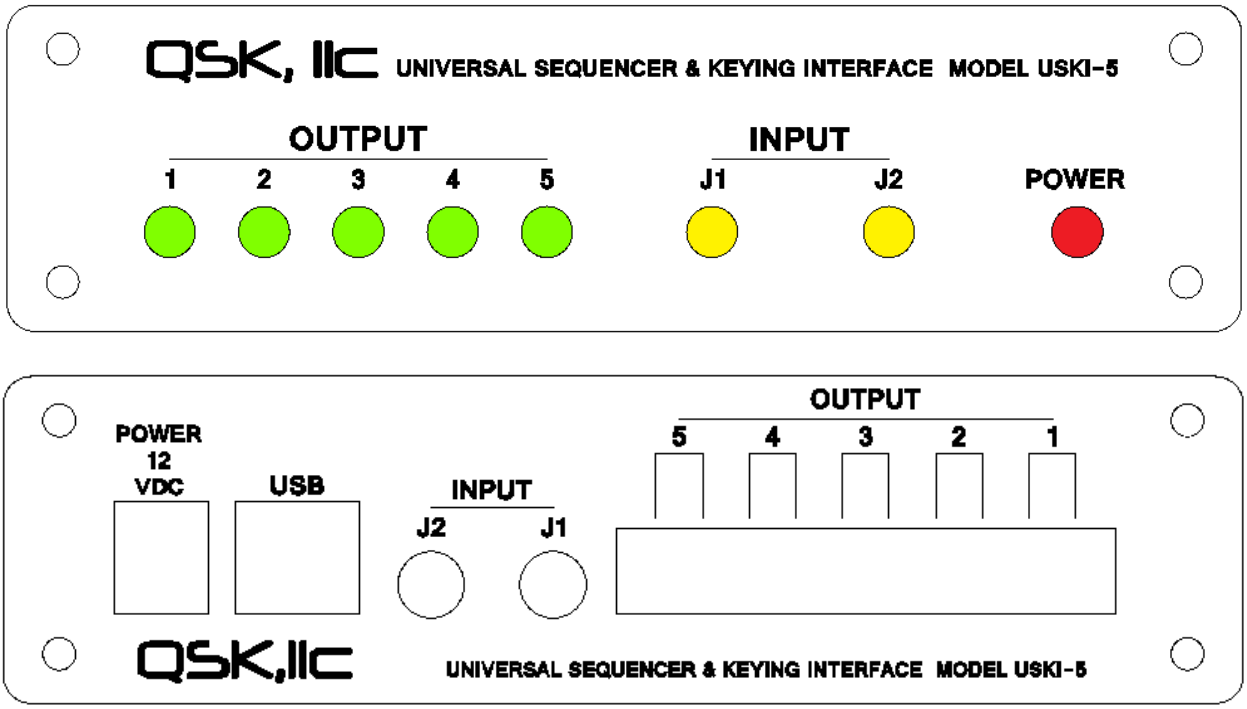
QSK, llc

USKI-5

Universal Sequencer and Keying Interface

Rev. D



FEATURES

- Ideal switching interface between transceivers, power amplifiers, tower mounted amplifiers, and other accessories
- Fully programmable via USB interface
- Highly versatile, virtually any sequencing scheme possible
- Multi-sequence capability for different operating modes (i.e., CW or Phone, etc.)
- Transmit inhibit capability
- Non-volatile memory
- Five output channels, four input control channels
- Delays programmable from zero to minutes and more in 1 ms steps
- Silent high speed opto-isolated solid state relay controlled outputs
- Various voltage/current relay options available
- Positive, negative, or AC voltage output switching
- Easily programmed in BASIC
- Downloadable prewritten programs available
- Works with most solid state and tube type equipment
- Dimensions, H x W x D, inches (mm): 1.37 x 5.25 x 3.15 (34.8 x 133.4 x 80.0)
- Power required: 12 VDC, 60 mA maximum, 5.5 x 2.1 mm input, universal input supply included

OVERVIEW

The USKI-5 is a programmable microcontroller based Universal Sequencer and Keying Interface suitable for use in many applications requiring accurate electronic timing between switching events. It is particularly suitable for amateur radio applications allowing sequenced keying of equipment such as transmitters (or transceivers), power amplifiers, receiver muting, VFOs, antenna relays, T/R switches, transverters, TMAs (tower mounted amplifiers), etc., as is typically necessary for equipment protection and QSK CW or EME operation. It is easily programmed and provides four input control channels and five output channels. Each output channel features a plug-in opto-isolated high speed MOS FET solid state relay, configured to switch AC or DC loads of either polarity. A variety of pin compatible relays are available with different output voltage and current ratings (up to 600 V and up to 4 A) that can be mixed among the output channels as necessary making it ideal for keying modern solid state as well as older tube equipment. This also allows for interfacing between for example, keyers, radios, amplifiers, etc., which do not have compatible keying voltage or current requirements. Since the USKI-5 is microcontroller based, it can be programmed for virtually any conceivable order of events. Each output can be programmed for normally open or inverted (normally closed) operation. Once programmed, the USKI-5 can be operated with or without connection to the programming computer. The stored program is nonvolatile and no backup batteries are required.

The heart of the USKI-5 is a PICAXE®[1] 14M2 microcontroller. It can be programmed or reprogrammed in BASIC language via a computer USB connection using software available free at the PICAXE® website[2]. There are also several manuals available on the website with comprehensive information about the PICAXE® series of microcontrollers for anyone interested in writing their own programs.

