User Manual and Kit Construction Notes

for

GeekKlok

kit order number code : GKKK

Documentation release version 2.5

written by Raymond Weisling

30 April 2004

PT Zetalink Technology Indonesia
FAX (USA) + 1–708–575–6950

Kaliurang Pratama E3
http://www.zetalink.biz

Yogyakarta, Indonesia
sales@zetalink.biz

CHANGE HISTORY

Rev 0.92: preliminary work,
• font changes, 4 new fonts added, 4 old fonts removed;
• register LZ added;
• other corrections & additions.

Rev 1.0: first release,
• numerous changes.

Rev 1.1:
• p. 5 text repaired;
• p. 19 note added about autostep;
• parts lists: U1, missing 7805 added;
• parts lists: N71, missing 220 µf/16v added;
• parts lists: missing U93, LM393 added;
• C59 added to schematic;
• Errata on battery holder holes removed (obtained different parts that fit existing holes);
• change marking for U93 on parts locator drawings (was U97);
• additional small changes.

Rev 2.0:
• changed to new PCB, ZFLW2391 Rev A;
• many part numbers changed, due to U5 & U6 change;
• parts list changes;
• schematic changes;
• assembly parts locator changes;
• OPT button text added;
• other miscellaneous changes;
• firmware version 1-1 change notice added.

Rev 2.1:
• corrected minor errors in parts lists;
• added panel/mounting drawing of remote switch PCB;
• changed reference to alternate socket pins from Mill-Max.

Rev 2.2:
• added notes on first-time turn-on testing and verification of operation;
• firmware release version 1-2 change notice added.

Rev 2.3:
• changed page order, cleared up some text that was misleading;
• firmware release version 1-3 change notice added.

Rev 2.4: (not issued)

Rev 2.5:
• changed to new PCB, ZFLW2391 Rev B;
• PCB change required addition and removal of components;
• parts list updated;
• assembly parts locator drawings updated;
• schematic updated;
• removed errata for PCB (Rev A)
• improved documentation on serial input and output options
• Rev 2.5a: added errata on PCB defect, changing page 16 and adding page 16.1
• Rev 2.5b: added R81 and R82 to parts list (was on drawings, missing on parts list)

The GeekKlok

SCOPE

This manual is intended for the GeekKlok Kit, model GKKK.

HISTORY

The GeekKlok is an outgrowth of the Four Letter Word (FLW), also designed by Raymond Weisling and produced by Zetalink. While a word sculpture may be fun for some people, some others just don't "get it". Clocks, on the other hand, have a much more universal appeal. Inspired by the dynamic nature of the FLW in its hangman game modes, the GeekKlok is an attempt to make clock-watching much more fun. It may well bring out the Hidden Geek in all of us.

The GeekKlok is built on the same printed circuit board as the FLW, but there are numerous features that set it apart from the FLW. It has a clock and calendar chip with battery backup; this chip also has a nonvolatile memory for storage of user settings. It also supports the addition of a simple seconds display subassemblies for those wanting to have a full six-digit clock. It is also a foundation, complete in itself, but which can be built upon by the avid and capable experimenter.

OPERATION

When the unit is first turned on it will always display a greeting message: "GEEK KLOK BY RAYMOND WEISLING" followed by the internal program version number, and then the word OK. At this point it will begin displaying the time. The very first time it is turned on the time is not set, so basic settings will be required. See the section on SETTING TIME.

Once the time and other settings have been completed, the battery-operated RTC chip will keep this information. If, however, the battery is removed or becomes depleted, then the setting are lost and will have to be set again. There are default settings that are placed into the RTC backup memory if it is found to be empty.

There are three groups of user settings, operated by the three buttons, SET, ADV and OPT. The first is the TIME setting editor/browser, which only sets hours and minutes. When exiting this setting, the seconds are automatically cleared to zero.

Another user preference editor/browser is for a group of data registers. These registers contain information for the calendar, automatic daylight savings time (summer time) corrections, display blanking hours, font change timings, date display program selection, etc. For further information, refer to the section on REGISTER SETTINGS

The third user preference editor/browser is for selecting fonts. Fifty fonts are provided for variety and novelty use. One or more fonts may be selected to appear all of the time or to cycle with different durations. For further information, see the section on FONT SETTINGS.

SETTING TIME

Pressing the SET button one time will show the prompt **TIME** on the display. If the time setting is not locked by DIP switch 1, then pressing the ADV button once will enter the hours setting mode. The ADV button can be pressed once to advance the hours, or held down to automatically advance. If the OPT button is held down when ADV is pressed, the hours decrease.

Pressing the SET button a second time will enter the minutes setting mode. Just as with hours, ADV steps through the minutes, and the OPT button pressed when pressing ADV will reverse the direction. The OPT button always reverses the step-wise direction of the other buttons.

Pressing SET again moves back to hours. SET always alternates between minutes and hours. To exit the time setting mode, press SET and ADV together at the same time. This will return the clock to the normal time display, using the last time entered, and with seconds set to zero. In the editing modes, the display always uses the font called Normal (NOR).

REGISTER SETTINGS

A number of user preference registers is provided to allow you to customize your GeekKlok. Registers contain numerical values between two preset limits, appropriate to their individual function. The display shows a two-letter register name and one or two digits representing the current value. You can browse through the registers and change them at any time. However, DIP switch 2 is a lock that prevents access to the register browser/editor if it is set to ON.

To enter the register browser/editor, press SET once (to display the **TIME** prompt) and then a second time. The prompt will show **REGS** on the display. Pressing ADV will then enter the register editor. Note that some register values change under control of the clock after you set them. For example, the date, day of week, month and year will change to reflect the current calendar changes. Values that remain fixed to your setting are noted below as **FIXED**. Pressing SET advances to the next register. The OPT button will reverse its normal stepwise direction of either SET or ADV. Holding either button will auto-step in the direction presently set. When setting a register (or font), it is necessary to step to the next item with SET before pressing SET and ADV at the same time to exit the menu.

Note

Regardless of the setting for 12- or 24-hour display modes, all register settings that involve specifying hours use the 24-hour time convention. This is done to simplify the display, since no additional characters are available for a.m. or p.m. indications.

FP 1 – 99 (Font, Primary) This value determines the duration the primary font is used to show the time (hours and minutes). It represents tens of seconds, so a value of 6 means that the primary font will be used for sixty seconds. The minimum duration is 10 seconds and the maximum duration is 990 seconds. It is possible to have the primary font show at all times by setting the FS register to zero. Any one of the 50 fonts (or two animation pseudo-fonts) may be used as the primary font. These are set using the font group browser/editor. **FIXED**

FS 0 – 99 (Font, Secondary) This value determines the duration the secondary font is used to show the time. The unit is one second, so a value of 99 means that the secondary font is visible for 99 seconds maximum. Any one of the 50 fonts (or two animation pseudo-fonts) may be used as the secondary font. These are set using the font group browser/editor. **FIXED**

MA 1 – 30 (font Motion program A) This is a special register paired with the pseudo-font ANA. If ANA has an attribute of 1 or 2, then register MA is used to select one of a number of "canned" animation (motion) sequences involving two or more of the animation fonts. **FIXED**

MB 1 – 30 (font Motion program B) This is a special register paired with the pseudo-font ANB. If ANB has an attribute of 1 or 2, then register MB is used to select one of a number of "canned" animation sequences involving two or more of the animation fonts. **FIXED**

RA 1 – 10 (animation Rate, program A) This register is used to select one of ten speeds to play the animation sequence selected with register MA and pseudo-font ANA. The speeds are in approximately 20% steps. **FIXED**

RB 1 – 10 (animation Rate, program B) This register is used to select one of ten speeds to play the animation sequence selected with registers MB and pseudo-font ANB. The speeds are in approximately 20% steps. **FIXED**

OP 0 – 2 (OPT button use) This register selects which of four operational parameters are controlled by the OPT button. For values 1-3 this allows a more direct way to browse or experiment with settings compared to changing the registers or font by means of the menu structure. These are the values for this register and the usage assigned to the OPT button:

0 OPT button toggles blanking mode on and off (see BA and BZ registers or BA and BZ serial commands)
1 OPT button directly alters register RA or RB animation speed if animation active
2 OPT button directly alters register MA or MB animation sequence selector (1 to 30)
3 OPT button directly selects the primary or secondary font

Note that the changes affect the current display context. If, for example, the secondary font is being displayed, and OP = 3, then the secondary font will be changed. If the display time for secondary font expires and the display returns to primary font, then the OPT button will change the primary font. In other words, the OPT button affects the current context if applicable. Note that font changes are temporary, and will not be saved to the font menu or to nonvolatile RAM for use after power outages. **FIXED**

BA 0 – 23 (Blanking-blinking start) This register holds the hour when the display will be turned into the low-power tube-saving mode. When this mode is valid, the display will be blank except for two brief flashes once every ten seconds (this helps you to know that the clock has not lost power, and you can still wait for the time to appear, albeit briefly). **FIXED**

BZ 0 – 23 (Blanking-blinking end) This register holds the hour when the display will resume its normal visible operation. If blanking is not desired, set both BA and BZ to the same value, which reduces the duration of blanking to zero hours. **FIXED**

BF 0 – 2 (Blanking Format This register controls the display mode when blanking has been activated by the BA register setting or by the BA serial command. A value of zero sets the display to wink the time in two short flashes every ten seconds. A value of 1 makes the display totally off when blanked, and a value of 2 selects the dimming mode for blanking; the display will operate normally but appear very dim. The colon, if used, never follows the blanking modes. These modes are for conserving the lifetime of the nixie tubes, which regardless, is expected to be very long even if no blanking is selected. This is register only available in firmware Version 1–6 or later.

