CES HDI-68/SSI-68 Interconnect Installation and Programming Instructions

Obsolete Product - No Longer Supported

The CES Model HDI-68 is a microprocessor controlled commercial-quality telephone interconnect device
designed for use in radio systems in which a closed repeater (full duplex radio that can transmit and receive at
the same time on two different frequencies) is the base, and the portable and mobile radios are semi-
duplex (transmit and receive on two different frequencies one at a time). Released originally in 1992, the
HDI-68 is currently in use in thousands of applications worldwide and has time and again proven itself to
be a durable and dependable device and an excellent value. The HDI-68 is electrically the twin of the
CES Model SSI-68, which is a dedicated Simplex interconnect. The HDI-68 and the SSI-68 can be converted to one another by purchasing an EEPROM from CES programmed with the appropriate firmware. As of January, 1997 the SSI-68 is a current product and is available directly from CES or widely through worldwide distribution.

The information that follows is key installation, programming and maintenance information.

Note: Charts, tables and figures referenced throughout the following sections are placed at the end of this information.

GENERAL INFORMATION

1.1 Topics Covered by this Manual
This manual provides information regarding the installation, programming, operation, and maintenance of the CES Model HDI-68 Half-Duplex Interconnect.

1.2 Equipment Description
The Model HDI-68 is designed specifically for land mobile two-way radio applications. The HDI-68 is controlled by DTMF (Dual Tone Multi-Frequency) audio from mobiles and landline users, and contains exclusive interface circuitry and operating software that allows for operation with a wide range of radio equipment and telephone systems.

The HDI-68 incorporates many features including:

* User programmable Access and Disconnect codes (up to 8-digits, including * and # characters)
* User programmable Toll Restriction and Toll Restriction Override codes
* Provuision for selectively enabling or disabling call to 911 emergency services
* User programmable CW Identifier with selectable ID speed and method (may be programmed to conform with most Amateur or commercial ID regulations)
* User programmable dialing modes, including regenerated DTMF and pulse dialing
* User selectable reverse interconnect operation, including remote programming, VOX-controlled Remote Base operation, or ringout to mobile stations (including DTMF Selective Ringout)
* Line In Use detection with busy signal for mobile user
* Line In Use override code for emergencies
* Switch selectable Compression Amplifier for improved telephone line to transmitter audio
* Provisions for operation with CTCSS and Digital Squelch systems
* User programmable Call Limit and Mobile Activity Timers
* Call Limit timer reset code (allows for call time extensions)
* Hook-Flash feature for use with Call-Waiting services
* Programmable busy channel lockout
* User selectable level setup commands allow for faster service and installation
* Provisions for operation with receivers providing TTL compatable Carrier Operated Squelch outputs (including AM systems with TTL compatable carrier detection logic outputs)
* 6-pin modular RJ-11 and 1/8" jacks on rear panel allow programming with either CES Model

340P DTMF keypad or standard DTMF (Touch-Tone) telephone (not supplied with unit)
* Single command default programming allows for easier installation
* Lightning protection networks on telephone line and DC power inputs, and RFI suppression networks on all significant input and output lines
* 25-pin "D" connector on rear panel for easy flexibility on installation and configuration
* EEPROM memory retains all user programmed information eliminates battery backup
* High intensity LED indicators on front panel for DC Power, Mobile Detection, DTMF Detection, Transmitter PTT, and Telephone Line Connection
* Powerful high-speed CMOS single-chip microcomputer with 8K ROM operating program and built-in watchdog timer allow for reliable intelligent operation
* Sturdy commercial quality metal case with grounding stud
* Full One-Year Limited Warranty on parts and labor

1.3 Specifications

1.3.1 Electrical

Power Requirements: +10.0 to +16.0 VDC @ 300 mA maximum (90 mA standby)

Transmit Audio output level: Adjustable from 5 mV to 2.5 mVpp (in two ranges)

Transmit Audio output Impedance: Switch selectable 600 W or 10K W

Receive Audio level requirements: 50 mV to 10 mVpp (in two ranges)

Receive Audio input Impedance: Greater than 50K W (DC-500 Khz)

Interconnect Frequency Response: 300 Hz to 2.7 Khz (3dB within this range)

PTT Output (NPN open collector): 100 mA maximum @ 12 VDC

PTT Relay Output: 1 Ampere maximum @ 30 VDC

1.3.2 Mechanical

Size: 6.2"W x 1.5"H x 8.6"D (15.8 cm W x 2.8 cm H x 22 cm D)

Weight: 2.5 lb (1.1 Kg)

1.3.3 Environmental

Operating Temperature Range: -10 to +55 C (14 to 131 F)

Storage Temperature Range: -40 to +70 C (-40 to 158 F)

Humidity Limitations: 0 to 90% (non-condensing)

2 INSTALLATION INSTRUCTIONS

2.1 General Information

The instructions included in this manual for installation of the HDI-68 assume that the person accomplishing the installation is either familiar with the radio equipment to be interfaced, or has the ability to understand the functional requirements of the HDI-68 interface (power supply, grounding system, transmitter and receiver functions). The information provided in this manual do include a 'basic' installation outline and a block diagram to illustrate a straightforward approach to performing an installation with a transmitter and receiver combination or repeater equipment. The "Quick Installation Instructions" section 2.12 in this manual describes the installation procedures for usual applications.

2.2 Radio Equipment Requirements

The HDI-68 is intended to operate with most repeater equipment, or separate receiver and transmitter combinations for a Full-Duplex mode of operation. The equipment should be verified to be in good working order (receiver sensitivity, transmitter modulation, power output, etc) prior to attempting installation of the HDI-68. The transmitter modulation should be set to, or just under, 5.0 KHz deviation. In systems where modulation is limited to 3.5 KHz, then verify that the deviation is set to 2.5 KHz.

