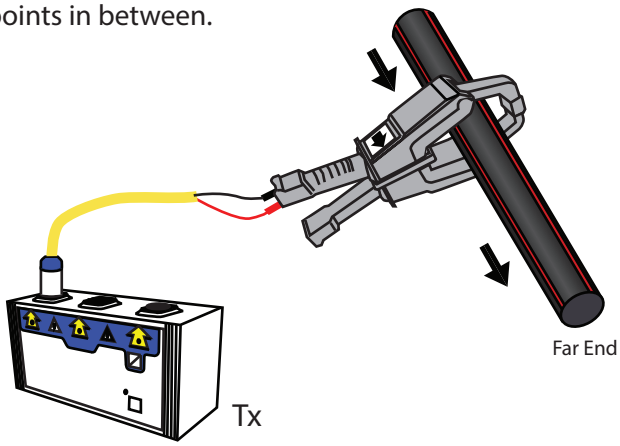
Connect Tx to cable conductor/s using alligator clamps. Ensure far end of cable conductor/s is grounded.



Hint

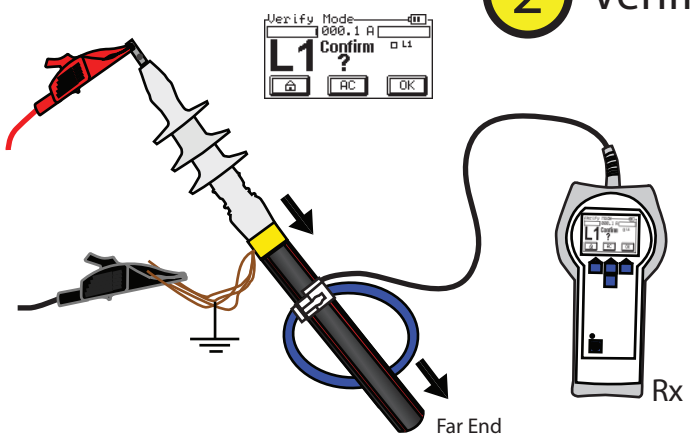
Try to use an adjacent de-energized phase conductor for the return if possible

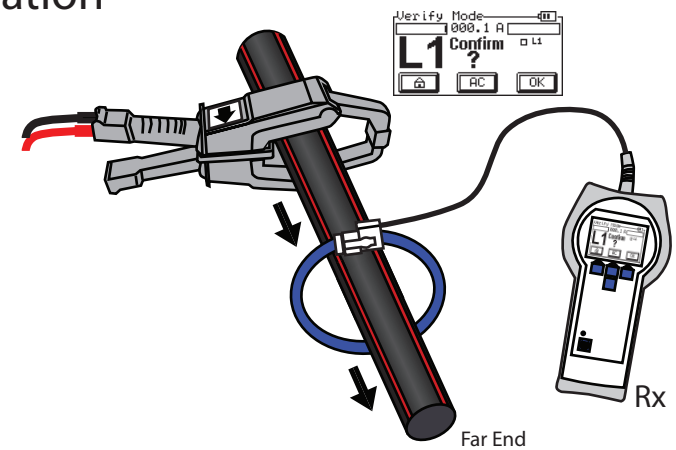
Connect Tx to clamp-on CT. Neutral/shield needs to be grounded on both ends of cable with no ground points in between.



Note: Polarity is important! (See Preferences)
Select L1 for Single Phase Mode or L123 for Three Phase Mode.

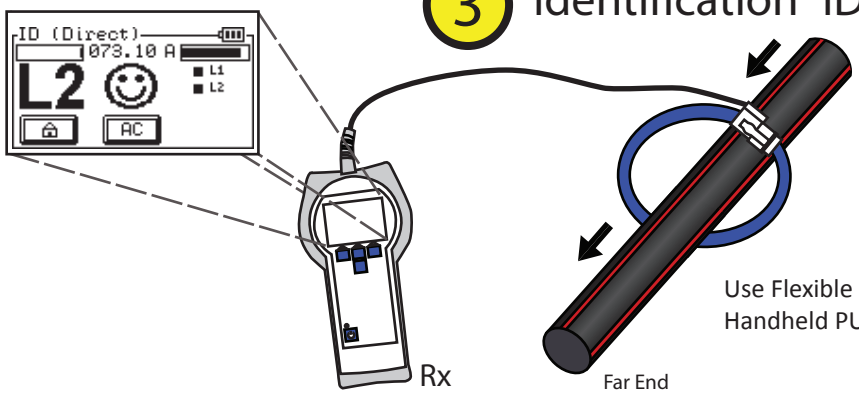
2 Verification





Press **OK** to confirm and verify correct phase identification at known reference point on cable.
Note: Sensor arrow direction (See Preferences)

3 Identification "ID"



- Remember "Like for Like"

Use Flexible Pickup Sensor or Handheld PUC with Rx.

Rev 2.0A

NEVER ASSUME CABLE TO BE DE-ENERGIZED

HV Diagnostics INC.

Declaration of Conformity

The EZ-Cable IDx, EZ-Cable IDxi, and EZ-Cable IDxi^3 have met the following requirements of the European Council:

LV Directive: 2006/95/IEC
EMC Directive: 2004/108/EC

and further conform with the following EU harmonized standards.

EN 61010-1:2010
EN 61326-1:2006

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