Easy-Link Plus

Easy-Link Plus
Version 2.2

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This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

>   (1) This device may not cause harmful interference, and
>   (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Caution: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment under FCC regulations.

This Class A digital apparatus complies with Canadian ICES-003.

DESCRIPTION

The Easy-Link Plus is a small controller that can be used to provide single-user linking between two LTR trunking systems or cross-band linking between VHF/UHF/800 conventional and/or LTR trunking systems.

An Easy-Link Plus eliminates the need for phone lines or microwave. For linking between LTR systems, the Easy-Link Plus uses the control station frequencies for the SMR sites being linked. Cross-band linking between other systems uses the frequencies already in use by the other systems, so additional linking frequencies are not needed.

The Easy-Link Plus is ideal for systems where a UHF link is used to access a VHF Hi/Lo base station, rather than using phone lines or microwave. For these systems where CTCSS monitoring is necessary, the ability exists to deactivate the CTCSS on the VHF Hi/Lo base station over the air by DTMF from the UHF control station at the end users office.

Operation is also almost completely transparent to the end user, since DTMF mikes or other complicated signalling methods or procedures are not needed in order to establish a path through an Easy-Link Plus system. DTMF mikes are only needed in cases where CTCSS monitoring is necessary or where special control of the link by the end user is desired.

No modications need be made to the end users mobile units and these mobile radios need not be any particular brand or model.

Provision is made so that an Easy-Link Plus can be remotely disabled and enabled by DTMF to meet FCC requirements for remote control of this type of link.

The Easy-Link Plus allows two radios to be connected together in a 'Back-to-Back' configuration, similar to a repeater, but providing bi-directional operation.

Setting up an Easy-Link Plus system is very simple. In order to link between two LTR systems, the two radios are programmed for the user's appropriate LTR codes used on each system. The Easy-Link Plus package, consisting of the two LTR radios and the Easy-Link Plus controller, is then placed at a location where both LTR systems may be accessed. The user then has a dedicated 2-way dispatch link between the two LTR systems, thus dramatically increasing coverage area.

Setting up an Easy-Link Plus for VHF/UHF and conventional 800 MHz. base station operation is likewise simply a matter of programming the two radios appropriately and placing the radio/controller package in a location where both systems can be accessed.

Only very simple modifications need to be done to the radios connected together with the Easy-Link Plus controller, and everything needed for quick installation of an Easy-Link Plus is provided (with the exception of radios, antennas, and power supplies).

MAIN FEATURES

Provides low-cost, easy-to-install, and easy-to-operate single-user linking between two LTR systems.

Provides crossband linking between conventional VHF/UHF/800 MHz. systems and LTR systems.

Automatic Path Turnaround reverses path to provide faster system access on trunking systems.

Amplified, muted receive-to-transmit audio paths allow an Easy-Link to be interfaced into a wide variety of radio equipment.

Audio levels are adjustable externally - no need to open the box to set levels.

Configuration options are set using DIP switches.

Makes use of existing frequencies - no microwave, phone lines, or other radio frequencies are needed.

No need for DTMF mikes on mobiles or any special procedures to access a link.

INSTALLING AN EASY-LINK PLUS

An Easy-Link Plus is a microcontroller-based, bi-directional COR circuit with a bi-directional, half-duplex audio interface. The audio amplifiers are muted by the microcontroller so that low-level, unsquelched audio from a receiver detector can be used as the receive audio input to the Easy-Link Plus.

When looking at the end of the Easy-Link Plus controller with the modular jacks, the jack on the left is J1 and the jack on the right is J2. The DB9 connector on the back of the controller is J3. When considering the following information, a radio connected to jack J1 will be referred to as RADIO 1 and a radio connected to jack J2 will be referred to as RADIO 2.

RECEIVE AUDIO TO EASY-LINK:

The best location to pick up receive audio of an Easy-Link Plus is at a point where the audio is under approximately 1 volt RMS (3 volts P-P). Either squelched or unsquelched audio may be used. The audio level at this point should NOT be effected by the radio's volume control. The high side of the volume control is usually a good place to consider first. The speaker audio output CAN be used, but obviously the volume control will effect the repeat audio level and the audio will need to be kept lower than about 1 volt RMS (3 volts P-P).

TRANSMIT AUDIO FROM EASY-LINK:

Transmit audio can usually be fed from an Easy-Link Plus directly into the microphone input of the radio. This should work fine on most, if not all, radios.