SU 0 – 2 (Seconds Underline) This register controls whether the underline segment in the nixie tubes will show a progress bar for seconds, or remain blank. If the value is zero, the underline seconds will not be used. A value of one allows stepping every 15 seconds (the first second is off, then one bar is added each 15 seconds). If the register has a value of two then the bar appears more linear, adding a segment every 12 seconds to form a 5-phase sequence (none, one, two, three and four bars). **FIXED**

DP 0 – 9 (Date Program) This setting determines if and how often the date will appear in place of the time on the display. The display of the date can also be invoked by commands sent to the GeekKlok over its serial input channel; see the section on SERIAL INTERFACE for more information. **FIXED**

0 no date time display used (default)
1 on for 1 second every 20 seconds
2 on for 2 seconds every 20 seconds
3 on for 1 second every 14 seconds
4 on for 2 seconds every 14 seconds
5 on for 1 second every 9 seconds
6 on for 2 seconds every 9 seconds
7 on for 1 second every 6 seconds
8 on for 2 seconds every 6 seconds
9 on for 3 seconds every 6 seconds (these intervals, 6, 9, 14, and 20, are in 49% steps)

DC 0 – 4 (Date Characteristic) Selects among several alternate display characteristics to help identify the presence of the date display as opposed to the normal time display. Note that the font selected with an attribute of 3 can also be used to differentiate the date display, and it is added to the identifier selection in this register; if no font is selected for date, the current primary font is used. Animated fonts ANA and ANB are not available for the date display. **FIXED**

The characteristic display options are:

0 no display modifications (default)
1 winking four times per second
2 spastic display
3 winking and spastic modes combined

DF 0 – 1 (Date Format) A value of zero selects the format MMDD and a value of 1 selects DDMM. **FIXED**

ZH 0 – 23 (alternate time display, Hours) The Z is taken from "Zulu" time, which is an historic abbreviation for what is now UTC (or GMT). However, this feature is not only limited to UTC. Any alternate time zone may be used including those offset by 15, 30 or 45 minutes (the offset can be in any integer minutes in case you want to track the sun time, based on "high noon"). There is no calendar association, so the offset is always positive, with 18 being the setting to achieve –6 hours, for example. Also, it remains fixed through daylight savings time changes (i.e., it does not follow the change); no separate rules are provided for such a change; if the alternate time zone uses daylight savings time, it will have to be manually changed. **FIXED**

ZM 0 – 59 (alternate time display, Minutes) This sets the minutes offset from the main time display. As noted above, the offset is always positive, so if the difference is negative, you must subtract it from 24 to get the value for registers ZH and ZM. For example, if you lived in Darwin, NT, Australia, which is UTC+9:30 and you wanted to have the alternate time display for Nepal (UTC+5:45) the difference is local time –3:45. To achieve this unusual offset ZH is set to 20 and ZM is set to 15. **FIXED**

ZP 0 – 9 (alternate time display Program number) This selects one of nine preset programs for the alternate time display. If set to zero there will be no alternate time display and all other Z-registers will be ignored. The display of alternate time can also be invoked by commands sent to the GeekKlok over its serial input channel; see the section on SERIAL INTERFACE for more information. **FIXED**

The preset program numbers and their timings are:

0 no alternate time display used (default)
1 on for 1 second every 20 seconds
2 on for 2 seconds every 20 seconds
3 on for 1 second every 14 seconds
4 on for 2 seconds every 14 seconds
5 on for 1 second every 9 seconds
6 on for 2 seconds every 9 seconds
7 on for 1 second every 6 seconds
8 on for 2 seconds every 6 seconds
9 on for 3 seconds every 6 seconds (these intervals, 6, 9, 14, and 20, are in 49% steps)

ZC 0 – 4 (alternate time Characteristic) This register selects among several alternate time display characteristics to help identify the presence of the alternate time zone display as opposed to the normal

time display. Note that the font selected with an attribute of 4 can also be used to differentiate the alternate time display, and this selection is in addition to the identifier selection in this register; if no font is selected for the alternate time display, the current primary font is used. Animated fonts ANA and ANB are not available for the alternate time display. **FIXED**

The characteristic display options are:

0 no display modifications (default)
1 winking four times per second
2 spastic display
3 winking and spastic modes combined.

FR 1 – 4 (line/mains FRequency selector) This register unequivocally sets the clock to match the power line (mains) frequency in use. The initial default value is zero, which selects 30 Hz. (This means the first time the clock is run, if register FR is not set, the time will run very fast, which is an alert that this register must be set.) The four possible values that can be stored into FR are:

1 50 Hz power from use of an AC "wall wart" power supply.
2 60 Hz power from use of an AC "wall wart" power supply.
3 100 Hz for use with a DC "wall wart" power supply run on 50 Hz mains.
4 120 Hz for use with a DC "wall wart" power supply run on 60 Hz mains.

Note that the last two selections require altered component loading. See the special notes on the DC power supply option elsewhere in the kit construction section.

CU 0 – 2 (Clock Update mode) This determines the fundamental operating mode of the GeekKlok with respect to how and where accurate time is counted, maintained and updated. If this register is set to zero, the RTC chip is assigned the role of being the master timekeeper. This would be done if the 50/60 Hz power line is unreliable for timekeeping, such as when running from a generator or in a location where the power line frequency is unstable. The GeekKlok follows the accuracy of the crystal oscillator (Y94). If this register is set to 1, the normal default value, then the 50/60 Hz power line is the standard for timekeeping, and the RTC is updated from the power line time counters once each 24 hours (at 03:30). If the CU register is set to 2 the source of timekeeping is external, as supplied by a 1 Hz pulse (from a GPS module, for example) connected to the IRQ line. The RTC is updated once each day, also at 03:30. Use of this external reference requires adding wiring and making additional PCB modifications. **FIXED**

LZ 0 – 2 (Leading Zero) This register controls whether the leading zero (tens hours) is blanked or shows when the digit is zero. If the value is zero, the leading zero is always blanked. If the value is 1 then it is blanked for static fonts, but is not blanked for animated fonts. If the value is 2 then the leading zero is always shown (unblanked). This is only active in 12-hour display mode. In 24-hour display mode the leading zero is always shown. Many animation sequences are most interesting if all four characters are used in the animation.

The next ten registers control the automatic, rule-based daylight savings time (summer time) correction system.

AD 1 – 7 (Autumnal Day) This register holds the day of the week for the autumnal revocation of daylight savings time. The day convention must agree with register DW, and each day begins at midnight. **FIXED**

AM 1 – 12 (Autumnal Month) This register sets the month when the change back to standard time occurs. **FIXED**

AW 1 – 5 (Autumnal Week) This register determines the week, within the month specified in register AM, when the change to standard time occurs. If the value is 1 and register AD indicates Sunday, then the change will occur on the first Sunday of the month specified by register AM and at the hour specified by register AH. The value of 4 indicates the fourth week and a value of five represents the last week in the month when AD occurs, which can be the fourth or fifth week, depending on the date and year. Continuing the example from above, a value of 2 for AW means the second Sunday of the month, 3 is for the third Sunday of the month, 4 is for the fourth Sunday of the month and 5 is for the last Sunday of the month. **FIXED**

AH 0 – 23 (Autumnal Hour) This register sets the hour when the change to standard time occurs. If this register is set to 2, then at 02:00 on the day, week and month specified by AD, AW and AM the time will change to 01:00. One hour later it will not change again, since register ST is the determining condition as to whether daylight savings time is in effect or not. Register ST is changed by the clock when the automatic adjustment occurs. **FIXED**

VD 1 – 7 (Vernal Week) See discussion for AD above. **FIXED**
VM 1 – 12 (Vernal Month) See discussion for AM above. **FIXED**
VW 1 – 5 (Vernal Week) See discussion for AW above. **FIXED**
VH 0 - 23 (Vernal Hour) See discussion for AH above. If this register is set to 2, then at 02:00 on the day, week and month specified by AD, AW and AM the time will change to 03:00. **FIXED**

SV 0 – 1 (Savings time Valid) This register determines if daylight savings time (summer time) is valid for your location. A value of zero means that none of the registers for auto adjustment described above will be acted upon to attempt automatic correction, regardless of their contents. If daylight savings time is legally mandated in your area, set this register to a value of 1. **FIXED**

ST 0 – 1 (Savings Time) This register must be set to properly indicate whether the present time and date being set is standard time or daylight savings (summer) time. This register is changed by the clock

when automatic correction takes place. If the value is not correct, the automatic correction will be skipped the first time the correct day, month and hour arrives, but will be correct every time thereafter. A value of zero indicates winter time and a value of one indicates summer time (daylight savings time). **VARIES**

YY 0 – 99 (current Year) This register is for the current year (last two digits). **VARIES**

MM 1 – 12 (current Month) This register is for the current month. **VARIES**

DD 1 – 31 (current Date) This register sets the date of the month. The browser/editor does not check the month to select the maximum value. If you set the date to 31 for a month with 30 or fewer days, it will revert to the last valid day of the month. **VARIES**

DW 1 – 7 (current Day of Week) This register sets the day of the week. You can use 1 for Sunday and 7 for Saturday, which we suggest, but any other day-one can be used. The convention used must be uniform for the automatic daylight savings time (summer time) correction registers (AD and VD). **VARIES**

FONT SETTINGS

Fifty different fonts are available for selection, to be displayed as a primary or secondary font for time, and to help differentiate the display of date and month and an optional alternate time zone, if desired.

To enter the font setting editor, press SET once (to display the **TIME** prompt), a second time to display **REGS** and then a third time. The prompt will show **FONT** on the display. Pressing ADV will then enter the font setting editor.

The font editor starts at the beginning of the list of 50 fonts (see Font Catalog). The SET button advances from font to font in the order shown in the FONT CATALOG. Holding the OPT button down reverses the direction of stepping with the SET button, allowing you to move forward and backwards through the list.

The ADV button will advance the font use number, or attribute, cycling to 1, 2, 3 or 4, then back to 1. Only one font can have each of these attributes. For example, if you set NOR to 1 and then set MIA to 1, NOR will automatically return to zero.

Attribute 0. The font is not used. Fonts with an attribute of zero can be changed to 1–4, but not back to zero.
Attribute 1. The font is the primary font and will display for a duration specified by the **FP** register.
Attribute 2. The font is the secondary font and will display for a duration specified by the **FS** register.
Attribute 3. The font is used for displaying the date and month. Refer to the description of registers **DP** and **DF**.
Attribute 4. The font is used for displaying the alternate "Zulu" time zone data. See registers **ZP**, **ZC**, etc. This font is also used in display the time when blanking of the display is active (see register BA, BZ, OP and serial commands BA and BZ).

Fonts can be activated to have an attribute of 1 through 4, but can not be deactivated except through activation of a different font for the same usage.