2.3 Materials and Equipment Required for Installation

The following items are needed for proper installation of the HDI-68:
#2 Phillips Screwdriver
1/8" flat blade adjustment tool or screwdriver
Soldering Iron and solder
Communications Service Monitor (preferred), or modulation deviation meter
Digital Multimeter
Oscilloscope
Radio Transceiver (in addition to the equipment to be installed with the HDI-68)

2.4 Mechanical Installation

There are no special requirements for mechanical installation of the HDI-68 other than placement

adjacent to the repeater or transmitter/receiver equipment it is to be installed with. The HDI-68 should be located close to a good grounding system for best lightning protection. As with any electronic equipment, the HDI-68 should be installed in a relatively dust-free and temperature and humidity-controlled environment for the best possible life of the equipment.

2.5 Electrical Installation

Electrical installation of the HDI-68 involves connection to the repeater or transmitter and receiver with the supplied interface cable and to the telephone line with the supplied modular cord. Table 2.5.1 provides functional information for each connection available from J4 on the rear panel of the HDI-68 and the interface cable.

If this is the first experience with installing the HDI-68, then it is recommended that the entire installation section be reviewed first before proceeding with the actual electrical installation and connections. In particular, notice that connections for a minimal, basic, or standard installation is outlined in Table 2.5.1 that follows and that the required connections are printed in bold. The basic installation is recommended and may be supplemented with other connections, such as a logic output from a CTCSS decoder.

One of the most significant difficulties many customers have with installing the HDI-68 interconnect is determining a source for Receiver Audio. It is recommended that FM detector audio that has not been conditioned by de-emphasis, not squelched (always present, even though the receiver squelch control is set to squelched), and is not controlled by the receiver volume control. In using this method, the internal HDI-68 carrier detection circuitry can be used and simplifying installation. For more information concerning connection to the FM detector circuitry, see this section in the Appendix of this manual.

2.5 Electrical Installation - continued

Description of Connections

The functional topics depicted in bold within this section are required minimum connections for a typical or standard installation. Other topics not in bold are optional input or output functions.

GROUND (System) - This ground connection is made at the threaded stud located on the rear panel of the HDI-68, and should be connected to a good earth ground shared by the repeater equipment.

GROUND (Shield - Pin 1) - Connect the shield conductor of the supplied cable to a common ground point that serves in the repeater or transmitter and receiver as: Power Supply Ground (A-), Audio Ground, and PTT Ground.

+12 VDC (Red - Pin 13) - This is a power supply input to the HDI-68 requiring a filtered and regulated source between +10 and +16 volts DC. It is recommended to verify with an oscilloscope or AC voltmeter that the +12 VDC power supply intended for use as a source for the HDI-68 and shared with the repeater or transmitter and receiver combination does not contain AC ripple (hum) that exceeds approximately 100 mV when the transmitter is transmitting. Some repeater equipment may have two separate +12VDC sources: one for the transmitter power amplifier and another for the lower level stages. If this is the case, use the power supply source that is normally used by the lower level stages.

Transmitter Audio Input (Orange - Pin 14) This is telephone line audio output to the transmitter from the HDI-68 that includes courtesy and ringout tones. Make this connection to the transmitter microphone input, transmitter audio line input, or other modulator input that will incorporate pre-emphasis before being transmitted..

Receiver Audio Input (Yellow - Pin 24) Preferred Method: This input to the HDI-68 should be connected directly to the receiver FM detector (discriminator, ratio detector, or other similar). For additional assistance in locating this point, refer to Appendix A of the manual. In some cases, it may be appropriate to install an suitable connector on the repeater or receiver wired to the FM detector for connection to the HDI-68. With this method of using FM detector audio, the internal HDI-68 carrier detection circuitry will be utilized, minimizing the number of connections to the repeater equipment.

Alternate Method: If a direct connection to the FM detector is not desired, or if it is difficult to accomplish this method, then connect Receiver Audio Input to another point in the receiver where audio is: Squelched when not receiving a carrier
Not affected by the receiver volume control (see note below)

If the point selected does not have de-emphasized audio (high frequency detector noise filtered out), then verify that JPR2 is installed. If the connection point does have high-frequency noise filtered out, then remove JPR2.

Note: The connection may be made to the speaker, but in doing so will require that the receiver volume control be preset and left at a fixed level once the HDI-68 adjustments have been performed. Subsequently changing the volume control level may result in difficulty in operation

of the interconnect. A preferred connection point would be at the 'top' of the volume control, where the volume control will not affect the audio level input to the HDI-68.

In using this alternate method, the External COR Input must be connected, covered on the following page.

2.5 Electrical Installation - continued

Description of Connections

PTT Open Collector Output (Brown - Pin 20) Connect this wire to microphone PTT or transmitter PTT, as appropriate; unless the transmitter push-to-talk logic requirement is non-standard (active low to ground for transmit) or requires switching in accordance with the PTT Relay Connections paragraph that follows.

PTT Relay Connections (Blue - Pin 21, Green - Pin 10, no existing wire - Pin 9) This optional connection may be used when the transmitter push-to-talk control requirement is different than a normal 100 mA open-collector active low output as otherwise provided at Pin 20. This function must be used when the transmitter PTT circuit requires a higher than normal current pull to ground, a source voltage that exceeds 12VDC, or requires a switched voltage to key the transmitter. Dated equipment, such as vacuum tube type of transmitters will require the use of the HDI-68 PTT relay control. The HDI-68 internal relay connections are: J4 Pin 21 is relay common, J4 Pin 10 is normally open, and J4 Pin 9. Suggestion: If using Pin 9, move the Green wire to Pin 9 and note the change in for your future reference.