A number of amateur radio application programs, already written for the USKI-5, are available for download at www.qskllc.com. These programs are easily modified for the required sequencing and timing, and in most cases eliminate the need for the user to learn the BASIC language or write their own programs from scratch. Instructions for the use and modification of these programs are included in the following sections of this manual.

REASONS FOR SEQUENCING

There are numerous reasons for sequencing events during the transition between receive and transmit (T/R switching) states in radio equipment.

Mechanical relays are often used in communications equipment. Because they require a relatively long time for actuation, typically between 5 and 25 ms, other events may need to wait until relays have fully transitioned. Without proper sequencing, relays may be subject to “hot switching” (which can cause relay contact damage) and parts of transmitted messages may be

[1] PICAXE® is a trademark of Revolution Education Ltd.
[2] http://www.picaxe.com/Software

lost. In particular, beginning portions if not all of the leading CW symbol[3] (dit or dah) may not be transmitted when operating in full or semi-break in mode. Modern transceivers are generally capable of good semi or full break in performance when operated alone ("barefoot"). Some external power amplifiers also have provisions for QSK operation. Amplifiers that do not should have their keying sequenced with that of the transmitter.

When operating QSK with a separate receiver and transmitter (even without mechanical relays), proper sequencing of receiver muting and transmitter keying is necessary for best QSK performance. By muting the receiver from before, until after, any transmitted signal is present, effect on the receiver AGC voltage will be avoided thus minimizing receiver recovery time after each CW element.

To avoid "key clicks" a transmitted CW symbol must have properly shaped attack and decay characteristics. Not only must the transmitter itself have proper shaping characteristics, there must not be external factors which can cause truncation of the keying envelope. If an external VFO is used as a transmitter frequency source, its RF output must be turned on before the transmitter begins the attack portion of a symbol and must remain on until after decay is complete. This same principal also applies to any power amplifier or antenna switching that may occur along with transmitter keying.

Many VHF/UHF and EME operators may use transverters and remote low noise tower mounted amplifiers (TMA). Being prone to damage from transmit signal levels, it is important for these devices to be switched out of line from before, until after, the period of transmitter power output.

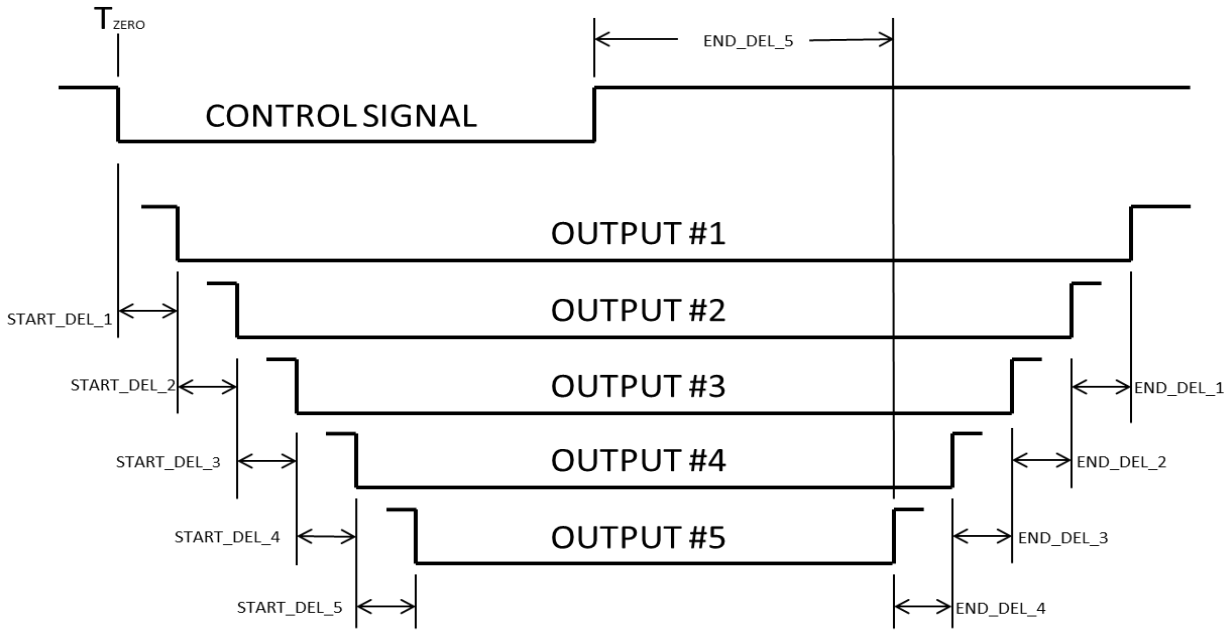
An electronic sequencer can provide the proper order and timing of events in these and many other applications.

TIMING PROGRAMS AND EXAMPLES

The USKI-5 can be programmed for virtually any conceivable sequencing routine. The programs presented here sequence the USKI-5 output channels in a sequential 1-2-3-4-5 fashion when switching from receive to transmit and with the reverse order when returning to receive as shown in figure 1. The control signals may be from a CW keyer or PTT switch in a microphone or footswitch. Start and end delays are simply shown as START_DEL_# or END-DEL_# in this figure as a general reference. Depending on the program and operating mode, they may have different references such as "CW_START_DEL_3", "PTT_END_DEL_2", or "TX_START_1", for example.

Users interested in modifying these programs or writing their own can review the PICAXE© manuals for programming techniques and functions if necessary.