At the end of the list of 50 fonts there are two additional "pseudo-fonts" shown in the editor/browser. These are named ANA and ANB, and are paired with user registers MA and MB, respectively. ANA or ANB can only be assigned to primary and secondary time displays; due to the brevity of the date and alternate "zulu" time displays, ANA and ANB can not be assigned an attribute of 3 or 4. The actual animation sequence that will play is then set by register MA and MB. It is with the actual font sequence number in MA or MB that the true fonts are called for use. The user has no ability to program his/her own variations of animation sequences; the "canned" sets already have quite a number of variations. The fonts that are used in the animation sequences include the four windblown "Burn" fonts (BNW, BNE, BSE, BSW), by Peter Csaszar, the pair of Dancer fonts (DNL and DNR), plus Normal, Missing in Action, Atrophy, Moocher, Visitor, Intruder, Warped, Motley Inverted, Reversed. These are arranged in 30 different sequences that are visually interesting.

For more immediate access to ANA and ANB, double-clicking the SET button will allow it to step in reverse order and will cycle from NOR (the first font) to ANB (the last font). As with other setting modes, double clicking the buttons changes the direction that they step.

See the Font Catalog section for a graphical description of all fifty fonts.

During display of primary or secondary fonts, the OPT button can be used to browse forward through all of the fonts, if register OP has been set to a value of 3. This makes it easier to browse the font list without having to refer to the fonts by abbreviated name and/or having the FONT CATALOG handy for reference. The OPT button browse includes animation fonts ANA and ANB.

DIP SWITCH SETTINGS

A four-position DIP switch is provided for setting different operational modes or user preferences. The switch is read at power-on and at the start of each new minute.

DIP switch position 1 = ON When set to ON this locks out the TIME editor/browser. The buttons will not allow entry to the time setting mode.

DIP switch position 2 = ON When set to ON this locks out the register editor/browser. The buttons will not allow entry to the register setting mode. These two locks help prevent inadvertent corruption of data by curious children and adults. This may be taken into consideration when designing a case so that the DIP switch is somewhat difficult to access.

DIP switch position 3 = ON When set to ON this switch bypasses the special date and alternate time zone displays, regardless of the setting in the user registers for these features. This is a convenient way to force the clock to only display time, or use the more elaborate special display features.

DIP switch position 4 = ON When set to ON this switch forces the GeekKlok to only use the secondary font as selected in the font editor/browser. When set to OFF the primary font is used and, optionally, the secondary font can appear if programmed with a nonzero time in register FS. By setting FS to zero, this switch effectively selects between primary and secondary fonts on a continual basis.

CLOCK ACCURACY

In most locations the timebase derived from the mains power line, 50 or 60 Hz, is very accurate over a long-term basis. The accuracy may drift during portions of any 24-hour period. For example, the frequency may be lower during the peak load hours, and then speed up to compensate during the low-load early morning hours. While the GeekKlok has an internal Real-Time Clock (RTC) chip that runs from a battery, it is typically not anywhere as accurate, over a long period, as the time from the 50/60 Hz line frequency. For this reason the RTC chip is updated periodically with the correct time as counted from the 50/60 Hz power line. See the description of the register CU setting.

If the power fails, the time based on the power line is lost. When power is restored again, the internal time is taken from the RTC. This is why the RTC is updated daily, since if it were not updated its time would drift. From investigations of power line accuracy in North America and Europe, accuracy over a 24-hour period is excellent, and updating the RTC every 24 hours will result in very accurate backup time data in the event of a power failure and restart cycle.

The first sixteen fonts, shown on this page, are available in both static forms and included in preset animation sets, which will be described at the end of the font catalog section. Each font name is shown with its three-character abbreviation that is used in the font editor/browser.

The first group starts with the "native" number set, **Normal**, followed by variations on this which subtract or add segments.

Missing in Action and **Atrophy** have segments removed. **Visitor**, **Moocher** and **Intruders** have added segments (adding one, one and two segments, respectively).

Normal Numerals NOR

Missing in Action MIA

Atrophy ATR

Visitor VIS

Moocher MOO

Intruders INT

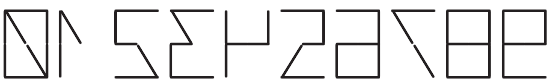
The next set use mirror reflection, or involve changes in shape from the normal font, usually with one to three segments affecting the shape change. These four fonts, and the above six, occur mixed in different animation sequences to achieve different effects.

Warped WAR

Motley MOT

Inverted INV

Reversed REV



The following four fonts were designed as a unified animation group. They appear in different animation sequences, but never mixed with the first ten in the left column. They can, of course, be selected to be static fonts as well.

These are clever designs by Peter Csaszar, specifically for the GeekKlok. The BURN designation applies to the corner that is "burned out" and where no segments can illuminate. They can also be called "Windblown" characters because they are tilted as if blown by a gale. Peter's fonts inspired the development of the animated feature that is unique to GeekKlok.

BurnNE BNE

BurnNW BNW

BurnSW BSW

BurnSE BSE

Dancer uses a kind of semaphoric scheme (inspired by, though not based on, real semaphore signalling codes). The upper arms form the coded part, while the lower "legs" are animated to make it appear to be a (well, headless) stick figure dancing.

Dancer Left DNL

Dancer Right DNR

The following 34 fonts are only available as static display fonts, though with primary and secondary font selection and use of the serial port Jump-to commands, they may to a limited degree be animated. **Normal**, shown above, is the design used in our Four Letter Word sculpture. It is slightly different from the original Burroughs character set for the B-7971 Nixie Tube, which is repeated here as "**Burros**". A standard seven-segment font, stark and ugly compared to those that use the diagonal segments, is also included. The font **Digits** starts to deviate from the classical numerals. More deviants are shown further below.

Burros BUR

Seven-Segment SEV

Digits DIG

The **Rotated** font uses basic numeral shapes that have been rotated anti-clockwise 90°, adjusted to fit the segment lengths. **Twister** combines rotation with reflection.

Rotated *ROT*

Twister *TWI*

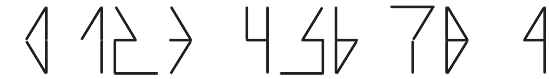
This group of characters is distorted by skewing, leaning or otherwise altering the shape of the basic numerals. They can still be read without "special training"

Deco *DEC*

Miring *MIR*

Skewed Up *SKE*

Tall & Thin *TAL*



Distortion and reshaping continues. Here we have a set of tiny characters, either in normal orientation or rotated by 90°. **Hi-Lo** is a combination of **Low-Boy** and **Hi-Girl**. The clock could be set on end to read the rotated ones, but then they couldn't be mixed with others.

Rotated CW *RCW*

Tiny Rotated *TRO*

Low-Boy *LOB*

Hi-Girl *HIG*

Hi-Lo *HIL*

Pythagoras is based on two or three triangles, attempting to use shapes that mostly are recognisable as normal numerals or their basic outline shape (except 3). **Doodles** starts to show significant deviation from normal numerals, but still retains some basic shapes for the majority of digits.

Pythagoras *PYT*

Doodles *DOO*

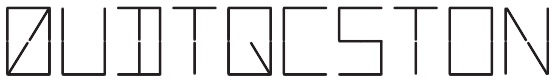
Language-Based Characters

Turning now to words for numbers, and letters from those words, these characters provide hints for the numerals that they represent. **ASCII** is actually based on English, taking the first or other prominent letter as a substitute for the number (**Z**ero, **O**ne, **T**wo, t**H**ree, **F**our, fi**V**e, si**X**, **S**even, **E**ight, **N**ine). The same scheme is approximately true for **Deutsch** and **España**, though not totally accurate. The other letter-hinting fonts are based on English but use other parts of the words to provide hints for the number.

ASCII *ASC*

Deutsch *DEU*

España *ESP*



Suggestion *SUG*

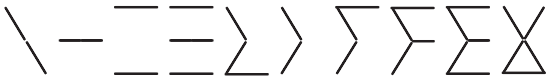
Hints *HIN*

Alternate Script Systems

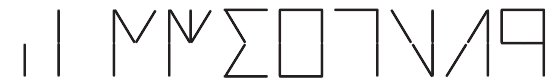
In this set we have two version of Roman numerals (standing and lying down), plus true **Arabic** numerals (as used in modern Arabic writing), and a set suggesting Chinese or Japanese written numerals (close, no cigar?). The **Klingon** set is an approximation of the canonical Klingon language taken from Star Trek.

Roman *ROM*

Nero *NER*



Arabic *ARA*



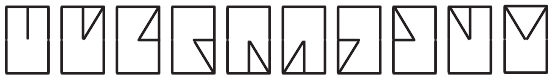
Tokyo TOK

Klingon KLI

Morsee (Morse-See) is a visual representation of Morse Code, read from left to right and top to bottom, with vertical lines for dits and horizontal lines for dahs. **Watchout** suggests the hands on a watch, but what is important is the position of the triangle. **Wedges** uses a similar process of clockwise triangle development for digits. **Fingers** represents one to five fingers, then for six to nine the left hand is brought in, palm down, to represent five, with the fingers counting again. **Starburst** adds segments to build only radial lines from the centre. **Binary** uses the four quadrants of the display to represent binary 8-4-2-1 weighting, moving in an anti-clockwise manner, the way that the quadrants are numbered in a two-dimensional Cartesian plane. With **Pie** the triangular portions removed are similar to the triangles in Wedges, but the order is reversed. And finally **Skarnox** is an invented alien font that uses its own "logical" system to represent the numbers. Most of these fonts are "private" fonts that the GeekKlok owner will have to memorize as a challenge, primarily to impress skeptical friends.

Morsee MOR

Watchout WAT



Wedges WED

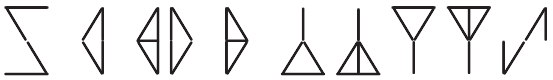
Fingers FIN

Starburst STA

Binary BIN

Pie PIE

Skarnox SKA



Selecting Animations

At the end of the font list in the editor/browser there are two pseudo-fonts named **ANA** and **ANB**. These are selected for display just like any other font, but they actually represent a collection of fonts in a preset timed sequence that will play when the pseudo-font is enabled for appearance. These fonts can only be set to primary or secondary (1 and 2), and are unavailable for date and zulu time display modes.

Animation Font A *ANA*

Animation Font B *ANB*

The font editor/browser setting is for primary or secondary. ANA can be secondary and ANB can be primary; the A and B designation is just to identify them as separate entities.

In order to actually select which fonts are used in the animation, registers have been paired with ANA and ANB for selection of the animation program or sequence, and additional registers have been paired for selecting the speed.