External COR (Violet - Pin 2) This input is not required if Receiver Audio was obtained directly at the FM detector. If using this function, connect to a point in the receiver squelch circuit that changes logic state when the receiver is squelched and unsquelched. This may either be an active high state (5-volts or greater) or and active low state (0-volts) when a carrier is being received. Use an oscilloscope or multimeter to verify this function. In some receivers this connection point may be at the output of a noise detector circuit or in some cases available at a pin of the FM detector IC or a an external switching transistor. If the unsquelched state is an active high switch S3-E is set to ON, or if the unsquelched state is an active low, then switch S3-F is set to ON (refer to Table 2.6.1 for further instructions in setting these switches). The HDI-68 will also allow for an open-collector output as it internally has a 100K ohm pull-up resistor.

Carrier Validation Input (Black - Pin 3) This input is used in conjunction with systems using CTCSS (Continuous Tone Controlled Squelch Systems) also known as PL, CG, and others; or DCS (digital coded squelch systems) also known as DPL, DCG, and others. This logical input from the receiver CTCSS or DCS decoder circuit must be an active low (0-volts) upon a valid CTCSS tone or DCS code being received, and a logic high (5-volts) when inactive. If the particular decoder output is greater than 5-volts (some systems may source 8V, 9.6V, or 12V for instance) then place an appropriate series current-limiting resistor with a 5.1 volt zener diode to ground in order to limit this input to the HDI-68 to the 5-volt range. If connecting to an open-collector output from the decoder, then remove the HDI-68 pull-down 10K resistor (R46) by cutting one end from the printed circuit board. The HDI-68 has an internal 100K ohm pull-up resistor (R44) in the event the existing decoder circuit does not have a pull-up resistor.
PL and DPL are trademarks of Motorola, Inc.
CG and DCG are trademarks of Ericsson-General Electric Co.

External Connect Switch (no existing wire - Pin 4) This optional input may be used in installations where a remote control receiver is used, or where an external (to the HDI-68) Local Connect switch is to be incorporated on a dispatch console. To use this input, pull it momentarily to ground to enable a landline to mobile connection. To disconnect, similarly pull this line ground again to terminate a landline to mobile call. This function could be utilized as a supervisory control concept in a communications center. If using a control connection that exceeds 25-feet, incorporate an electronic buffer circuit immediately adjacent to the HDI-68, and return the ground connection to the HDI-68 ground connection. Also see section 3.4.

Control Receiver Audio Input (no existing wire - Pin 7) This optional input may be used where an auxillary receiver is used in the system for the purpose of dialing telephone numbers for users separately from the user-active channel, or for remote programming the HDI-68 on a different radio channel. This is an input directly into the HDI-68 DTMF decoder and requires approximately a 1.0 V peak-to-peak DTMF audio level.

2.6 Internal Switch Settings
Table 2.6.1 shows the possible settings for the 8-section DIP switch S3 and the 2-pin header jumpers JPR1 through JPR3. Note: The "ON" position for JPR1 through JPR3 is when the jumper is in. Note that the three COR switches (E, F, & G) must be set in accordance with one configuration only. Switch or Jumper settings in bold are factory default or recommended settings for most installations:

Table 2.6.1

2.7 Audio and Threshold Level Setting Proceedures

Initial setup of many of the adjustments in the HDI-68 has already been accomplished at the factory. However, transmitter and receiver audio levels will likely have to be adjusted for the particular equipment the HDI-68 is being installed with. Potentiometers that have a paint dot on top should not be adjusted unless the applicable function associated with a potentiometer is determined to be unsuitable upon actually verifying operation when the HDI-68 has been placed into service and operationally tested.

Audio and Threshold Level Setting Proceedures - continued

2.7.1 How to Enter the Program/Setup Mode

In order to provide for easy installation, a number of level setting commands have been made available in the HDI-68 Program/Setup mode. To enter the Program/Setup mode:

1. Connect an RF dummy load to the transmitter antenna port (recommended). Set the communications service monitor to the transmitter frequency, or use a monitor receiver, to hear the acknowledgement or prompt tones generated by the HDI-68.

2. Plug a DTMF telephone into J2 or plug a CES 340P handheld programmer into J3 (do not use both at the same time).

3. Turn OFF the HDI-68 power switch by placing the front panel POWER switch in the OUT position.

4. Press and hold the front panel CONNECT switch IN and turn on the HDI-68 Power switch by pressing it to the IN position. Release the CONNECT switch. A series of three prompt tones should be heard from the communications service monitor speaker, confirming successful entry into the Program/Setup mode. The HDI-68 will remain in the Program/ Setup mode until:

a. The power is turned off.
b. The "01#" command is entered from the programming telephone.
c. Program mode timer expires (10-minutes upon no DTMF key entry)

2.7.2 Entering Programming Commands

Programming commands are entered by pressing the appropriate keys (0 - 9, "*", and "#" only) on the programming telephone or 340P programmer. Each command is a sequence of two digits followed by a "#". Once a valid command has been entered, a single prompt tone, or a series of three prompt tones (depending on the command entered) will be heard on the service monitor. If a mistake is made when entering a command sequence, simply press and release the "#" key slowly until a response of three prompt tones is heard, and then re-enter the desired command. After three prompt tones are heard, the HDI-68 is ready for another command. Upon a single prompt being heard, the HDI-68 is waiting for a parameter for the particular command entered. When all programming is done, enter "01#" to exit the Program/Setup mode. A series of plus an additional will be heard, comfirming that the HDI-68 has exited the Program/Setup mode and is now in the normal operating mode.

Additional Programming notes:

(1) It is helpful to monitor the transmitter output while in the program/setup mode to hear the that are generated by the HDI-68, indicating the progress of the programming entries.
(2) After a valid command entry [2-digits + #] a will be heard.
(3) After a valid parameter entry [1 or more digits] (if entering fewer than the maximum number of digits allowed, terminate the entry with a "#") a will be heard.
(4) If an invalid entry is made, an (series of low tones) will be heard.