COR INPUT TO EASY-LINK:
The COR input to an Easy-Link Plus can come from several different sources, depending upon what type of radio is being used. The voltage on this input should switch from a high of 1 volt or more to a low of .5 volts or less. (If the Easy-Link Plus needs to detect a voltage change from LOW-to-HIGH, see the next section below, "COR VOLTAGE SHIFT").

If an Easy-Link Plus is being interfaced with a trunking radio, a LOGIC SQUELCH output from the microprocessor should be used. This point will give an indication that the radio's squelch is open or closed, but ONLY if the proper ID code is being received. The point used MUST NOT switch on carrier alone. It's also good to make sure that this point has a 10K ohm or 15K ohm resistor in series with it to the Easy-Link Plus. If the LOGIC SQUELCH output from the microprocessor is shorted directly to ground without 10K to 15K of series resistance, the microprocessor may likely be damaged. A 10K to 15K resistor in series with this line to the Easy-Link Plus will prevent this from happening. Such a resistor may already be present in some radios, such as the UNIDEN SMS-815/825.

If an Easy-Link Plus is being interfaced with a radio that uses CTCSS, then most likely, the decode switching output from the CTCSS, decoder will be the best place to connect the squelch input to the Easy-Link Plus.

If an Easy-Link Plus is being used with a carrier squelch radio, then any point that gives a large enough voltage level change, as discussed above, can be used.

COR VOLTAGE SHIFT:
Easy-Link Plus controllers are configured, when shipped, to accept a high-to-low voltage change to indicate that a signal is being received. In this configuration, it is not necessary that the 'low' voltage be at 0 or ground, but it must be at or below approximately .5 volts. If an Easy-Link Plus needs to detect a low-to-high voltage change, then the appropriate DIP switch can be set to provide this. Additionally, pullup voltage may or may not need to be provided on the COR input to the Easy-Link Plus. This pullup voltage can be set ON or OFF by setting the appropriate DIP switches. See the listing of DIP switch settings to determine the proper configuration for your needs. Switches are provided for both 'sides' of the Easy-Link Plus controller, so it is very easy to configure an Easy-Link Plus to work with a variety of radio equipment.

AUTOMATIC PATH TURN-AROUND:
The AUTOMATIC PATH TURN-AROUND feature can be disabled for either radio by setting the correct DIP switch which corresponds to that radio. See the listing of DIP switch settings to determine the proper settings for your needs.

CTCSS MONITOR CONNECTION:
A CTCSS monitor function is provided for systems where a UHF (or other RF) system is used as a link to control a VHF Hi/Lo band system and CTCSS monitoring is necessary. This mode of operation is set by DIP switch SW5 being set to OFF. If this mode of operation is selected, Pin 4 of the DB9 connector (located on the side of the Easy-Link Plus opposite the modular jacks) provides an open collector output that is normally LOW. when the Easy-Link Plus is powered up. When the CTCSS monitor mode has

been activated, this pin goes HIGH. Once this output has been connected properly to Radio 2 (the radio that is connected to modular jack J2 on the Easy-Link Plus), the radio can be made to monitor by transmitting over the air a DTMF * into Radio 1 (the radio connected to modular jack J1 on the Easy-Link Plus controller) from the control radio at the end users location. This open collector output can also have pullup voltage applied by setting switch SW10 ON. The open collector output remains HIGH and Radio 1 (the radio connected to modular jack J1) transmits for approximately 6 seconds, allowing the end user to monitor the channel before continuing with his/her transmissions.

DIP SWITCH SETTINGS:

All functions and modes of operation are set using DIP switches. The following is a list of the functions that each switch controls.

SW1 - Automatic Turnaround for Radio 1 (radio connected to J1)

Set to ON or OFF for LTR trunking systems (personal preference. Setting to ON reduces key-up delay during a conversation between two linked trunking systems. When one unit un-keys his transmitter, the link path is automatically reversed for about 3 seconds. Probably will be OFF for conventional systems).

SW2 & SW6 - Automatic Turnaround for Radio 2 (radio connected to J2), Duplex Mode, and Repeater Mode

Switch SW2 and switch SW6 are used together to control four different 'modes' of operation. Each mode actually controls three different functions - Auto-Turnaround for Radio 2 (as explained above, except for Radio 2 instead of Radio 1), Duplex Mode, and Repeater Mode. Duplex Mode and Repeater Mode are explained below. The different modes of operation and the correct settings for switches SW2 and SW6 are shown in the following table.

Duplex Mode (Transmitter Override) on Port 2 (J2)

This feature is ONLY to be used when 'full-duplex' operation is desired on Port 2, as described below.