Consequently the pseudo-fonts are paired with these registers:

font	program	speed
ANA	***MA***	***RA***
ANB	***MB***	***RB***

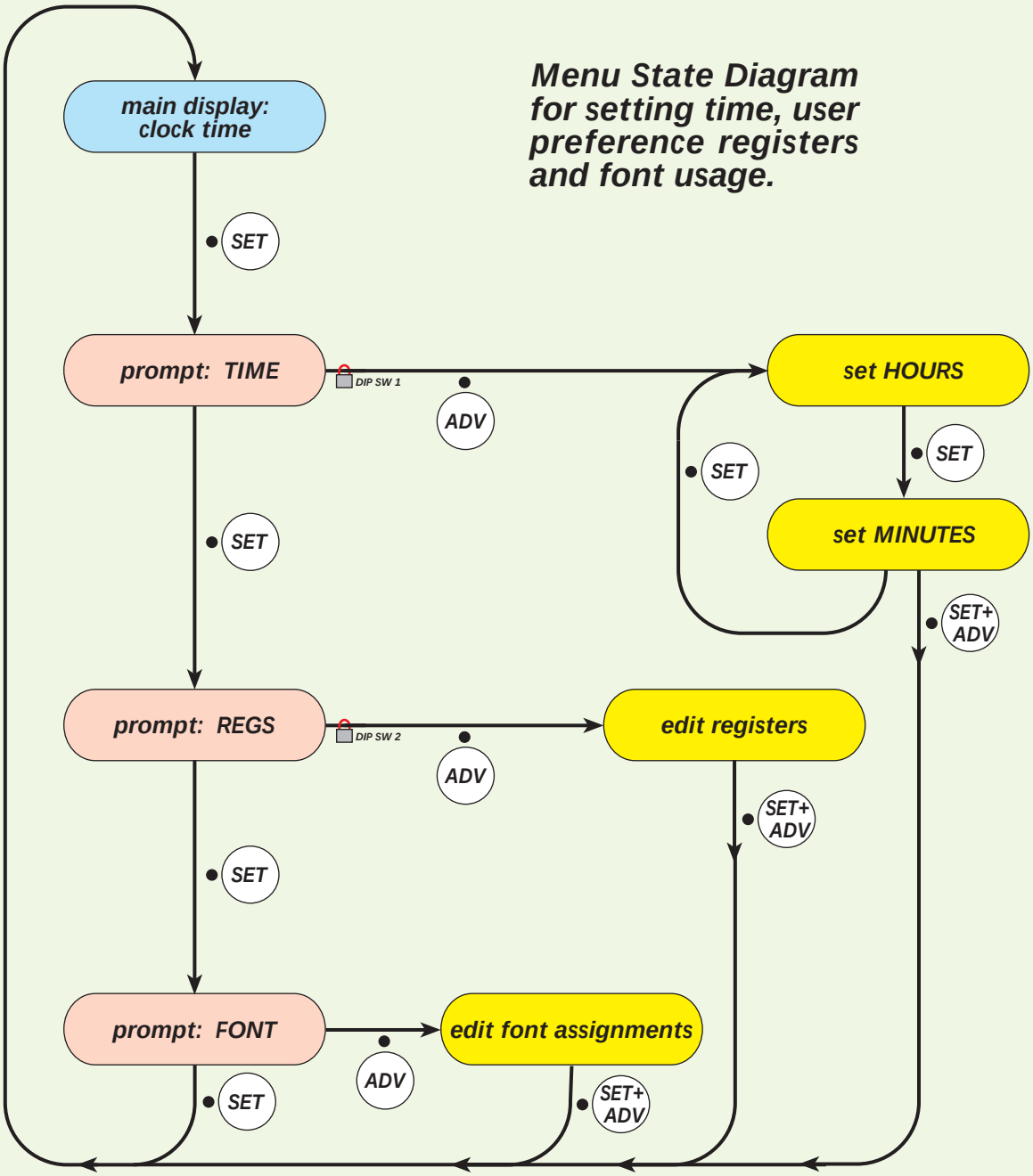
The list below describes the animation programs available. The number is the value stored into the **MA** or **MB** register. The speed or rate is stored in the **RA** or **RB** register. L-R means left to right, L-R-L-R means movement in both directions, left to right and then reversing, right to left.

1 Four-step rotary motion of all four windblown (burn) fonts.
2 BNE & BNW flip-flop of all four characters.
3 BSE & BSW flip-flop of all four characters.
4 BNE & BNW opposing motion in hours and minutes.
5 BSE & BSW opposing motion in hours and minutes.
6 BNE & BNW flip-flop alternating hours and minutes.
7 BSE & BSW flip-flop alternating hours and minutes.
8 Left-to-right ripple rotation of all four windblown (burn) fonts.
9 BSW & BNE left-right-left-right (L-R-L-R) ripple.
10 BNE & BNW in L-R-L-R ripple with pause at each end.
11 BSE & BSW in L-R-L-R ripple with pause at each end.
12 BSE & BSW in slow L-R-L-R ripple, fast return at ends.
13 BNE & BNW in slow L-R-L-R ripple, fast return at ends.
14 BNE & BSE in slow L-R-L-R ripple, fast return at ends.
15 BNE & BNW in L-R ripple-kick motion.
16 BSE & BSW in R-L ripple-kick motion.
17 All four windblown fonts in L-R and R-L ripple-kick motion.
18 All four windblown fonts in L-R-L-R ripple, random durations.
19 NOR, MIA and ATR fonts in L-R-L-R ripple, long NOR periods.
20 NOR, MOT and VIS fonts in L-R-L-R ripple, long NOR periods.
21 NOR, MIA, ATR, VIS, MOO, MAR, MOT randomly appearing.
22 NOR, WAR and MOT randomly timed, HH & MM pair changes.
23 NOR, INV and REV in L-R-L-R ripple.
24 NOR (long), occasionally all change to MIA, ATR, WAR and MOT.
25 MIA, ATR, VIS, WAR, MOT but no NOR, random, with spastic effect added. (This is the "major defect simulation" mode.)

Note: Firmware version 1-5 and earlier had 30 animation sequences. Beginning with Ver 1-6 the number was reduced to make room for the dim blanking option. Old sequences number 19, 20, 21, 22 and 29 were removed.

Internal operation of the font sequences (under the hood)

Animation sequences are based on internal database tables each containing a sequence of bytes, either directly controlling the font and position, or modifying the step that it precedes. Each step can set one or more characters to any of the sixteen animation fonts, lasting for the duration specified in the rate register (RA or RB). However, this duration can be lengthened by two, four or eight times, or made random, by preceding the step with one of four duration modifiers. Another step modifier can cause the next two steps to execute at the same time. Yet another step modifier can randomly modify the next step's font (e.g., if MOO is specified, the actual font displayed will randomly be either MOO or INT, the next one in the font list). Finally, the spastic effect can be applied to the next step. Modifiers can usually be combined, e.g., set a random duration followed by duration multiplied by eight.



Key to Symbols:

= Editing of numeric values with ADV button: 1x click forward, reverse if OPT button held down. OPT + SET button reverses order of register or font access. Hold button down for autostep.

SET = 1x click of SET button chooses this path.

ADV = 1x click of ADV button chooses this path.

SET+ ADV = 1x click of SET and ADV at same time button chooses this exit path.

= path locked out if specified DIP switch set to ON.

SERIAL INTERFACE

The standard GeekKlok kit does not include components for the serial interface, but they may easily be added by an experienced builder. With the serial option added, remote control of the GeekKlok is possible by sending commands to it on ther serial input channel. The serial output channel also has information that is sent once each minute which can be used for accessory modules. Zetalink provides such a module that adds several useful functions to the clock.

For the serial input, a simple protocol is used to allow the user to control certain aspects of the display system. There is no provision to display messages or user-transmitted text via this port.

The commands consist of two to four ASCII characters followed by a carriage return. No line-feed character is required (and its use should be avoided). The format is 2400 baud, 8 bit length, no parity, one stop bit (8N1). This can not be changed. The ASCII NUL character (0) can be sent as a padded character if necessary and is simply ignored.

These are the commands supported (the quote marks are not transmitted):

"BA" Immediately blank the display, the same way that register BA controls blanking at a preset time. If this command has been received and the time set in register BZ occurs, the display will remain blanked. Thus command BA overrides register BZ. An external PIR or similar sensor may be used to sense the presence of people in the room, and when the room is empty, to blank the display. (Note that blanking still flashes the display two brief times every ten seconds, to indicate that the clock is not dead and to still show the time fleetingly.)

"BZ" Immediately return the blanked display to normal operation, similar to the BZ register function. If this has been received, and the time set in register BA occurs, the display will blank as one would expect. Thus register BA overrides command BZ.

"DD" Display the date, using the register DC setting for display characteristic and font selected for date. This overrides any date display interval program that has been set up in the DP register.

"DZ" Display the alternate "Zulu" time zone, using the register ZC characteristic and font selected for Zulu time display. This overrides any Zulu-time display interval program that has been set up in the ZP register.

"DT" Return to time display, used after "DD" or "DZ" have been sent.

"JP" Jump to Primary font. This forces a jump to the beginning of the timed Primary font cycle, as set by register FP.

"JS" Jump to Secondary font. This forces a jump to the beginning of the timed Secondary font cycle, as set by register FS.

"Pxxx" Set font xxx to Primary Display Font. This is the equivalent of entering the font browser/editor to change the font's attribute to a 1. This font will now be used as the primary display font, according to register FP and FS display periods (or course, FS may be set to be zero).

"Sxxx" Set font xxx to Secondary Display Font. This is the equivalent of entering the font browser/editor to change the font's attribute to a 2. This font will now be used as the secondary display font, according to register FP and FS display periods. If register FS is set to zero, the change is made but the font will not appear until register FS is changed to a nonzero value.

"MAnn" Set register MA to the value specified by two digits nn. The number represented by nn must be a valid number between 01 and the maximum number of animation sequences supported. Leading zero must be supplied for numbers from 01 to 09.

"MBnn" Set register MB to the value specified by two digits nn. See description of "MAnn" above.

"TShhmmss" Time setting. Six ASCII numbers are sent after the TS, which contain hours, minutes and seconds. The hours must be in 24-hour format, regardless of the display setting from jumper WM. The calendar must be set manually. This provides a way to frequently set the clock from an external source of accurate time, such as a GPS receiver. The data format from a GPS receiver has to be translated to the GeekKlok's protocol.