2.7.3 Adjustment Procedures

Use the following procedures to adjust levels at inital installation or for subsequent desired re-adjustment by placing the HDI-68 in the Program/Setup mode:

* ID/Ringout Tone Level Adjustment

Enter the command "55#" to send a single tone to the transmitter. Using the communications service monitor, set potentiometer RV4 for approximately 2.5 KHz deviation. If RV4 does not provide enough adjustment range, then set switch S3-C and/or jumper JPR3 to increase or decrease the output level. After adjustment is completed, press the "#" key to exit this Setup command level.

Audio and Threshold Level Setting Proceedures - continued

* Telephone Line to Transmitter Audio Level

Temporarily remove jumper JPR1. Enter command "50#" to complete the audio path between the telephone line and the transmitter. Adjust RV3 for approximately 80% deviation of dial tone audio, as observed on the service monitor.
Reinstall jumper JPR1.
Enter "#" to exit this Setup command level.

This command level may also be adjusted as an alternate method:

1. Disconnect the telephone line from J1 and place the HDI-68 in the Program/Setup mode.
2. Enter command "50#" and call the interconnect telephone line from another telephone. Answer the call by plugging the telephone line into J1.
3. Have the calling party speak in an above-average voice and adjust RV3 from a full counterclockwise position slowly clockwise until the observed modulation on the service monitor just reaches modulation limiting (clipped). If the service monitor used does not have a built-in oscilloscope, then connect an oscilloscope to the "DEMOD" output of the service monitor to make this adjustment.
4. When the adjustment is completed, enter "#" to exit this command level and to disconnect the line.

Note for Speaker Audio (non-Discriminator Audio) installations:
Place the receiver volume control approximately 1/3 clockwise and mark the physical position. This type of installation requires that a constant receiver audio level be always present to the HDI-68 interconnect. Verify that Jumper JPR2 is removed.

* Receiver to Telephone Line Level and Carrier Detect Adjustment

This section involves RV9 (Carrier Detect) and RV8 for proper Receiver to Telephone Line

This section involves RV9 (Carrier Detect) and RV8 for proper Receiver to Telephone Line Audio level:
Note - The adjustment of RV9 may be ignored if not using Discriminator Audio, and using speaker or other squelched audio in conjunction with an External COR input.

1. Rotate RV8 and RV9 to the fully counterclockwise position (CCW).

2. Preferred Method: Adjust RV9 clockwise just far enough to extinguish the "Mobile Detect" LED DS2 (located on the HDI-68 printed circuit board) without any flicker. If the adjustment range is too low, then place switch S3-D to the "ON" position. If the adjustment range is too high, then place S3-D to the "OFF" position. Plug a local telephone into J1. Connect the service monitor to the receiver and set it to generate an on-channel unmodulated full-quieting signal. Now slowly reduce the generator output until an approximate 10-dB (signal-to-noise ratio) is heard on the local telephone. Verify that reducing the generator output just below this point results in LED DS2 becoming extinguished (not illuminated). If not, then adjust RV9 so that it becomes illuminated above a 10-dB signal-to-noise signal (normally 0.3 to 0.35 uV receiver input) and extinguished when the generated signal is below this point. Unplug the local telephone from J1 and plug the telephone line into J1.

Alternate Method: Adjust RV9 clockwise just far enough to extinguish the "Mobile Detect" LED DS2 without any flicker. If the adjustment range is too low, then place switch S3-D to the "ON" position. If the adjustment range is too high, then place S3-D to the "OFF" position. Readjust RV9 as necessary with a weak (noisy) signal received from a mobile. Verify that the LED DS2 is not illuminated, or flickers, when a mobile is not transmitting.

Audio and Threshold Level Setting Proceedures

Receiver to Telephone Line Level and Carrier Detect Adjustment - continued
3. Place the HDI-68 into the Program/Setup mode and enter command "51#" to turn on the receiver to telephone line audio path. With the service monitor, generate an on-channel full-quieting signal modulated with a 1 KHz tone set to 3.0 KHz deviation. Adjust RV8 for 1.5 volts peak-to-peak as measured at test point TP1 with an oscilloscope. If using an AC millivoltmeter, set RV8 for 540 mV rms at TP1. This is a preferred method. If a service monitor is not available, then use the following alternate method.

Alternate Method: Remove JPR2. Place the HDI-68 in the Program/Setup mode and enter command "51#". Set RV8 for 2.0 volts peak-to-peak as measured at TP1 with an oscilloscope. Reinstall JPR2.

4. Enter "#" to exit this command level and to disconnect the telephone line.

Mobile DTMF Sensitivity Adjustment
This adjustment must be made for reliable DTMF tone decoding from a mobile.
1. Enter the Program/Setup mode by entering command "52#".
2. Have a mobile press and hold a DTMF digit, and adjust RV10 clockwise from it's fully counterclockwise rotation, so that the front panel "DTMF" LED is ON or illuminated. The mobile DTMF encoding should be known to be properly set for 2/3 DTMF modulation with reference to a maximum 5 KHz deviation.
3. Now adjust RV10 clockwise approximately 1/8 of a full turn past the point where the DTMF LED became illuminated.
4. Since this test mode causes the HDI-68 DTMF decoder to become 'swamped' with receiver noise and otherwise impairing decoding from the DTMF test telephone or 340P handheld programmer, exit the Program/Setup mode by turning off power to the HDI-68 with the front panel Power switch.

2.8 Interconnect Programming Configuration

2.8.1 General Information
The HDI-68 may be configured to operate in a number of different methods, depending upon the user requirements. Before attempting to further configure the HDI-68 for operational features, decide on the following:

1. Will the HDI-68 be answering incoming calls? If so, after how many rings?

2. Do the users of the interconnect want incoming telephone calls to be automatically forwarded and to alert the mobiles?

3. What are the CWID (Morse code station identification) requirements for the system being installed?

4. What telephone numbers are to be Toll-Restricted?

5. Should the Mobile Connect Code users (low-level or secondary users) be allowed to dial 911?

Reprogramming or the changing of any operational parameter of the HDI-68 may be done at any time.