[3] The basic element "dit" has a duration in seconds equal to 1200/WPM



GENERAL TIMING SEQUENCE

FIGURE 1

Four pre-written programs are presented in the following sections which should satisfy the requirements of most any amateur radio application. These programs are available for download at www.qskllc.com. Before using a program, delays must be set to values appropriate for the specific application. Timing examples are presented in the addendum section at the end of this document.

A transmit inhibit function is included with each program by the available interrupt function of the PICAXE® 14M2 microcontroller. The input designated for transmit inhibit (interrupt) is continuously monitored and when activated, will immediately execute the routine programmed for such an event. If the program is in standby and the interrupt is activated, transmitting will be inhibited, regardless of the state of other inputs. If the program has already begun the transmitting sequence, an interrupt condition will cause the program to immediately "back out" of the sequence with proper delays to protect sensitive equipment, just as in a normal transmit-receive sequence.

- **USKI-5 Program (A)** is ideal for sequencing of all devices in the transmit/receive system including TMA, transverter, power amplifier, etc. All keying functions (CW, PTT, etc.) must be connected to inputs of the sequencer which then controls switching of each device (see **USKI-5 Program (D)** for PTT operation only). This allows sensitive devices such as a TMA and/or transverter to be switched into a safe condition before transmitter RF power is applied. Transmitter external amplifier relay control output is monitored for an open contact state to further ensure that the transmitter has returned to standby before the system is returned to a receive condition. Direct activation of the transmitter

(PTT, VOX, or use of internal CW keyer) must be prevented since there would be no way for the sequencer to properly coordinate switching of the system components. Transmitter external amplifier control output is however monitored in case of accidental activation of the transmitter directly. In such an event, outputs for the transverter and TMA are immediately switched into a safe transmit mode. Although this does not guarantee that there will not be damage to the transverter or TMA, it can hopefully provide some degree of protection.

Program (A) provides a transmit inhibit function. If initiated, sequencing will not start regardless of the states of other inputs. If inhibit occurs after a start sequence has begun, the program will immediately begin the end sequence from the last started output channel. For example, if inhibit occurs during the delay TX_START_DEL_3, the program will immediately switch off OUTPUT #3 (disregarding the time remaining of TX_START_DEL_3) and will continue by switching off OUTPUT #2 and #1 in sequence with delays TX_END_DEL_2 and TX_END_DEL_1 respectively as it would during a normal “key up” (or release of PTT) event. If transverter or remote TMA switching is controlled by the sequencer, this provides the same necessary timing delays to protect these devices during an inhibit condition just as in normal operation.

A station configuration suitable for control with Program (A) is shown in figure 2 (some components shown are optional and may not actually be used). In this case, PTT and CW keying is connected to inputs of the sequencer. Switching of all devices is thereby controlled by the sequencer. Note the output numbers and the functions or devices they control. The order is again chosen so that the TMA and transverter are first switched into a safe transmit condition before the transmitter/transceiver is keyed and the reverse order is followed when returning to receive. The actual order of output connections may be different if other types of devices are being controlled.

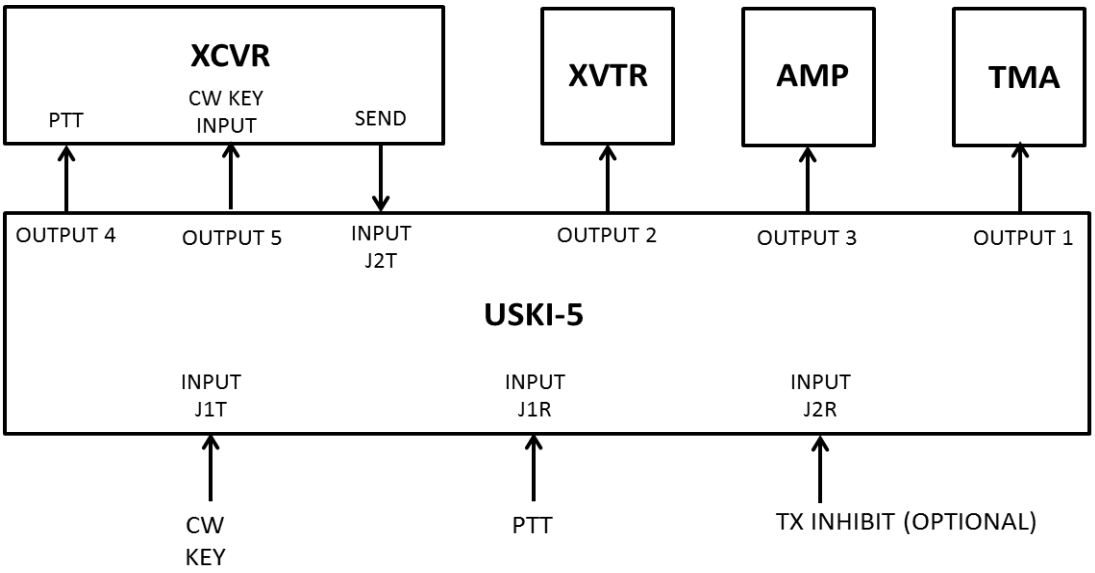


FIGURE 2

- **USKI-5 Program (B)** has all the features of Program (A) but in addition has two separate timing sequences, one for CW and one for PTT operation. Each can be programmed with different delays if necessary.