When commands are sent to the GeekKlok, no response is echoed on the serial output channel. The serial output has a totally different function. It supplies time-coded data that can be used to support remote seconds displays, produce periodic chiming signals and trigger alarms. The protocol is extremely simple. Once every minute five characters are transmitted at 2400 bps. No carriage return is sent. The first byte is ASCII "A" to "G" representing

the day of the week (Sunday to Saturday). When the day of week is an upper case character, the GeekKlok is not blanked, but when the display has been blanked the day of week changes to lower case. This allows an accessory display of seconds to also blank its display when the main display is blanked (by the BA register, BA command or OPT button). The next four characters are ASCII numbers, two for the hour (in 24-hour format) and two for the minute. These canbe used to trigger periodic chimes and alecial alarms.

The serial output is available for use without the RS-232 option (U95) installed, from optional connector J91. If U95 is installed the serial input on J91 (only available on Revision B PCBs and later) is still usable as a wired-OR input. Since an external RS-232 device would normally not send commands very often, an accessory module connected to J91 can also send serial commands with a CMOS/TTL level. One use for such a command input might be from a Passive Infrared (PIR) sensor that can blank the GeekKlok if no motion in the room has been detected.

CIRCUIT DESCRIPTION

The heart of this device is the microcontroller, a Motorola MC68HC705C8A device that has 7684 bytes of program storage and 176 bytes of RAM. The program is stored in one-time programmable memory and is protected from copying or downloading. If you attempt to read the contents of the chip you will fail and might damage the part. The program is copyright by the author and represents an investment of considerable effort, both in recreational linguistic research and assembly language programming.

This clock uses multiplexing to display characters on the nixie tubes. Only one tube at a time is turned on, but the rotation or sequencing occurs so quickly that you see a steady display of four characters. Multiplexing requires 15 driver transistors to turn on each segment (cathode), and four transistors to connect each tube's anode to the high-voltage power in sequence. Cathodes and anodes that are turned off are brought to the potential of about 85 volts through "pull-middle" resistors. This is done to eliminate ghosting effects, where a tube may show a different character or part of a character dimly besides the bright segments that show the desired character. The resistors discharge residual charges of the parasitic capacitance formed by the tube's internal form and the tracks on the PCB. Evidence suggests that these resistors also help reduce acoustical noise or "singing" that can occur in multiplexed nixie tube displays.

The time counting is based on the 50 or 60 Hz power line (unless disabled). The AC is filtered and sent to U93 and associated components. This is a 50 or 60 Hz oscillator that is phase-locked to the mains power supply. If for any reason the AC drops out for a brief moment (not long enough to shut down or reset the microcontroller), the oscillator will free run at the line frequency, thus continuing supply timing pulses. The AC might drop out when a heavy motor (like an air conditioner) starts up or when a distant lightning strike disturbs the power line voltage for a period ranging from one tenth of a second to over one second. Without the "flywheel" effect of this oscillator, each such brief dropout would cause loss of pulses and consequently a general slowdown of the clock. This circuit also eliminates severe noise pulses from disturbing the timing. The output of U93 is sent to the timer capture input of the microcontroller.

The AC power is rectified and supplied to a linear regulator (U1) to generate 5 volts for the logic. The unregulated power is used by the switchmode power supply, employing a MAX771 IC operating at about 300 kHz to boost the 12 volts (approximately) to about +170 volts to power the nixies.

Another very important IC is the RTC (Real Time Clock), U94, which operates from a battery when power is removed from the GeekKlok. Under battery operation a 32768 Hz oscillator operates to keep time and date (calendar). When the GeekKlok is powered up the date and time, plus all of the user settings in registers and fonts, is recovered from U94. This IC is not generally used for keeping time information because the accuracy of the 32768 Hz crystal is several orders of magnitude worse than the average of the AC power line, provided you are operating the unit in a country where such power is kept accurate and stable by the power generating authority. See the section on CLOCK ACCURACY for more information.

CONSTRUCTION NOTES

PRINTED CIRCUIT BOARD

The PCB is a double-sided board made with flame-retardant FR4 material. The copper circuit paths are solder plated and covered by a solder mask to help make soldering easier. Holes (except the largest ones) are all plated-through. To reduce radiated noise, improve reliability and lessen susceptibility to external noise, the surface is mostly covered with a copper ground plane in between tracks and component pads or lands.

BOARD MOUNTING

Ample mounting holes have been provided at the front corners and along the rear, plus holes are provided in between each Nixie socket. The intent is to use threaded standoffs in each hole to ensure stability and prevent drooping of the board, and prevent possible board damage if tubes are inserted or removed through excessive rocking. Use any or all holes at your preference. You may mount the sockets on either side of the board. See the section on reverse (solder side) mounting of the sockets.

NIXIE TUBE SOCKET OPTIONS

The PCB has three holes for each tube pin. If you have original (vintage) sockets, the socket terminals must have the very tip cut off, leaving a two-prong fork-like shape. This also makes it easier to remove any old wires from the original Ultronics equipment from which the sockets were removed. Straighten the pins as best you can. These go into the outer pair of holes. Getting 17 pairs of pins into the holes may be a little difficult, but this was the only way to allow use of this socket or the use of other pins if sockets are unavailable. The pins need to be bent outward slightly to align with the holes. You may cut off one of the two prongs leaving just half of the fork, or make one a bit shorter; that will make it much easier to insert the pins. The Sylvania sockets, which have a large centre hole, have slightly larger and thicker pins than the Cinch sockets. The Cinch ones are marked with the name CINCH U.S.A. and also have a second set of 12 pin holes inside of the outer ring.

If you have no sockets, the larger holes for each pin are meant to receive pins made by Tyco/AMP or Mill-MAX and available from Mouser, Digi-Key or Jan Wuesten (in Germany). These pins mount in the innermost holes, which are positioned exactly the same as the pins on the tubes. The tubes can not be directly soldered since the kovar material is not easily wetted with solder, and the heat could stress and crack the glass. The large centre hole in the PCB is intended to allow the tube's vacuum tip-off seal to protrude below the surface. There may be a rare tube with the seal larger or offset from the centre, which would require a small amount of filing (of the PCB, not the tube). Also note that socket pins used in place of a socket could have the pins improperly aligned with the tube's pins, inducing stress on the glass base, and leading to cracking and permanent damage to the tube. Be sure that all such pins are inserted properly and soldered in place while straight and uniform. Any other type socket pins that are not on our recommended list might not fit the holes snugly and should be soldered while attached to a tube with the pins made as straight as possible, as an alignment guide. We have done this with some units with success.

In every case, triple check the tube socket position and alignment before soldering. It is almost impossible to remove a socket once soldered down without incurring severe damage to the PCB.

SWITCHES

The three buttons and DIP switch may be mounted on either side of the board, to be activated from access holes in the top or bottom of your case. There are DIP switches with side-activated levers, which can be set from a hole in the rear of a case. The DIP switch and tactile switches may also be mounted externally, and for this there is a provision for a two-row 16-pin connector, located in the same place as the DIP switch. The connector is assumed to be of the type that uses 0.025 inch square pins (0,63 mm) on 0.100 inch (2,54 mm) centres, with either discrete wire or ribbon cable. The GeekKlok requires a 4-position DIP switch, mounted in holes marked 1 through 4. The circuitry cannot read an 8-position DIP switch (due to conflicts with the DS1305 chip input and output ports).

In addition, a small "bonus" satellite board is supplied that can accept 12mm tactile switches and slide switches. This is to be connected between a 2x8 pin header installed in place of S82 and a similar header in the smaller board. Headers are supplied, but no interconnect cable or ribbon wire is furnished. On the Rev B PCB the order of these remote switches is reversed from those on earlier PCBs.

POWER SUPPLY

The kit builder will have to furnish an external power supply. The PCB has a full-wave bridge rectifier and other parts to receive AC from a transformer. The suggested power supply is a wall-mounted ("wall wart") AC power supply (most are DC, but many AC types are readily available from DigiKey and other suppliers). Use of such a commercial power supply, usually approved by regulatory agencies for one or more countries, makes the overall unit much safer to operate. This way the mains line voltage (110 or 220 volts) is never brought into the case. You must accept responsibility for the ultimate safety of the mains (line voltage) power supply and step-down transformer.

The external power transformer must supply 12 volts AC at 500 mA. The on-board switchmode power supply will generate 170 volts DC for the nixie tubes. No power switch is furnished. Well, it is a clock and must run continuously.

A DC power supply may optionally be used, but this requires changes to a number of components. The DC power supply must consist of a traditional transformer, bridge rectifier and filter capacitor. Regulated or switchmode power supplies cannot be used if the power line frequency is to be depended upon for keeping accurate time (i.e., register CU = 1). The power supply must have more than 15 millivolts of peak-to-peak ripple when loaded to 300 mA. It is suggested that the builder who wants to use such a power supply also have the knowledge and means to test these requirements.

Furthermore, resistor R85 must be removed and R86 must changed to 4.7 megohms. Resistor R90 will need to be changed (lowered) to get 100 or 120 Hz output from U93 when either end of R84 is grounded (which lets part of U93 run free, not locked to the power line).

An alternate component switchmode power supply is possible using MC34063A at U4B in place of MAX771CPA at U4. Some of the parts associated with U4 move to new locations, shown with a "B" suffix added to the same number. These include Q27B, L71B, C60B, D1B, C57B and C59B. Some of these parts require different values from their U4-related ones. If the MC34063A is supplied in place of the MAX771CPA, a special addendum sheet will be provided with the kit.

BUILDER'S OPTIONS

The PCB incorporates many features to maximise your enjoyment and allow customisation to match your needs and taste.

1. Nixie Location. The nixie tube sockets are traditionally mounted on the component side of the board. However, there are occasions when it is better to mount the sockets on the solder side of the board. When the latter mounting is required the board is intended to be reversed with the components facing down. This reduces the mechanical interference from components, allowing the use of cases with nearly no gap between the PCB plane and the inside top of the case. Such case designs usually have the tubes exposed through holes in the top of the case. Choosing which side to mount sockets on affects the position of jumpers and some component locations and component values. Plan this carefully, as it is close to impossible to change your mind once construction has begun. See the special section on Reversed Tube Mounting for further information.