2.8.2 Using the Factory Default Configuration
This feature of the HDI-68 permits the installing technician to get the interconnect into operation with least amount of effort. In addition, it provides the ability to return to a

operation with least amount of effort. In addition, it provides the ability to return to a known starting point in the event unusual difficulty is experienced in programming, or if a number of programming changes are made but not known. Although the factory default configuration is designed to accomodate most installations, it is suggested that the installer view each command factory default parameter. If any parameter is not set to the desired operation, then make the appropriate changes in the Program/Setup mode.

Enter the Program/Setup Mode: Press and hold the front panel CONNECT switch IN and turn on the HDI-68 Power switch by pressing it to the IN position. Release the CONNECT switch.

Enter command "00#" from the DTMF test telephone (plugged into J2), or the 340P handheld programmer. will be heard on the service monitor to indicate that initialization to factory defaults has been completed.

Continue with programming the various command levels with parameter changes for the desired functions. If you are not sure about a particular feature or function, then operationally try the factory default first. Any feature or function may be changed at any time.

2.8.3 Dialing Mode Selection

The method of dialing the phone line may be changed by using the "24#" command. The choices available include both regenerative and nonregenerative DTMF dialing, U.S.A. Pulse Dialing, and European method of pulse dialing. The Regenerated DTMF mode is the default mode and is the preferred mode of operation with the HDI-68. To change the Dialing Mode:

1. Enter the program/setup mode.

2. Enter the "24#" command and wait for a .

3. Enter ONE of the following choices for a dialing mode:

Note: The term pps = pulses per second

2.8.4 Landline to Mobile Signalling Options

The HDI-68 may be programmed to handle incoming calls from the landline in several ways. In addition, when the call is answered, there are a number of options which may be placed on the way that the call is handled, and on what choices of operation are available to a caller with the proper codes. In the default configuration, the HDI-68 automatically answers the call at the end of the 2nd ring. This may or may not be the desired configuration, especially on a shared telephone line.

In changing this feature, the first choice that must be made (as mentioned previously in section 2.8.1) is how to respond to an incoming call (or what to do if the line is ringing). The available choices are:

2.8.4 Landline to Mobile Signalling Options - continued

A second command entry must be made if the HDI-68 is configured to automatically answer a call, where the number of rings on which to answer is programmed:

A further choice is whether to automatically ring out to the mobile, or answer the line and wait for a request for an alternate mode from the landline caller. This feature is controlled by the Ringout Security Code "05#" command. To disable this feature (already disabled as a factory default), enter "05#", wait for a and enter another "#", where will confirm acceptance of the command. To enable the feature, program a Ringout Security Code [example: code "688"]:

With the above code entered into the HDI-68, landline callers desiring to ring a mobile(s) must enter "688" on a DTMF telephone immediately after the HDI-68 answers the line with a single prompt tone.

When configured to automatically answer the phone line, the caller is given a choice (after a prompting tone from the interconnect) of entering one of serveral other modes not yet described. The first mode, enabled by dialing a code that has been programmed under command "08#" allows the use of the HDI-68 as a Remote Base Station. The second mode, enabled by dialing a code that has been programmed with command "09" allows the user to remotely program the HDI-68. This operation is similar to the local programming mode as described in sections 2.7.1 and 2.7.2, except that the setup mode is not allowed (commands 50# through 55#).

The remaining mode, enabled by dialing a code that has been programmed with the command "10#" plus an additional string of numbers (up to 6-digits), allows the user to selectively page (or call) a mobile that is equipped with a DTMF selective call decoder. Refer to section 3.3.3 for more information on how to use these features, and sections 2.9.4 through 2.9.7 for information on programming the required codes.

2.8.5 Setting Up Toll Restriction

One of the more powerful features of the HDI-68 is the ability to restrict mobiles from dialing long distance (toll) calls. You may place up to four restrictions on both the first and second digits dialed. If it is desired to restrict all long distance calls, the digits 1 and 0 should be placed on boththe first and second digit "restriction lists" (set up with the "21#" and "22#" commands). With the 1 and 0 digits restricted in this manner, a mobile attempting to dial an operator for assistance (0), a station-to-station call (1-xxx-xxxx), or an operator-assisted call (1-0-xxx-xxxx) will be disconnected and the call will not go through. You may also restrict calls to particular local (PBX) exchanges or other types of toll calls (such as information or time)

(such as information or time).

In order to provide the HDI-68 user with maximum flexibility, a means of bypassing toll restriction has been provided in the form of a Toll Restriction Override Code. System owners may issue this code to select users who have a need to make toll calls. This code is used in place of the standard mobile connect code (see section 3.2.3 for more information on this feature). The code may easily be changed if it becomes known to unauthorized users.

In many instances it will be desired to have Mobile Connect Code users be unrestricted from dialling 911, even though the toll restriction 'lists' contain 9 or 1 in th first and second digit positions, respectively. In these cases, the toll restriction for 911 may be disabled by entering the sequence "23#" and then a "1".

2.8.6 Call Limit Timer
The Call Limit Timer controls the maximum interconnected call length. This timer is set to a length of time long enough to allwo for a normal call and short enough to insure that all users are given a fair chance to use the interconnect. The timer initiates a series of warning tones at intervals of 10-seconds beginning 30-seconds before the call is automatically terminated.

To set the Call Limit Timer:

The Call Limit Timer can be reset during a call by using the Reset Call Limit Timer Code (see section 2.9.8 for more information on using this code).

2.8.7 Mobile Activity Timer
The Mobile Activity Timer automatically disconnects the telephone line (hangs up) if a mobile drives out of range during a call, the mobile user fails to properly terminate the call, or if the mobile otherwise abandons the call. This timer (set in 30-second increments) terminates a call whenever a mobile transmission is not detected within the prescribed time period. The HDI-68 will send a single warning tone 15 seconds prior to automatic disconnect. To reset the timer, the mobile need only to transmit carrier briefly. In addition, this timer is used in Remote Base Operation to disconnect the phone line in the event that the caller forgets to send the "#" disconnect command after using this feature (refer to section 3.3.2 for more information on Remote Base Operation).