In normal operation, with the Transmitter Override feature disabled, the Easy-Link Plus operates in a 'simplex' mode - i.e. if a the radio connected to Port 1 (Radio 1) is receiving, and thus the radio connected to Port 2 (Radio 2) is transmitting, there is no way to 'override' the Radio 2 transmitter, and reverse the path, until Radio 1 stops receiving. This is normally not a problem, since the radios that are often used with the Easy-Link Plus are simplex, or half-duplex, transceivers anyway.

However, in some cases, it would be advantageous to connect a full duplex radio to Port 2 (J2), whereby a portable, or mobile, that is working into the Easy-Link Plus from the Radio 2 'side', could 'override' the Radio 2 transmitter, and reverse the path (so

even though Radio 1 is still receiving, Radio 1 could be placed in the transmit mode when Radio 2 receives a signal).

An example of this 'full duplex' operation would be where a vehicular repeater link is needed to work between portables and a 'fixed' repeater, which remains on the air with a 'hang time', when the portables stop transmitting. If a full-duplex radio is connected to Port 2 (Radio 2), then the Transmitter Override feature will allow any portables that transmit, to 'override' Radio 2 transmitting and Radio 1 receiving, so that transmissions can occur from the portables, through the Easy-Link Plus, and into the 'fixed' repeater, even while it's 'hanging' on the air.

Repeater Mode

This mode allows the Easy-Link Plus to work as a simple repeater interface. The receiver should be connected to Port 1 (J1) and the transmitter should be connected to Port 2 (J2). When COR is detected on Port 1, the PTT line will go low on Port 2. When COR is removed from Port 1, the PTT line on Port 2 will remain low for a 3 second 'hang' period. COR should NOT be applied to Port 2, and the PTT output on Port 1 should NOT be connected, for operation in this mode.

Switch Settings for Easy-Link Plus Modes of Operation

Mode	Description	SW2	SW6
====	=========	====	====
1	Auto-Turnaround Radio 2 OFF Duplex Mode OFF Repeater Mode OFF	OFF	OFF
2	Auto-Turnaround Radio 2 OFF Duplex Mode ON Repeater Mode OFF	OFF	ON
3	Auto-Turnaround Radio 2 ON Duplex Mode OFF Repeater Mode OFF	ON	OFF
4	Auto-Turnaround Radio 2 OFF Duplex Mode OFF Repeater Mode ON	ON	ON

SW3 - COR Polarity for Radio 1

For Low-to-High set to OFF.

For High-to-Low set to ON (this is the proper setting for E. F. Johnson 8600 series and Challenger series radios, if installation is done according to the instructions listed in this manual.

SW4 - COR Polarity for Radio 2

Same settings as SW3, but applies to Radio 2.

SW5 - Remote Control/CTCSS Monitor

For CTCSS Monitor mode, set to OFF.

For Remote Control (for trunking system linking, per FCC), set to ON.

In the Remote Control mode, sending a DTMF * into Radio 1 (or Radio 2 if switch SW12 is OFF) will cause the Easy-Link Plus controller to quit repeating. Sending a DTMF # into Radio 1 (or Radio 2 if switch SW12 is OFF) will re-enable the controller. This feature is necessary to have when using this type of linking between trunking systems in order to meet FCC requirements.

In the CTCSS Monitor mode, sending a DTMF * into Radio 1 will cause Radio 2 to stop transmitting immediately upon decoding this DTMF digit (approximately 50 ms after the beginning of the tone). As soon as the COR is removed from Port 2 (Radio 2 stops receiving), and after a 1 second delay, Radio 1 will begin to transmit for about 6 seconds, allowing whatever is being received by Radio 2 to be transmitted on Radio 1. The OUT.1 line (Pin 4 of J3 - the DB9 connector) will also go HIGH for this 6 second period, allowing the CTCSS on Radio 2 to be put into the monitor mode for this period of time. This mode of operation is for using a UHF (or other band) radio to control a VHF Lo or Hi band (or other band) radio remotely without having to use telephone lines. (If switch SW12 is OFF, the obove operation will be the same when Radio 2 receives a DTMF *. Radio 1 will then transmit for 6 seconds and the OUT1 line will go HIGH for this 6 second period, allowing the CTCSS on Radio 2 to be put into the monitor mode for this period of time).

SW7 - Pullup resistor for COR 1

Switching this switch ON provides a pullup voltage for the COR 1 input (COR input from Radio 1.) Leave this switch OFF for E. F. Johnson radios, if installation has been done according to the above instructions.

SW8 - Pullup resistor for COR 2

Same as SW7, but applies to COR 2 (COR input from Radio 2)

SW9 - Pullup resistor for OUT.2

Switching this switch ON provides a pullup voltage for the OUT.2 output. The position of this switch will be determined by the specific installation needs.