- **USKI-5 Program (C)** provides for sequenced keying of a transmitter (or transceiver), amplifier, and other accessories from an external (not the radio's built in keyer) CW keying device while allowing normal direct non-sequenced PTT or VOX control of the transmitter. This program is NOT intended for use in stations with transverters, TMAs, etc. Program (C) also provides a transmit inhibit function. Several station configurations are suitable for control with Program (C). Probably the most common is shown in figure 3 (the order of connections for outputs 1 – 4 may be different depending on the specific devices being controlled

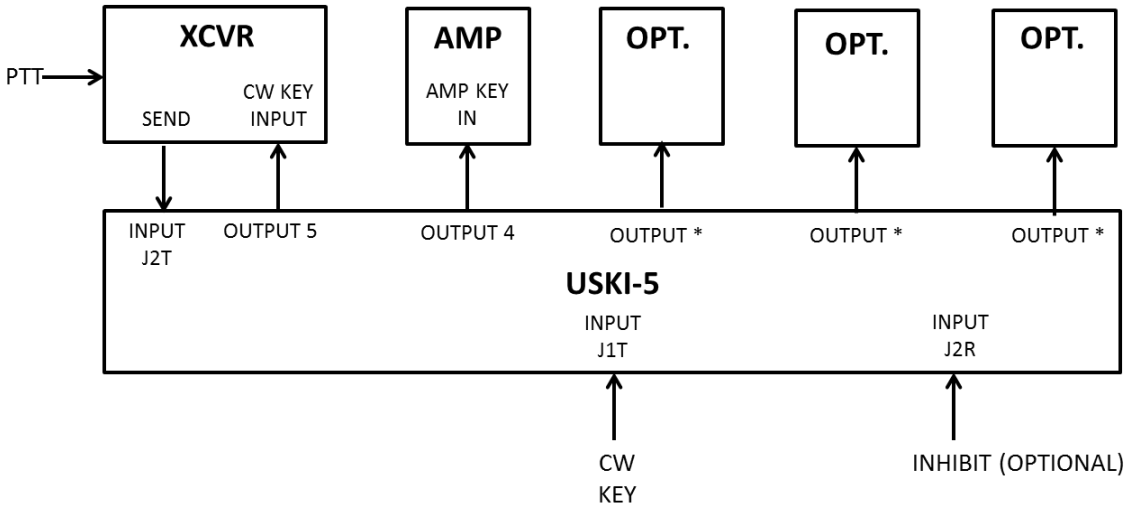


FIGURE 3

The CW keying device is connected to J1T. The transceiver's external amplifier relay control output is connected to J2T. Closures between J1T and ground will sequence the outputs of all connected devices and send a closure to the CW input of the transceiver. When PTT is activated directly into the transceiver, the send output connected to J2T will cause all other devices to key simultaneously without any delays.

Another application for Program (C) is with stations that use separate components such as a VFO, transmitter, receiver, and possibly other devices (power amplifier, antenna T/R switch or relay, etc.) as shown in figure 4.

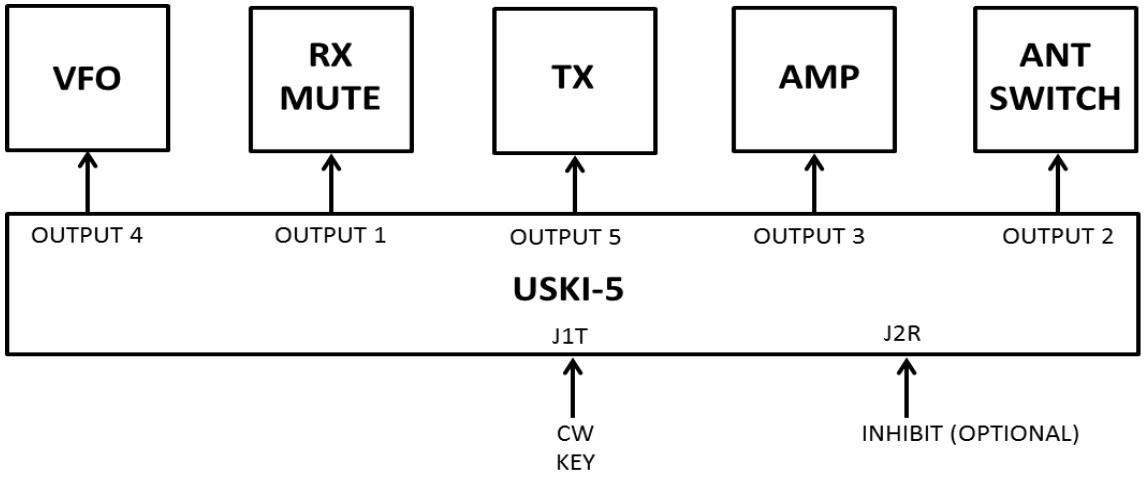


FIGURE 4

- **USKI-5 PROGRAM (D)** is similar to Program (A) and applies to stations configured as shown in Figure 2 but has no provision for CW break-in operation. In some applications the required sequencing delays are of sufficient length that CW break-in operation at any reasonable speed is not possible. In these cases Program (D) can be used with only PTT control of transmit-receive operation. CW keying is still connected to input J1T, as shown in Figure 2, but CW keying output from the sequencer is only applied to the transmitter if PTT is activated via input J1R. With no CW activation of the timing sequence, Program (D) only requires setting of PTT sequencing delays.

TIMING CONSIDERATIONS

If the sequencer is controlling RF sensitive devices such as TMAs or transverters, make sure to allow a sufficient amount of time for switching to avoid component damage from transmitter power output. If in doubt, add extra time to be on the safe side!! The user is responsible for correct programming and use of the USKI-5 sequencer.

During normal receive-transmit-receive sequencing, the transmitter will be the last device to be turned on (started) and first to be turned off (ended). In CW operation it is important to have the transmitted signal's time duration the same as that of the control signal. Therefore it is necessary to compensate for the time lost in the START delays. This is easily done by simply setting END_DEL_5 equal to the sum of all the START DELAYS.