If the Mobile Activity Timer setting is too short, the mobile may get disconnected inadvertently because it has not transmitted frequently enough, although transmit periods may be considered normal. On the other hand, if the value is too long, the telephone interconnection may be occasionally left hanging off-hook for unnecessary periods of time due to a mobile user not properly terminating the call. We recommend the factory default setting of 1-minute.

To change the Mobile Activity Timer:
(An entry of <2> will result in a timer length of 1-minute)

2.8.8 Enabling Automatic CW Identification (CWID)
CWID is used for station identification as may be required by national or international law or regulation. The method of sending the CWID station call sign is different for various classes of stations encountered worldwide. The HDI-68 can be programmed to identify in accordance with virtually all of these methods:
The speed or Morse code rate in words-per-minute is set as follows: See Chart at End

2.8.9 Programming the Station Call Sign
The station call sign is programmed by entering a 2-digit code for each alpha character or number from Table 2.8.12, while in the program/setup mode. The command sequence is as follows:
Example: A station call sign of WXX24 would be programmed as follows:

Table 2.8.12 CWID Character Codes

2.8.10 Courtesty Beep
The courtesty beep, when enabled, will provide an audible short tone to the telephone line each time the mobile stops transmitting to indicate to the landline party that they may begin to talk.

To enable or disable the Courtesy Beep feature: See Chart at End

2.8.11 Busy Channel Lockout
Busy Channel Lockout, when enabled, will check for carrier activity on the channel before answering a landline call and will answer only if there is not activity on the channel. If this feature is disabled, the interconnect will continue to process the call as normal.

To enable or disable the Busy Channel Lockout feature:

.6 IN CASE OF DIFFICULTY

In this section, one or more suggestions are described in order to resolve the problem. If the first or next suggestion does not eliminate the difficulty, then proceed with the subsequent item listed for the problem.

HDI-68 is apparently dead or non-operational
(1) Check internal fuse F1. If open, replace with a 1-ampere fast blow 3AG type.
(2) Verify that the HDI-68 connection to +12VDC is good.

(2) Verify that the HDI-68 has a proper ground connection to the source power supply.
(3) Verify that the HDI-68 has a proper ground connection to the source power supply.
(4) Enter the Program/Setup mode (Power up with Connect switch depressed) and re-initialize to factory defaults. Program other parameters in accordance with your requirements for this installation.

Upon installation and configuration HDI-68 does not acknowledge mobile
(1) If using Discriminator Audio from the receiver, verify that jumper JPR2 is removed, and that LED DS2 is illuminated when a mobile is transmitting and off when not transmitting. Verify that DIP switch S3-E, S3-F, and S3-G are correctly configured for the HDI-68 Internal Mobile Detector.
(2) If using External COR input, verify that DIP switch S3-E, S3-F, and S3-G are correctly configured for external COR and the proper active level (high or low) upon receipt of carrier. Verify that this active logic level is present on the interconnect cable Violet wire.

HDI-68 not responding to telephone line ringing
(1) Verify that the Ring Counter parameter is not set longer than desired. Enter the Program/ Setup mode and set command 13# to the for the number of rings for the HDI-68 to wait until answering (1-9 Rings).
(2) Troubleshoot the Ring Detector by connecting an oscilloscope to R6-5 and adjust RV6 for a 12-17 msec negative-going pulse width at the 1V level during ringing. Make this measurement with the vertical mode set to DC and the horizontal mode at 5 msec/div, or adjust RV6 in very small increments (10 or less) to either side of the factory set position (clockwise for greater sensitivity) until proper operation is achieved.

Line In Use detector not operational
(1) Connect a 2 to 1 line "Y" adapter to J1 on the rear of the HDI-68 and connect a local telephone to one port and the telephone line to the other jack.
(2) Connect an oscilloscope (set to DC and 1 or 2 volts per division) to U5 pin 7.
(3) Press and release the front panel CONNECT switch. While intermittently pressing the telephone hook switch on and off at a rate of approximately once every second, adjust the Line In Use detector potentiometer RV7 to the center of a narrow range (usually about 10 of rotation) where the oscilloscope display toggles between 0 VDC and 5VDC as the telephone hook switch is pressed and released.
(4) If the detector is impossible to adjust due to a very low loop current, then disable the Line In Use circuit by entering the Program/Setup mode and programming command "07#" for parameter "#" (disabled).

Programming notes:
(1) It is helpful to monitor the transmitter output while in the program/setup mode to hear the that are generated by the HDI-68, indicating the progress of the programming entries.
(2) After a valid command entry [2-digits + #] a will be heard.
(3) After a valid parameter entry [1 or more digits] (if entering fewer than the maximum number of digits allowed, terminate the entry with a "#") a will be heard.
(4) If an invalid entry is made, an (series of low tones) will be heard.

Appendix A

How To Locate Discriminator or FM Detector Audio

Most receivers used in conjunction with CES Simplex Interconnects will likely have an integrated circuit FM detector, where the detected audio will appear on one pin of the IC. This pin will normally exit to the receiver's squelch circuit (sometimes part of the same IC) and to an audio amplifier incorporating de-emphasis (removes the high-frequency noise components) and/ or and audio switch controlled by the squelch circuitry. In interfacing to an interconnect, several factors should be considered: (1) That connecting any external circuit to the IC does not load or affect it's operating characteristics, and (2) that any other external noise or RF is not permitted to be coupled back into the receiver. Locate the IF/Detector or Detector IC in the radio schematic. Verify with an oscilloscope that the pin contains both unsquelched high frequency noise (300 mV to 2 V typical) and only detected audio when receiving a modulated carrier. Connect the CES interconnect's Receiver Audio input to this point and note if the level is affected. If it becomes reduced by more than 20%, try placing a 10K to 20K resistor in series to minimize any loading. If necessary, use a higher value resistor. Place heatshrink tubing over the resistor and the connections to prevent any chance of shorting to surrounding components. If unusual noise is observed either in the radio speaker or interconnect when either is used, then an RF choke of perhaps 1 mH in series and at this point of connection may be needed.