2. Accessory Connector J91. A seven-pin connector, J91, is provided for the intended connection to a simple module for displaying seconds as two digits, using smaller numeric nixie tubes. Zetalink offers a GeekKlok Accessory Module (GAM) for this purpose. Ground, 5-volt logic power and 170-volt nixie power is supplied on this connector. The battery is also brought to one of the pins in case it is needed to retain data in an external device. One control pin connects to the TCMP output of U2, which generates one pulse per second, suitable for driving a pair of counters for seconds and tens of seconds. Another pin is the GeekKlok serial output channel, which carries a five-byte message (see serial data description). This signal appears at the start of each minute, when the seconds display would be zero. It can be used to reset the seconds counters without regard to the actual serial data that it is sending. The six bytes complete their transmission in less than 150 milliseconds, well before the first seconds advance pulse arrives. A simple seconds display consisting of counters and nixie drivers will not blank when the main display is set to blank, and continues to display when editing time, user preference registers or fonts. This feature is provided for the person that absolutely must have a seconds display and can live with the shortcomings inherent in its simplicity. The seventh pin on J91 is the serial input to the GeekKlok. This is a TTL/CMOS level (not RS232) that can be used to input commands. In the Zetalink GAM this pin is used to send BA and BZ blanking commands to the GeekKlok.

3. Serial Input with EIA-RS232A. The addition of U95, a MAX232 chip for RS232 serial data input and output, gives the user access to additional features. This option is at the user's discretion. No components are included in the kit. The user must supply an RS232 connector, wiring, MAX232, four capacitors (C90, C91, C92 and C93) and R89.

The serial input is used to send commands to the GeekKlok. A simple protocol is used to allow the user to control certain aspects of the display system. There is no provision to display messages or user-transmitted text on this port.

For information on the command protocol, see the section on the Serial Interface on an earlier page.

The serial format is EIA-RS232A, 2400 baud, 8 bit length, no parity, one stop bit (8N1). This can not be changed.

One additional special RS232 level input is provided, marked as DA on the board. This signal, used in the Four Letter Word, can not be used in the GeekKlok due to a conflict with U94. It is disabled by not installing jumper WZ.

4. Colon Option. There is a driver transistor intended for the addition of a pair of neon glow lamps as colons for the clock. These colons are turned on during time display but turned off during setting modes. Since the characteristics of these are not known, anyone wishing to add colons to separate hours and minutes should determine the actual value of resistor R83. The schematic shows two neon lamps in series, but the user may wish to place them in parallel, each with its own resistor. Connection to the drive is via pads and holes marked COL-OPT, located immediately

"north" of U2.

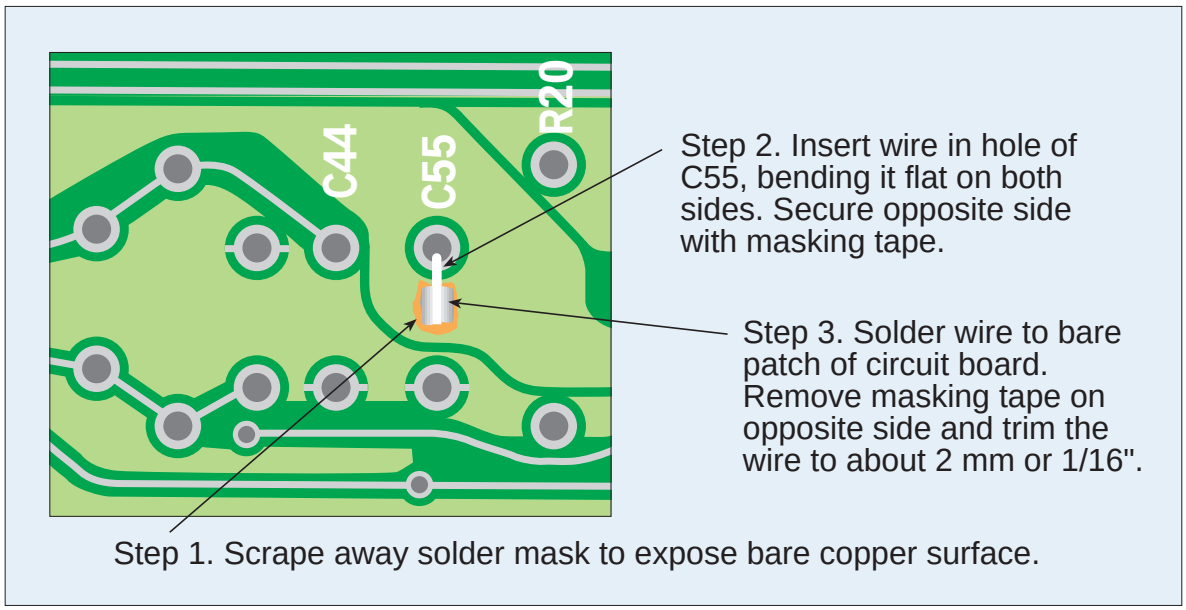
5. Remote Switches. A small accessory PCB is supplied with switches and a connector header, for use in placing the option and setting switches in a more accessible location than on the main circuit board. The CDTU assembly drawing shows this board and the 2x8 pin header installed in place of the DIP switch. A mating ribbon connector is not supplied, since the length of the cable is a user preference. Components may mount to this switch PCB from either side, whichever way is most convenient. Several other variations in slide switches will fit the holes, so these may be changed if desired. The 2x8 pin header may be straight or right angle. Note that the mounting of this header and the header on the main board must agree with respect to pin 1. Each board has an "A" and "B" marking. The header must be on the same side (i.e., same letter A or B) on both boards.

BUILT-IN SEGMENT TEST

If the two buttons (SET and ADV) are pressed when the unit is powered up, the unit goes into a segment test mode. The ADV button steps through the segments. The button handler routine is very simple and it might jump over a segment now and then. The only way to exit this test mode is by removing power.

ERRATA — PCB ERRORS

There is a very small error on the printed circuit board which results in the unit not being able to function. Refer to the illustration below.



The view shown is from the component side. C55 is located near U3. The repair shown above may have already been performed on the board shipped in your kit, since it can be quite easy for an experienced person yet remain difficult for inexperienced hands. Two photographs of completed repair work along with more detailed instructions can be found on this Zetalink web page: <http://zetalink.biz/FLGKerrfix.html>

(Note that the AC input in the corner of the board has pads for a surface-mount power jack, made by Switchcraft, Digi-Key order number SC1154-ND. This is intended as an option for use by Zetalink for fully assembled models. You may add this if you wish.)

FIRMWARE REVISIONS

Version 1-0. 14 July 2003. First release.

Version 1-1. August 2003.

1. Fix rare occurrence of skipped animation step.
2. Added support for third (OPT) button.

3. Added register OP for assigning OPT button to animation sequence, animation speed and font selection.
4. Added register FR for setting line/mains frequency, instead of using measurement.
5. Added support for 100 and 120 Hz mains timing pulses if a DC wallwart with ripple output is used

Version 1-2. November 2003.

1. Added timing filter to eliminate occasional extra pulses coming from line noise or other sources which cause occasional speedup of time. (Earlier versions can fix this with an added capacitor from U3 pin 7 to pin 8, with a value of about 10 nf.)
2. Improved error checking for RS232 serial input channel.
3. Now totally ignores NUL character on serial input.
4. Serial output error fixed. It now works. Earlier versions do not output any serial data.
5. Serial output includes code for whether display is blanked or not, so that and auxiliary seconds display can be blanked or so that chime annunciation can be silenced, if desired, when the main diaplay is blanked by register BA or the BA serial command.
6. Improved watchdog operation to detect and reset if inadvertent hangs occur.

Version 1-3. November 2003.

1. Fixed bug where if register FS = 0; it actually was 256 seconds and not zero seconds.
2. Fixed bug for OPT button action when OP = 2 and primary font is ANB or secondary font is ANA.
3. New: program integrity check on power-up. If program checksum error detected "CKER" will appear and end of greeting.
4. Default fonts changed to NOR = 1, DIG = 2, DEC = 3 and SKE = 4

Version 1-4. February 2004.

1. Multiplexing anode drive signals disappear when blanking (BA–BZ). This will not work with DS1232 watchdog chip. This problem is now corrected inthis version.
2. If register FR=0, the hello message was very slow in playing. Fixed.

Version 1-5. March 2004.

1. Serial output only sends hours in 12-hour form (01–12, no am/pm signal) if jumper WM set to 12-hour mode. It is a bug. This is now fixed so that accessories can properly respond for alarms. GeekKlok Accessory Module (GAM) requires Ver 1–5.

Version 1-6. May 2004.

1. Added Register BF (Blanking Format) and two new blanking modes: totally "dead" display and very dim display. Register BF controls which of these modes is active when blanking occurs.
2. Removed five animation sequences to make room for blanking changes. All "Dancer" font animations are now gone.

REVERSED TUBE MOUNTING

The printed circuit board was designed to allow the option of mounting the nixie tubes (and of course the sockets) on either the normal component side or on the opposite side, usually called the solder side. When they are mounted on the "bottom" side the whole board must be reversed when using it so that the tubes project upwards and the other components hang downwards from the PCB. These two mounting options are herein abbreviated to CDTU, Components Down, Tubes Up, and CUTU, Components Up, Tubes Up.

With reversed CDTU mounting there will be no mechanical interference between components and the top of a low-profile case. Such a case usually is intended to show off the tubes, projecting out from the case in plain view.

To build the kit for CDTU mounting, please refer to the separate parts list and assembly diagram. The all-important firmware control over the operation is determined by D98. Absense or presence of this diode selects between normal and reverse segment decoding and anode switching sequences. The second page of the schematic shows the pin numbers resulting from both mounting options. The signal names for the cathodes are only valid for CUTU (on the second page of the schematic both cathode names are noted). The anode names, however, refer to CUTU, followed by an underline, then the CDTU anode number.

Furthermore, when the tubes are on the opposite side, the tube pin for the anode changes position with one of the cathode pins (and the same is true for another internal connection pin that was used during manufacture to boil off a small amount of mercury). To properly steer the correct anode and cathode functions to the correct pin, a group of numbered jumpers are provided, located between or near the tubes. Jumpers marked W (W1 to W11) are to be installed for CUTU mounting. Jumpers marked X (X1 to X11) are to be installed for CDTU mounting. Additionally, anode driver components R46, R66, Q16, R71, Q21 and R26 are only mounted for CUTU, and are left open for CDTU.