For modes of operation other than CW, timing delays for various components during transmit-receive switching is not usually as important. Tens or hundreds of milliseconds delays can often be tolerated without adversely affecting operations. For CW full break in (QSK) operation however, proper timing is critical. Sequencing delays are necessary but in the interest of maximizing receive time, it is important that the delays be as short as possible consistent with proper operation.

For a given sum of START and END delays, there is a maximum CW speed possible without introducing errors. If the sum of is too long, the control signal could go low or "key down" before

the last sequence has completed thereby missing the beginning of the next symbol. The time duration of one “unit” in milliseconds (length of one “dit” or space between symbols within a letter for normal weighting) is given by the formula

$$T_{unit} = \frac{1200}{WPM} \text{ ms}$$

where WPM is the code speed in Words Per Minute. Since the time between two sequential symbols within a letter is one unit, it is necessary for the sum of all START and END delays to be less than the duration of one unit. As an example, for operation up to 50 WPM, the sum of START and END delays must be less than 24 ms.

USKI-5 PREPARATION FOR USE

The USKI-5 is shipped without the output relays installed. Remove the four #1 Pozidriv screws (a number #1 Phillips driver can be used with care) from either the front or rear panel and slide out the circuit board. Install the desired relays into the sockets labeled RY1 through RY5. Make sure of the relay orientation is as shown in figure 5. Pin #1 of each relay is indicated by a dot. If relays are being used of different voltage/current ratings, make sure they are installed in the correct channel positions.

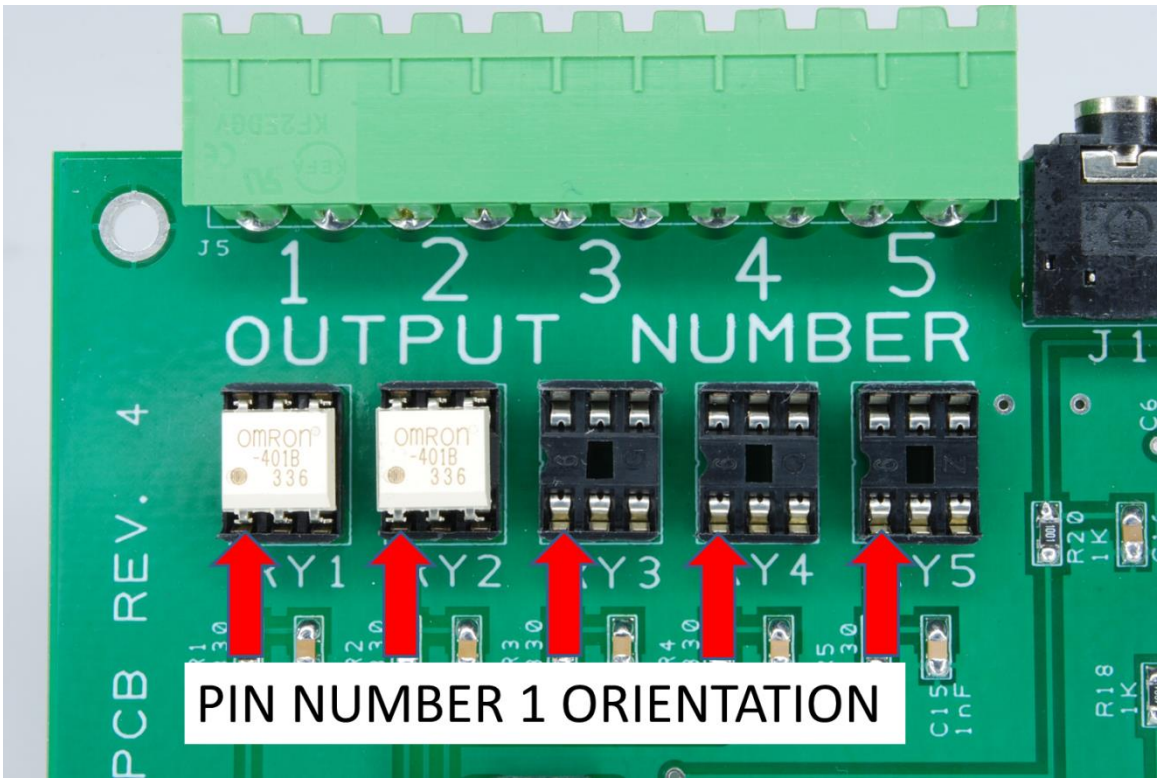
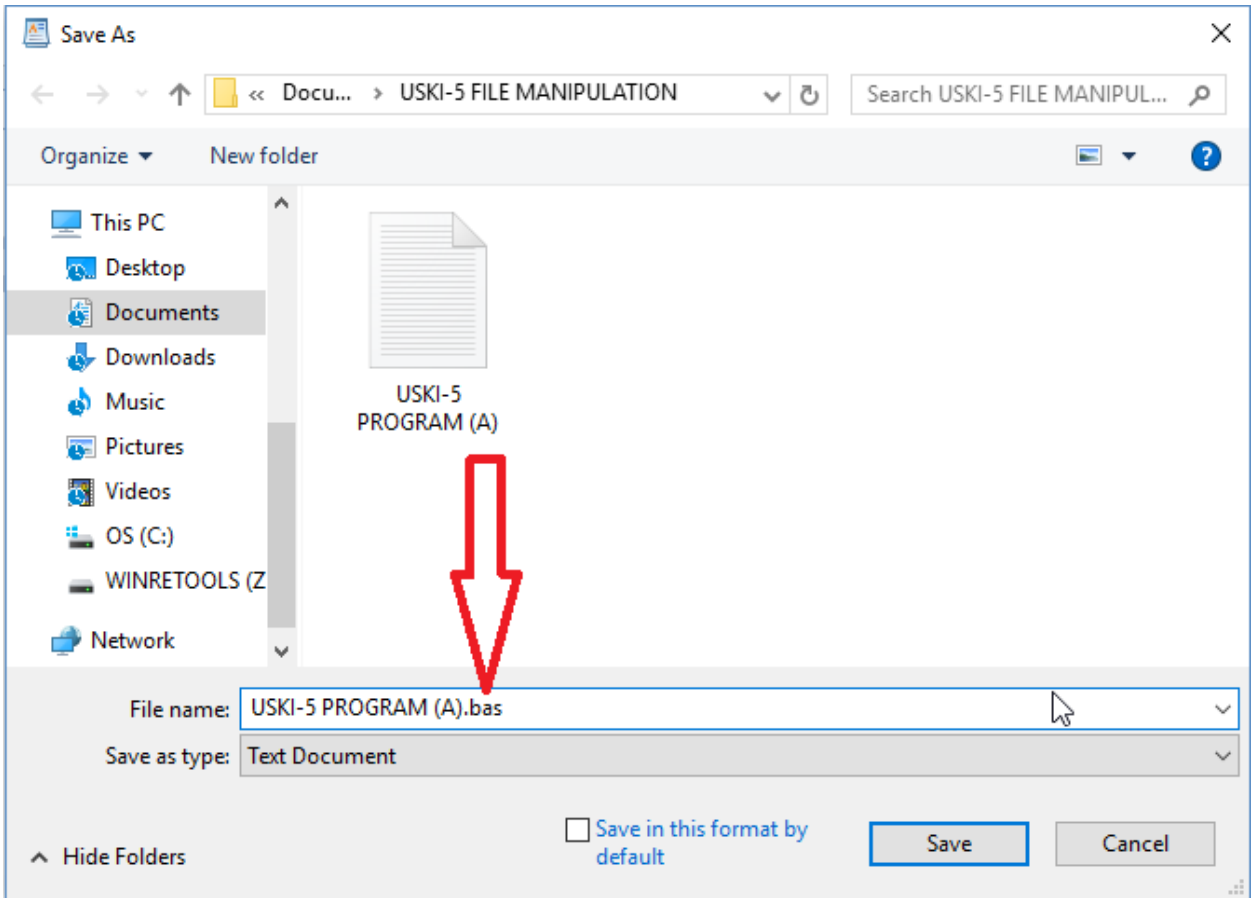