The table later in this appendix lists several types of applicable detector IC's. If the IC type is not listed, and you are unable to determine the proper pin on the detector IC on the radio schematic: Use an oscilloscope to locate the detected audio output. With no carrier being received, look for a pin that has high frequency noise (up to approx. 10 KHz or greater), and that has detected audio when receiving a modulated carrier. The audio level at the correct pin will not be affected by the receiver squelch control or the volume control. The correct pin will not normally be connected to a tunable coil, crystal filter, or ceramic resonator.

If the detector IC output pin cannot be determined, then proceed with the following suggestions:
(1) In no case will true FM detector audio be available at the speaker output connection of the receiver. Similarly, it is unlikely that the desired FM detector audio will be available at the 'top' of the receiver volume control. The recovered audio at these points will normally already be de-emphasized and will not include the high-frequency noise components necessary

for most simplex interconnects to operate in this mode.
(2) The correct point will be somewhere between the 'top' of the front panel volume control and the detector IC. Looking at the radio schematic diagram, an FET audio gate may be seen with its' gate connected to the squelch circuitry. Verify with an oscilloscope that audio is always present at this point, even when the squelch control is set to squelched (no audio is heard from the speaker). With an RF signal generator or communications service monitor, generate a full-quieting on-channel carrier modulated with a 1 KHz tone.
After verifying the presence of the 1 KHz tone, vary the modulated tone upward to 10 KHz. If the recovered audio signal observed stays at approximately the same level, then make the discriminator audio connection to this point. If the level drops to a substantial level below that observed at 1 KHz, such as 30% or less, then move to a point in the schematic diagram toward the FM detector where the level of noise and recovered audio, including the 10 KHz test, are approximately the same.

Common FM Receiver IC's

Manufacturer	Part Number	Detector Output Pin
Motorola	MC3357, MC3361 MC3359 MC3362 MC3363 MC3367	9 11 13 16 10
National Semiconductor	LM1865*, LM1965*, LM2065* LM3089*, LM3189* LM3361 TBA120S	15 6 9 5
Plessey	SL6637 SL6652 SL6653 SL6654 SL6655	1 3, 4 3 4 17, 18
RCA	CA3089*, CA3189*, CA3209 CA3215	6 7
SGS-Thomson	TDA7359, TDA7361 TDA3089*	9 6
Sharp	IR3N06, IR3N37	9
Siemens	TBA120S, TBB1469 TBA120T, TBA120U TBB469, TBB2469G, S041P	5 8 or 12 8

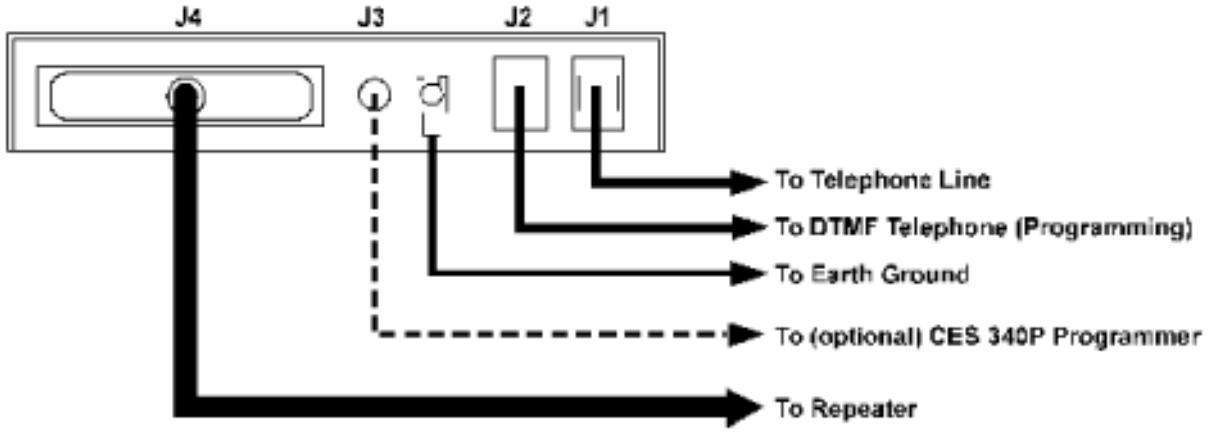
Note: Some of the IC's listed above, in particular those marked with an "", may have the detected audio pin squelched when a carrier is not being received. If this is the case, then the receiver must be left unsquelched at all times, or the External COR function must be used.

Table 2.5.1 HDI-68 Radio-Interface Cable and Color Code

J4	Wire Color	Description
1	**Shield**	**Ground**
2	Violet	External COR TTL or CMOS Logic Input
3	Black	CTCSS Detection TTL or CMOS Logic Input
4		External Connect Switch
7		Control Receiver Audio Input
9		PTT Relay Normally Closed Contact
10	Green	PTT Relay Normally Open Contact
11		External Connect Sense
13	**Red**	**+12 VDC Input**
14	**Orange**	**Audio Output to Transmitter**
16	White	not used
20	**Brown**	**PTT Active Low Output (Open Collector)**
21	Blue	PTT Relay Common
24	**Yellow**	**Receiver Audio Input**

Note: The functions in BOLD are minimal or normal connections required for a carrier squelch repeater or transmitter and receiver combination. Other connections are for optional functions such as CTCSS Detection Logic from receiver CTCSS decoder output, if used. J4 Pins 8, 15, 23, and 25 are all spare ground connections. Pins not listed are not connected internally.