For CDTU mounting, R30, R50, Q25, R70, Q20 and R80 are loaded, but are left open for CUTU. These components are merely different locations for R46, R66, Q16, R71, Q21 and R26, and retain the same values for each function.

Also note that R31 and R44 values are reversed in the parts lists. The markings on the board for these two resistors have an asterisk (*) to alert you to this change. These values control the correct amount of cathode current to only two out of 15 cathodes that change when the tubes are inverted. All other resistors remain the same because, though the drivers go to different cathodes, by luck (and to a degree tube symmetry) the physical length of the cathodes is no different for both mounting options. Only R31 and R44 must be altered. These are correctly adjusted for each of the two parts lists.

When sockets are mounted on the top, note that pins 1 and 17 are marked, and that the hole between 1 and 17 is not used. If individual socket pins are used, it is a good idea to fill these holes with solder so that the tubes can not be inserted rotated to some other orientation.

When sockets are mounted on the reverse side (CDTU), likewise pin 1 and pin 17 are marked on that side, with the unused pin not to be used. The correct pads are encircled to further assist you in mounting socket pins or sockets. Again, the unused holes in the extra pad should be filled with solder if socket pins are used.

The position of the numbered W or X jumpers must be correct to avoid possible component damage. The absence or presence of diode D98 selects between the two modes at the firmware level (to select between two different sets of segment coding tables and anode sequences). It can be installed incorrectly with no harm, except that the characters will be garbled since the wrong segments are being decoded from the characters. If this symptom is observed, check to see if D98 is incorrectly present or absent.

The following pages contain the parts lists for CUTU and CDTU mounting.

This is a summary of the differences between the CUTU and CDTU parts lists:

CUTU		*CDTU*	*value*	*PCB mark*
R66	=	R70	100k	[1]
R46	=	R50	470k	[2]
R71	=	R80	33k	[3]
R26	=	R30	2.2k	[H]
R31	=	R44	18k	[*]
R41	=	R31	27k	[*]
Q16	=	Q20	MPSA42	
Q21	=	Q25	MPSA92	
W1..W11	=	X1..X11	jumper wire	
—		D98	diode, only for CDTU	

PARTS LIST — For CUTU Mounting, ZFLW2391 Rev A board

Some parts are also marked on the PCB with a single character, to facilitate assembly of identical parts. These markings are shown in the "PCB" column, adjacent to the reference designation for the parts.

description	*qty*	*value/identifier*	*PCB*	*reference designation*	*notes or marking*
cap. alum.	1	470µf/25v	—	C40	
cap. alum.	1	4.7µf/250v	—	C57	
cap. alum.	1	220µf/16v	—	C58	
cap. alum.	2	2.2µf/160v	—	C42 C43	
cap. ceramic	2	20 or 22 pf	—	C44 C45	20, 22, 200 or 220
cap. mono.	11	100nf	—	C46 C47 C53…C56 C59…C62 C94	104
diode, ultra fast	1	600V, 1A, 75 ns		D1	MUR1100E or UF1005
diode, 1A	4	1N4002	—	D5 D6 D7 D8	plastic, may be 1N4002, 4003, 4004
diode, sig.	5	1N4148	—	D90 D91 D92 D93 D99	glass
resistor	1	10M	—	R17	brn-blk-blu
resistor	2	560k		R85 R92	grn-blu-yel
resistor	1	680k		R93	blu-gry-yel
resistor	1	68k		R90	blu-gry-orn
resistor				R90T	(may be used to trim U93 frequency to 50 or 60 Hz)
resistor	2	27k	[A]	R40 R44*	red-vio-orn
resistor	2	47k	—	R8 R9	yel-vio-orn
resistor	3	18k	[K]	R31* R34 R45	brn-gry-orn
resistor	4	10k	—	R20 R22 R75 R76	brn-blk-orn
resistor	4	20k	[E]	R37 R39 R41 R43	red-blk-orn
resistor	5	2.2k	[H]	R18 **R26** R27 R28 R29	red-red-red
resistor	6	22k	[B]	R32 R33 R35 R36 R38 R42	red-red-orn
resistor	6	470k	[2]	**R46** R47 R48 R49 R81 R86	yel-vio-yel
resistor	7	100k	[1]	**R66** R67 R68 R69 R77 R78 R79	brn-blk-yel
resistor	15	1.5M	[9]	R51...R59 R60...R65	brn-grn-grn
resistor	21	33k	[3]	R1...R3 R5 R6 R10...R16 R19 R24 **R71** R72...R74 R82 R84 R88	orn-orn-orn
resistor	1	0.33R		R21	(orn-orn-silver) may supply 0.5R instead
resistor		note		R21T	not supplied unless R21 = 0.5 (R21T = 1.0, makes 0.33 ohms)
transistor, PNP	4	MPSA92	—	**Q21** Q22 Q23 Q24	alternate marking: KSP92
transistor, NPN	6	MPSA42	—	Q15 **Q16** Q17 Q18 Q19 Q26	alternate marking: KSP42
power FET	1	IRF830/840		Q27	
crystal	1	4.0 MHz	—	Y81	
crystal	1	32.768 kHz		Y94	small cylindrical watch crystal
inductor	1	220 µH		L71	
DIP sw	1	4-position		S82	mount in holes 1-4
IC socket	1	40-pin		(U2)	
IC	1	DS1232		U92	
IC	1	LM393		U93	
IC	1	68HC705C8ACP		U2	pre-programmed with GKK firmware
IC	1	DS1305		U94	must not be socketed!!
IC	1	MAX771CPA		U4	must not be socketed!!
IC	2	SN75468N		U5 U6	
IC	1	7805		U1	
tactile switch	3	6mm		S83 S84 S85	
battery holder	1	20 mm coin cell		(B82)	
battery, 3v Lithium	1	20 mm coin cell		B82	CR2025
jumper wire	11			**W1...W11**	(See section on Reverse Tube Mounting)
jumper wire	1			WK	for 1 Hz pulse on J91
jumper wire	1			WG	
jumper wire		user option		WM	(install for 24-hour clock display)
jumper wire	1			WS	required (unless using external 1 Hz pulse from GPS)
Nixie Tube	4	B-7971		V91...V94	
Tube Socket	4				if using vintage sockets
Socket Pins	68	optional		Mill-Max no. 0316-0-15-01-3427100	see Note 1
Socket Pins	68	optional		Tyco-AMP no. 1–380758–0	see Note 2
tactile switch	3	12mm		S883 S884 S885	on small remote switch board
slide switch	4			S821 S822 S823 S824	on small remote switch board
header	2	2x8		J820 & S82	to connect small remote switch board

* R31 and R44 values are correct for CUTU mounting. See section on Reverse Tube Mounting.

ICs that may use sockets: U2, U5, U6, U92, U93, U95. However, U4 and U94 must be soldered into the board without sockets.

Parts in **bold type** are specific to CUTU tube mounting. See section on Reverse Tube Mounting.

Note 1: Digi-Key order no. ED5012-ND, Mouser order no. 575-031600 (this has a better, tighter grip)
Note 2: Digi-Key order no. A29073-ND, Jan Wuesten (www.askjanfirst.com) order no. FAS900 (the grip is looser than the Mill-Max one)

PARTS LIST — For CDTU Mounting, ZFLW2391 Rev A board

Some parts are also marked on the PCB with a single character, to facilitate assembly of identical parts. These markings are shown in the "PCB" column, adjacent to the reference designation for the parts.

description	*qty*	*value/identifier*	*PCB*	*reference designation*	*notes or marking*
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cap. alum.	1	220µf/16v	—	C58	
cap. alum.	2	2.2µf/160v	—	C42 C43	
cap. ceramic	2	20 or 22 pf	—	C44 C45	20, 22, 200 or 220
cap. mono.	11	100nf		C46 C47 C53…C56 C59…C62 C94	104
diode, ultra fast	1	600V, 1A, 75 ns		D1	MUR1100E or UF1005
diode, 1A	4	1N4007		D5 D6 D7 D8	plastic
diode, sig.	6	1N4148		D90 D91 D92 D93 **D98** D99	glass
resistor	1	10M		R17	brn-blk-blu
resistor	2	560k		R85 R92	grn-blu-yel
resistor	1	680k		R93	blu-gry-yel
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resistor	2	27k	[A]	R40 R31*	red-vio-orn
resistor	2	47k	—	R8 R9	yel-vio-orn
resistor	3	18k	[K]	R34 R44* R45	brn-gry-orn
resistor	3	100		R96 R97 R99	brn-blk-brn
resistor	4	10k		R20 R22 R75 R76	brn-blk-orn
resistor	4	20k	[E]	R37 R39 R41 R43	red-blk-orn
resistor	5	2.2k	[H]	R18 R27 R28 R29 **R30**	red-red-red
resistor	6	22k	[B]	R32 R33 R35 **R36** R38 R42	red-red-orn
resistor	6	470k	[2]	R47 R48 R49 **R50** R81 R86	yel-vio-yel
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resistor	15	1.5M	[9]	R51...R59 R60...R65	brn-grn-grn
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resistor	1	0.33R		R21	(orn-orn-silver) may supply 0.5R instead
resistor		note		R21T	not supplied unless R21 = 0.5 (R21T = 1.0, makes 0.33 ohms)
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power FET	1	IRF830/840		Q27	
crystal	1	4.0 MHz		Y81	
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IC	1	MAX771CPA		U4	must not be socketed!!
IC	2	SN75468N		U5 U6	
IC	1	7805		U1	
tactile switch	3	6mm		S83 S84 S85	
battery holder	1	20 mm coin cell		(B82)	
battery, 3v Lithium	1	20 mm coin cell		B82	CR2025
jumper wire	11			**X1...X11**	(See section on Reverse Tube Mounting)
jumper wire	1			WK	for 1 Hz pulse on J91
jumper wire	1			WG	
jumper wire		user option		WM	(install for 24-hour clock display)
jumper wire	1			WS	required (unless using external 1 Hz pulse from GPS)
Nixie Tube	4	B-7971		V91...V94	
Tube Socket	4				if using vintage sockets
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slide switch	4			S821 S822 S823 S824	on small remote switch board
header	2	2x8		J820 & S82	to connect small remote switch board

* R31 and R44 values have been reversed in this list for CDTU mounting of tubes/sockets. See section on Reverse Tube Mounting.

ICs that may use sockets: U2, U5, U6, U92, U93, U95. However, U4 and U94 must be soldered into the board without sockets.