FIGURE 5

It is a good idea to make note of what relay types are used and in which channels they are installed. When all relays are in place, reassemble the sequencer.

PROGRAMMING THE USKI-5

From the PICAXE® website http://www.picaxe.com/Software , download and install the Editor 6 software[4] (use AXEpad for Mac or Linux). Then download the desired USKI-5 program located at the bottom of the webpage http://www.qskllc.com/#!uski-5/cee5. The downloaded USKI-5 programs files have .doc extensions and must be converted to .bas files so that they will be recognized by PICAXE® Editor 6. This is easily done by opening the downloaded file in WordPad (in Windows Explorer right click on the downloaded file and select "Open with" and choose "WordPad"). Select "File", "Save As" and add the extension ".bas" to the file name as indicated below and then select "Save". The file will be saved with the proper extension.



Connect the sequencer to the computer with the USB cable. The computer should recognize that new hardware is connected and begin "Installing Device Driver Software". Installation may take several minutes. When driver installation is complete, connect power to the sequencer.

Launch the PICAXE® Editor software. In the "Workspace Explorer" window, set the PICAXE® Type to PICAXE-14M2. Under "COM port", click on "Refresh COM ports". In the dropdown window, the COM port for the USKI-5 should be listed as a "COM# USB Serial Port". Note all the COM port numbers listed. If the one for the USKI-5 is not known, unplug the USKI-5 USB

[4] References in this document are for the Windows version of the PICAXE© Editor 6 programming software.

cable and refresh the COM ports again. Note the listed COM ports again. The one missing is that of the USKI-5. Again, plug in the USKI-5 USB cable and refresh one more time. Select the one for the USKI-5. Then click on “Check PICAXE type connected”. If successful, a window will appear indicating that “Firmware Check Successful”. If necessary, repeat the “Refresh COM ports” and “Check PICAXE type connected” routines.

Open the desired USKI-5 program in the editor. Near the beginning of the program are lines for specifying each START and STOP delay as shown below. Depending on the program, the actual start and stop delays may be called “CW_START_DEL”,”PTT_START_DEL”, or “TX_START_DEL”, for example.

It may be helpful to first fill out a timing delay work sheet shown in the notes section at the end of this document.

```
symbol CW_START_DEL_1 = 8 * 0
symbol CW_START_DEL_2 = 8 * 0
symbol CW_START_DEL_3 = 8 * 0
symbol CW_START_DEL_4 = 8 * 0
symbol CW_START_DEL_5 = 8 * 0

symbol CW_END_DEL_5 = 8 * 0
symbol CW_END_DEL_4 = 8 * 0
symbol CW_END_DEL_3 = 8 * 0
symbol CW_END_DEL_2 = 8 * 0
symbol CW_END_DEL_1 = 8 * 0
```

Change the START and END values (in milliseconds, maximum[5] of 8191 ms) shown here within the red blocks as necessary for each of the output channels.