SW10 - Pullup resistor for OUT.1

Same as SW9, but applies to OUT.1 output.

SW11 - Pullup resistor for AUX.IN

Switching this switch ON provides a pullup voltage for the AUX.IN input. The position of this switch will be determined by the specific installation needs.

SW12 - DTMF Receive 2

With this switch OFF, the Easy-Link Plus will respond to DTMF signalling from either Radio 1 or Radio 2. If this switch is set ON, the Easy-Link Plus will only respond to DTMF signalling from Radio 1.

PINOUT OF J3 (DB9) CONNECTOR:
The pinout of the DB9 connector on the back of the Easy-Link Plus (J3) is as follows. The pin names, as found on the schematic, are listed in brackets [].
Pin 1 - Not used
Pin 2 - [V.IN] External B+ (9 to 15 v.d.c.) input to power Easy-Link Plus   controller (not needed if controller is receiving B+ through J1 or J2)
Pin 3 - [V.OUT] B+ output (can be used to power external CTCSS encoder, etc. Current drain of external device MUST NOT exceed 50 ma)
Pin 4 - [OUT.1] (auxiliary output 1. Used for CTCSS monitor line on Radio 2 in CTCSS monitor mode. When using this mode of operation, this line (which is normally LOW), goes HIGH for about 6 seconds when a DTMF * is received by Radio 1)
Pin 5 - [OUT.2] (auxiliary output 2. Not used at this time)
Pin 6 - [AUX.IN] (auxiliary input. Not used at this time)
Pin 7 - [MICAF1] (external input to Radio 1 microphone audio input)
Pin 8 - [MICAF2] (external input to Radio 2 microphone audio input)
Pin 9 - [GND] Ground

PINOUT OF J1 AND J2 (MODULAR CONNECTORS):
The pinout of the modular jacks (J1 and J2) is as follows. The pin names, as found on the schematic, are listed in brackets [ ].
Pin 1 - [RXD] Not used

Pin 2 - [GND] Ground
Pin 3 - [MIC_AF] Microphone Audio output to transmitter
Pin 4 - [LOGIC_SQ] COR input from receiver (Logic Squelch IN from trunking radios)
Pin 5 - [PTT] PTT output to transmitter
Pin 6 - [13.8vdc] B+ (9 to 15 v.d.c.) input to power Easy-Link Plus controller
Pin 7 - [RCV_AF] Receiver Audio input from receiver
Pin 8 - [TXD] Not used

INSTALLATION TIPS FOR SMR SITE LINKING

An Easy-Link Plus can be located at one of the SMR sites that is being linked, or can be located at some point between the two SMR sites that are being linked.

If EASY-LINK is located at one of the SMR sites that is being linked, it may be necessary to physically separate the two radios by several feet in order to reduce interference caused by the high rf level from the trunking system. It would also be best if a dummy load is used for an antenna on the radio that is working this site. (If longer interconnecting cables are needed between the EASY-LINK interface and the radios, please contact us).

If EASY-LINK is located at some point between the two SMR sites that are being linked, the antennas used on the link radios should be positioned to obtain some attenuation of signals between the antennas. Vertical separation is usually the best. Doing this will help to prevent interference between the two link radios.

The two link radios should NEVER be stacked top of each other, but should be separated physically by one foot or more, either vertically or horizontally.

LIMITED WARRANTY

IDA Corporation products are warranted to be free of defects in material and workmanship for a period of 12 months from date of shipment. This warranty does not apply to any parts damaged due to improper use or violation of instruction. It does not extend to damage incurred by natural causes such as lighting, fire, floods, or other such catastrophes; nor to damage caused by environmental extremes, such as power surges and/or transients.
All warranties must be performed at IDA Corporation. No Credit will be given for unauthorized repair work attempted by the customer. In-warranty merchandise must be shipped freight prepaid to IDA Corporation. IDA will repair or replace equipment and return to customer, freight prepaid, with in the continental United States. Equipment found not to we defective will be returned at purchaser's expense and will include cost of handling, testing and returning of equipment. A $5.00 handling fee will be assessed on all repairs after 90 days of purchase. Equipment returned for repair must have a return merchandise authorization number (RMA). Please contact IDA Corporation for required RMA's prior to shipment. Ship all warranty units to **1345 Main Avenue, Fargo, ND 58103**. Out of warranty repairs will be billed at the established factory flat rate per hour, plus components for replacement.
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Information Pertaining to FCC Rules, Part 15, Class A Digital Device

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