Figure 2.5.1 HDI-68 Back Panel Layout



Switch	ON Function	OFF Position Function

Switch Position	ON Function	OFF Position Function
S3-A	**PTT Relay Common Grounded**	PTT Relay Common Open
S3-B	not used	not used
S3-C	**TX Audio Low Impedance**	TX Audio High Impedance
S3-D	**RX Audio Low Range - FM Detector Audio**	RX Audio High Range - Speaker Audio
S3-E	External COR Active High	Ext. COR Active Low or **Internal COR**
S3-F	External COR Active Low	Ext. COR Active High or **Internal COR**
S3-G	**Internal Mobile Detector COR**	Ext. COR Active High or Low
S3-H	PTT Relay Enabled	**PTT Relay Disabled**
JPR1	**Compression Enabled**	Compression Disabled
JPR2	**FM Detector Audio**	Speaker Audio
JPR3	TX Audio Low Level Output	**TX Audio High Level Output**

Notes:
(1) For HDI-68 installations using speaker audio, or othe receiver audio other than FM detector audio, DIP switch S3-E or S3-F should be "ON", and S3-D and S3-G (and jumper JPR2) should be "OFF". Speaker audio should be squelched when a mobile is not being received and the receiver COR logic level should be connected to J4-2. See Section 2.3 for information on External COR.

(2) Settings of S3-C, S3-D, and JPR3 may be changed to increase the ranges of RV3 and RV4 (related to S3-C and JPR3), and RV8 (related to S3-D).

(3) S3-H should be placed in the "OFF" position when using the open-collector logic output for PTT.

"25#"	2	HDI-68 set to answer the telephone line
"13#"	4	HDI-68 set to answer after 4-rings

"05#"	"688"	HDI-68 set for a Ringout Security Code of 688

"12#"	**<x>**	where x = 1-digit <1 through 9> in Minutes

"11#"	**<x>**	where x = 1-digit <1 through 9> in 30-second increments

"18#"	**"0"**	**No CWID (Disabled)**
"18#"	"1"	CWID at End of Interconnect operation only
"18#"	"2"	CWID at Beginning, End, and every 10-minutes during interconnection
"18#"	"3"	CWID at Beginning, End, and every 15-minutes during interconnection

"19#"	<2-digit codes>	Up to twenty 2-digit codes are allowed Terminate the entry with a "#"

"19#"	33 34 34 02 04	"#"

"27#"	"0"	Disable Busy Channel Lockout
"27#"	"1"	Enable Busy Channel Lockout

"26#"	"0"	Disable Courtesy Beeps
"26#"	"1"	Enable Courtesy Beeps

"20#"	"1"	10 WPM
"20#"	**"2"**	**20 WPM**
"20#"	"3"	30 WPM
"20#"	"4"	40 WPM

Command Feature	**Factory Default Parameter**
Toll Restriction Code	Disabled
Mobile Connect Code	*
Mobile Disconnect Code	#
Ringout Security Code	Disabled
Call Limit Reset Code	*99
Line In Use Override Code	Disabled
Remote Programming Access Code	746 or "PGM"
Remote Base Operation Code	768 or "RMT"

DTMF Selective Ringout Code Mobile Activity Timer	77 or SR 1-minute
Call Limit Timer	4-minutes
Ring Counter (# of rings to answer)	2nd Ring
Maximum Mobile Ringout Period	15-seconds
CWID Mode	No ID
CWID Call Sign	Disabled
CWID Rate	20 WPM
Restricted First Digits	None Selected
Restricted Second Digits	None Selected
Priority 911 Feature	Calls to 911 not toll restricted
Dialing Mode	Regenerated DTMF
Answer Mode	Answer on 2nd ring and automatically rings out to mobiles if no other operational mode is selected by the caller (see section 3.3)
Courtest Beeps	Enabled
Busy Channel Lockout	Enabled

"1"	Regenerated DTMF (HDI-68 decodes and regenerates each DMTF digit)
"2"	Nonregenerated DTMF (all mobile DTMF is passed directly to phone line)
"3"	U.S.A. Pulse Dialing (40:60 make to break ratio, 10 pps dialing rate) (HDI-68 decodes DTMF from mobile and sends pulse dialing to phone line)
"4"	European Pulse Dialing (35:65 make to break ratio, 10 pps dialing rate) (HDI-68 decodes DTMF from mobile and sends pulse dialing to phone line)

"25#"	0	HDI-68 ignores a ringing phone line
"25#"	1	HDI-68 rings out to mobile, but does not answer line. The mobile may answer the call by using the Mobile Connect Code. See section 3.3.3 for more information.
"25"	**2**	[Factory Default] HDI-68 answers the phone line on the number of rings set in command 13# and then automatically rings out to the mobile, unless the Ringout

		Security Code, Remote Programming Mode, or Remote Base Mode is enabled where the landline caller is prompted to enter a code.
"25#"	3	HDI-68 answers and goes into Remote Base operation without an access code.

Character	Code	Character	Code	Character	Code	Character	Code
1	01	D	14	Q	27	E	42
2	02	E	15	R	28	O	43
3	03	F	16	S	29	N	44
4	04	G	17	T	30	U	45
5	05	H	18	U	31	Z	46
6	06	I	19	V	32	Z	47
7	07	J	20	W	33	CH, S	48
8	08	K	21	X	34	Period (.)	49
9	09	L	22	Y	35	Comma (,)	50
10	10	M	23	Z	36	Hyphen (-)	51
A	11	N	24	Å	37	Colon (:)	52
B	12	O	25	Ç	38	Slash (/)	53

C	13	P	26	E	39		

Back To Product Manuals Main Page

Home | Contact Us | Company Info | Dealer Login | Products | Support | Employment | Search

Send mail to webmaster@CES.com with questions or comments about this web site.

This page last updated on 01/10/13

This site developed and maintained by Oro-Tech Systems