In some cases, inverted or normally closed output may be desired on some channels (such as for the mute function in many older receivers). This can be accomplished by simple changes in the programs. Each program has an initialization routine that sets the outputs to their proper states upon power up. The default setting is open circuit which corresponds to a “low” command. Changing any “low” to “high” in the section indicated in red will initialize that output to normally closed.

```
initialize:
      low 1
      low 2
      low 3
      low 4
      low 5
```

[5] If delays longer than 8191 ms are required, refer to the addendum section at the end of this document.

It is also necessary to change the states for inverted outputs within all the “start” and “end” routines of the program. Depending on the program they may include “cwstart”, “cwend”, “pttstart”, “pttend”, “txstart”, or “txstend” routines. For any inverted channel, change “high” to “low” in the start routines of the program and “low” to “high” in the end routines of the program as shown in the following illustrations. The actual structure of the specific routine may differ from that in the illustration, depending on the program. Make changes only where “high” or “low” appear as indicated in red:

```
cwstart:

      setint %00000000, %00000100
      pause CW_START_DEL_1
      if bit0 = 1 then goto standby
      high 1
      pause CW_START_DEL_2
      if bit0 = 1 then goto cwend1
      high 2
      pause CW_START_DEL_3
      if bit0 = 1 then goto cwend2
      high 3
      pause CW_START_DEL_4
      if bit0 = 1 then goto cwend3
      high 4
      pause CW_START_DEL_5
      if bit0 = 1 then goto cwend4
      high 5
```

```
cwend5:
      pause CW_END_DEL_5
      low 5
      pause CW_END_DEL_4
cwend4:
      low 4
      pause CW_END_DEL_3
cwend3:
      low 3
      pause CW_END_DEL_2
cwend2:
      low 2
      pause CW_END_DEL_1
cwend1:
      low 1
      goto cwrestrt
```

Channels that have inverted outputs will have their green front panel indicators illuminated when in standby indicating that their outputs are closed and will turn off when opened during transmit.

Once the delays and any channel inversions are set, the sequencer is ready to program. To program the sequencer, click on the “Program” button under the “Home” tab of the PICAXE® editor. The editor program will indicate after a few seconds if the download was successful. If so, the USKI-5 sequencer is programmed and ready to use.

Many applications will use relatively short delays. When keying the sequencer, it may be difficult or impossible to see the delays on the green front panel indicator LEDs. It is therefore advisable to first set much longer delays (maybe hundreds of milliseconds) so that the relative sequencing and operation can be easily observed and verified with the indicators. This can be done with only the controlling input devices connected to the sequencer and without the outputs connected to the station equipment. Once the correct relative sequencing has been confirmed, the sequencer can be reprogrammed with the delays necessary for normal operation.

CONNECTIONS TO THE USKI-5 SEQUENCER

The outputs of the USKI-5 sequencer are non-polarized and completely isolated so each can be used without regard to ground or the polarity of the device being switched. Output connections are simply made via the screw clamp terminals of the one piece output connector plug to the appropriate channels as indicated on the sequencer’s rear panel.

Input connections are made through the standard 3.5 mm stereo jacks J1 and J2. Each jack has two inputs (Tip and Ring) which have designations such as J1T (Jack 1 Tip contact) or J2R (Jack 2 Ring contact) as referenced in previous station configuration illustrations. Inputs are controlled by external closure between the tip and sleeve or ring and sleeve contacts of the mating 3.5 mm plug shown in figure 6.

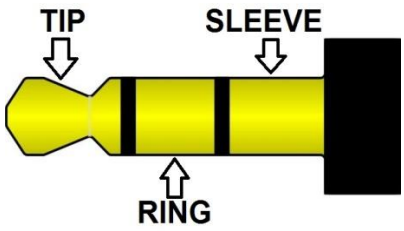


FIGURE 6

See PROGRAMMER’S NOTES section at the end of this document for details about the input connections and respective microcontroller pin connections and program designations.

WARRANTY

By installing and using the USKI-5 Universal Sequencer and Keying Interface, you agree to accept all responsibility for any resulting damage, injury, or related consequences. The only warranty provided is for refund of your purchase price or replacement of a defective unit during the first year after purchase. Output relays are not included in this warranty.

--ADDENDUM------------------------------------

SEQUENCER TIMING WORKSHEETS

Use the following worksheets as necessary. Fill in descriptions of the devices being controlled and the desired starting and ending delays. **Remember that for Programs (A), (B), or (C), the sequence will progress from left to right for the start delays and from the right to the left for the end delays.**

For the output connections shown in previous station block diagrams, the CW key input to the transmitter is device #5. Transmitter PTT (if controlled by the sequencer), will be connected to output #4. For any output channels that are not used, enter 0 ms for their delays.

SEQUENCE TYPE (CW, PTT, etc.):____

DEVICE					
OUTPUT #	1	2	3	4	5
START DELAY, ms					
END DELAY, ms					

SEQUENCE TYPE (CW, PTT, etc.):____

DEVICE					
OUTPUT #	1	2	3	4	5
START DELAY, ms					
END DELAY, ms					

SEQUENCE TYPE (CW, PTT, etc.):____

DEVICE					
OUTPUT #	1	2	3	4	5
START DELAY, ms					
END DELAY, ms					

TIMING EXAMPLES

Several examples of typical timing delays for USKI-5 Program (A), (B), and (C) are presented in this section. These are only examples and actual timing required may be different depending on the specific devices or station configuration.

USKI-5 Program (A)

For the station configured as in figure 2, the following timing delays may be a good starting point with Program (A):

SEQUENCE TYPE (CW, PTT, etc.):____CW & PTT___for Program (A)_____

DEVICE	TMA	XVTR	AMP	PTT INPUT TO TX	CW INPUT TO TX
OUTPUT #	1	2	3	4	5
START DELAY, ms	0	15	0	15 See note 1	15 See note 2
END DELAY, ms	0	0	5	0 See note 1	30 See note 2

Note 1: used only for PTT input and is skipped in the CW sequence
Note 2: used only for CW input and is skipped in the PTT sequence

Since the TMA must be protected from transmitter RF output, to be on the safe side, it is the first device switched off or out of circuit. In this example it is assumed that there are mechanical relays which do this switching and transition in 10 ms. In case the XVTR is capable of RF output by itself, its transition to a transmitting mode is delayed by 15 ms to ensure that the TMA is off line (if it is certain that the XVTR does not have output until driven on its transmitter input, start delay 2 could be set to zero). With no additional delay, the amplifier is then keyed. Assuming the amplifier requires 15 ms to be ready for transmission, that delay is applied to start delays 4 and 5. In order to make up for time lost during the start sequence, the sum of start delays for CW operation is applied to end delay 5. To be sure that the end of the CW symbol is not truncated and the transmitter has a 5 ms CW envelope decay time, this delay is applied to the amplifier end time.

USKI-5 Program (B)

Programming for USKI-5 Program (B) is similar to Program (A) except there is provision for two different sequences. Therefore two worksheets should be used, one for each mode.

SEQUENCE TYPE (CW, PTT, etc.):___CW_____

DEVICE					
OUTPUT #	1	2	3	4	5
START DELAY, ms				NA	
END DELAY, ms				NA	

SEQUENCE TYPE (CW, PTT, etc.):___PTT_____

DEVICE					
OUTPUT #	1	2	3	4	5
START DELAY, ms					NA
END DELAY, ms					NA

USKI-5 Program (C)

Program (C) is primarily intended for use with the CW mode, particularly QSK operation. Since transmitter PTT is not connected to the sequencer, this allows for up to five other external devices to be controlled. This example is for a station with separate transmitter, receiver, VFO, amplifier, and T/R switch.

SEQUENCE TYPE (CW, PTT, etc.):_____CW_____

DEVICE	T/R SWITCH	AMP	RX MUTE	VFO	CW INPUT TO TX
OUTPUT #	1	2	3	4	5
START DELAY, ms	0	0	0	10	5
END DELAY, ms	0	0	0	5	15

For this station configuration, there is no reason for delaying the start of the T/R switch, amplifier, or receiver muting at the beginning of a CW symbol, so their delay times are set to

zero. Assuming the T/R switch and amplifier relays require 15 ms to switch, that amount of time is accounted for in the sum of the VFO and transmitter start time. This allows the VFO time to start before the transmitter (modern DDS VFOs are generally so fast that no delay is necessary after starting before keying the transmitter). Again, as in previous examples, end delay 5 is equal to the sum of the start delays so that the CW weighting of the transmitted signal correct (intentional changes if weighting can be also be accomplished by proper choices of delays). End delay 4 is set to 5 ms to allow the transmitter time to complete each CW symbol envelope before turning off the VFO. If the VFO turns off its RF output quickly, the RX mute end delay can be set to zero. If not, and sometimes for cleaner sounding QSK operation, sometimes a few ms delay in the RX mute end delay may be necessary.

USING LONGER DELAYS

To minimize timing errors, the microcontroller is overclocked to the maximum frequency allowed (32 MHz) in programs (A), (B), and (C). For the programs as written, every delay or "pause" is limited to a maximum of 8191 ms. If longer delays are desired, up to 65535 ms, the microcontroller can be set to operate at its default frequency (4 MHz) by "commenting out" the command line that sets the clock frequency to 32 MHz. This is done by simply adding a semicolon in front of the line with the "setfreq m32" command. The START-DEL and END_DEL lines should also have the "8 *" removed as shown here:

```
symbol START_DEL_1 = 0
symbol START_DEL_2 = 0
symbol START_DEL_3 = 0
symbol START_DEL_4 = 0
symbol START_DEL_5 = 0

symbol END_DEL_5 = 0
symbol END_DEL_4 = 0
symbol END_DEL_3 = 0
symbol END_DEL_2 = 0
symbol END_DEL_1 = 0

setint %00000000,%00000001
pullup %0000011100000000
;setfreq M32
```

If even longer delays are required, refer to the PICAXE© programming manual.

PROGRAMMER'S NOTES

The following information is provided for anyone who wishes to write their own programs. Pin designations apply to the PICAXE® type 14M2 microcontroller which is used in the USKI-5.

INPUTS:

JACK CONNECTION	14M2 PIN NUMBER	PIN PROGRAM DESIGNATION
J1 TIP	6	C.1
J1 RING	7	C.0
J2 TIP	4	C.3
J2 RING	5	C.2

OUTPUTS:

OUTPUT NUMBER	14M2 PIN NUMBER	PIN PROGRAM DESIGNATION
1	12	B.1
2	11	B.2
3	10	B.3
4	9	B.4
5	8	B.5

USEFUL INFORMATION

Enhanced switching capabilities, over what is possible with the standard MOS relays, are available with various other devices which can be connected externally and controlled by the USKI-5's internal relays. One device is the infinion® BSP772T Smart High-Side Power Switch which provides features such as short circuit protection, capacitive and inductive load switching, etc. Further data is available in the associated data sheet:

Infineon-BSP772T-DS-v01_01-en.pdf