Parts in **bold type** are specific to CDTU tube mounting. See section on Reverse Tube Mounting.

Note 1: Digi-Key order no. ED5012-ND, Mouser order no. 575-031600 (this has a better, tighter grip)
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FIRST TIME TURN-ON

If you have assembled the kit and checked all parts placements and are confident that everything is correct, it is time to turn it on. There is no danger in starting right off with the battery installed and four nixie tubes plugged in.

Apply 12 VAC to the power input connections. The display should come on and a hello greeting will display, followed by the firmware (software) version number. At that point the display should show "FRXX" (Version 1-1 or later). This signifies that the register FR has not been set. It is necessary to set this to the power line frequency in your area (North America is 60 Hz, FR = 2, and most other locations are 50 Hz, FR = 1). Enter the register menu and step to the FR register, set it to your frequency, then step to the next register (so it gets saved), and then exit (press both SET and ADV buttons at the same time). The next time the GeekKlok is powered up it will not display "FRXX" but should instead show "OK" after the version number. To check if the register has been saved to the backup RAM (in U94), remove power for 10-30 seconds and then apply power again. It should show the OK. Of course, the battery must be installed for this to work.

(Version 1-3 and later also checks the program memory for integrity, and if it is found to be in error, will display "CKER" for checksum error, where otherwise "OK" is displayed.)

You may want to test all tube segments at this point. Remove power, wait 10-20 seconds, and then apply power again while holding down the SET and ADV buttons. The ADV button will then step through the segments (on all tubes at the same time). Some nixie tubes may have segments that appear or turn on slowly. This may disappear in time, and is a result of the tubes not being used for many years. (In version 1-0 and 1-1 the segment test program was quite long because it attempted to display the segments in the order that Burroughs marked them, but only for CUTU mounting. In Version 1-2 the segment test was simplified to make room for more important changes, so the segment order is now quite mixed; it is actually the PortA and PortB bits sequentially shifting a single high bit from low to high port numbers; in programming terms it is a shift left.)

The default register settings will show the NOR font as primary font and DIG as secondary font (for version 1-0 through 1-2 the secondary font is MIA, which intentionally has certain segments missing). To test all segments, turn off the unit, wait a few seconds, than hold down the SET and ADV buttons while applying power.

The next check might be to set the time and run the clock for a day to be sure that the time is always correct. Improvements in the Ver 1-2 firmware have eliminated occasional speedup errors that a few units experienced with earlier versions. You can test the ability to read the date from the RTC (U94) by setting the time to 23:59 and letting it go to 00:01 and then check the date registers. If they are correctly altered for the next date, then the RTC is working.

GETTING STARTED

To better acquaint yourself with the fonts and animation sequences, please read the discussion for register OP. This selects whether the OPT button steps through fonts or animation sequences. This is a very handy feature for browsing and trying out the many features. The OPT button can also be programmed, through the OP register, to alter animation speed. The default setting for OP is zero, which allows this button to conveniently blank and unblank the display.

Here are some sample settings to illustrate different features:

1. Static primary and static secondary fonts alternating every 20 seconds. Set register FP =2, FS = 20, then set font NOR =1 and font SEV = 2. Be sure that DP = 0 and ZP = 0. Set SU = 0 so that no underline segments show for seconds, then later try changing SU = 1 and SU = 2 to see the two different progress bar effects on the underline segments.

2. Static primary and animated secondary font, alternating every 20 seconds. Set FP = 2 and FS = 20, MB = 1, OP = 2. Next go to the font menu and use the OPT button and the ADV button to step backwards to ANB (a reverse step). Set ANB =2, which makes the animation pseudo-font ANB the secondary font. Now, when the secondary font appears it will be an animated sequence using the "windblown" fonts. Since OP=2, pressing the OPT button while animation is running will allow stepping through all 30 canned animation sequences.

3. This setting makes the clock look normal most of the time, but once out of every minute it spends ten seconds adding and subtracting segments by switching to a similar animated font for the secondary font. Set FP = 5, FS = 10, MB = 25, RB = 8; set font NOR = 1, ANB = 2. You can try MB = 23 to 28, for variations on NOR. If MB = 30, the animation includes the spastic display attribute, and if the last step of animation has spasms on, they will remain on even for the static font display.

4. This one will use the Burroughs original font for time, no animation, and the font Skewed Up for the date, winking. Set FP = 90, FS = 0 (only for firmware Ver 1-3 or later), DP = 6, DF = 0 or 1 for your date MMDD or DDMM preference, and DC = 1. Set font BUR = 1, SKE = 3 and LOB = 2. DIP switch 4 will select Lo Boy as the time font when turned ON (note: the switch is only read once per minute); when OFF the time is shown in Burroughs font.

FAQ

Q. When the room is extremely quiet I can faintly hear a hum or buzz from the display. What is this?

A. Nixie tubes involve a lot of nasty physics at the molecular level. The ionized gas near each cathode heats up, though not enough to matter relative to the volume of gas in the tube. And there are electrostatic forces at play when the voltages are changed. These contribute to a very slight degree of acoustical noise emitted from the tubes as they are switched on and off (swept) 125 times each second. Some nixie tubes may be louder due to internal differences in construction (looseness of parts). We were unable to produce any truly annoying sounds with a sample of nixie tubes. In a very quiet room we still had to get within two centimeters (an inch) of the tubes before anything at all could be heard. We have seen reports of other people using B-7971 tubes (with their own circuitry) who experienced annoying "singing" sounds, but we also have had reports from experimenters that used our driver circuitry and found that the noise was eliminated. While the main focus of the driver circuitry was to eliminate ghosting and spurious glow, it appears that it also is responsible for silencing some noise, but we can only speculate why this occurs since nobody has been able to conclusively identify the exact cause of noise (some say heating, other say electrostatic charges are involved).

Q. Why is there no alarm function?

A. We didn't think that a simple alarm would do justice to the other advanced features. A good alarm scheme would involve the ability to select which days it would sound, with an option for snooze or momentary deferment of the occurrence. It should also have more than one alarm. There was not enough memory space to add the many extra registers required to do this well. The GeekKlok Accessory Module (GAM) can be added via connector J91. GAM has a numeric nixie seconds display, four recurring 24-hour alarms with day-of-week selections, two chime modes with 15-, 30- and 60-minute annunciation intervals, plus a PIR infrared sensor input that can blank the GeekKlok. The serial information is documented so that you may also design your own accessory module to do what you want.

Q. *Why use 50/60 Hz for timing? Why not use a receiver for receipt of atomic clock data, or other similar data?*

A. In large, advanced power grids, such as in Europe and North America, the line or mains frequency is very accurate over a period of 24 or more hours. This is a simple and effective way to get excellent accuracy. The radio transmissions from governmental agencies are not global, but have different frequencies and data formats, and are not perfectly reliable for all locations. The only true global time reference is from GPS receivers. We provide the option of using a GPS 1 Hz pulse for controlling the time. Some technical know-how is required to implement this.

Q. Can the serial input interpret NMEA data from GPS receivers?

A. No, not at this time. Several users have achieved this and we can help in sharing the information or connecting you with them.

Q. Can I add a larger capacitor in parallel to C40 to provide greater protection against brief power interruptions?

A. Yes. Since U93 continues to supply 50 or 60 Hz pulses (not very accurately, however), enough capacitance for up to five seconds or so of operation may be used. R90 or R90T may be adjusted to bring U93 closer to your line frequency. If U93 oscillates at 62 Hz (and your line frequency is 60 Hz), the clock will gain 2 seconds in one minute, or only 330 milliseconds in a 10-second power outage. This error may be less than relying on the RTC backup (U94) if very short power outages are common, such as during frequent thunderstorms in rural areas. This information is for your consideration and evaluation if your goal is very reliable timekeeping.

Q. Can I use Telefunken ZM1350 Varisymbol display tubes instead of B-7971?

A. Yes. They will work with no changes in component values or circuitry. You will have to provide a mounting panel or board for them, since the GKK PC board was not designed for these. Since the same numbered cathode of each tube connects together, the total number of wires between the display and the GKK board will be 15 for cathodes and 4 for anodes, or 19 total. The decimal point and keep-alive cathode are not used and are not connected.

TROUBLESHOOTING

Usually the GeekKlok will run when it is first started up. The "hello" message should run and then time should appear. If this doesn't occur, then troubleshooting is required. The basic requirements are a multimeter, but an oscilloscope is generally the preferred instrument for serious troubleshooting.

Some problems are shown below.

1. Unit is totally blank. Check to see if there is about 10 to 14 volts at the cathode of D6 or D7. Then check for 5 volts on pin 40 of U2 or pin 14 of U3. If these are OK, then check the high voltage. R9 has a marking on the PCB showing which lead should be at about 170 volts. Don't forget to insert U2. It is often recognized as the "brain" for the unit and is set aside in a special place, and could be forgotten.

2. Unit shows only the first word of the hello message: "GEEK" and then it stops. This symptom indicates that the 50 or 60 Hz power line pulses are not getting to the microcontroller (U2). U93 should output a 50 or 60 Hz waveform. If it does not, check all components associated with U93 as well as possible soldering problems, such as a short to ground.

3. Unit does not keep accurate time. It gains or loses time. Be sure that register CU is set to 1 if you have a stable 50 or 60 Hz power line. Be sure that there is a good 50/60 Hz signal at U93 pin 2. If this is missing, the upper portion of U93 (as shown on the schematic) will self-oscillate at about 45 to 65 Hz. (In a working unit this can be checked and adjusted by changing R90 or R90T while U93 pin 2 is grounded, which forces U93 to oscillate on its own.) The lower half of U93 synchronises the oscillator to the line frequency when a sine-wave signal is present at U93 pin 2.

4. Some segments are missing in one or more tubes (but not all tubes). Using the segment test (press both setting buttons when applying power), cycle through to see if all segments are showing. A segment missing in some of the tubes indicates a bad socket connection. Check the socket. Occasionally vintage sockets do not grip the pin properly. It may be necessary to use a pointed tool to bend the socket clip inwards just a bit. If the affected segment is number 4 or 10, check the W or X jumpers (one might be missing).

5. A segment is dead in all tubes. This indicates that the driver transistor (part of U5 or U6, or Q15 for one cathode) is not turning on. The transistor could be defective, not soldered correctly or its base resistor might be the wrong value (U5 and U6 have internal resistances). The signal to these, from U2, might be shorted to ground.

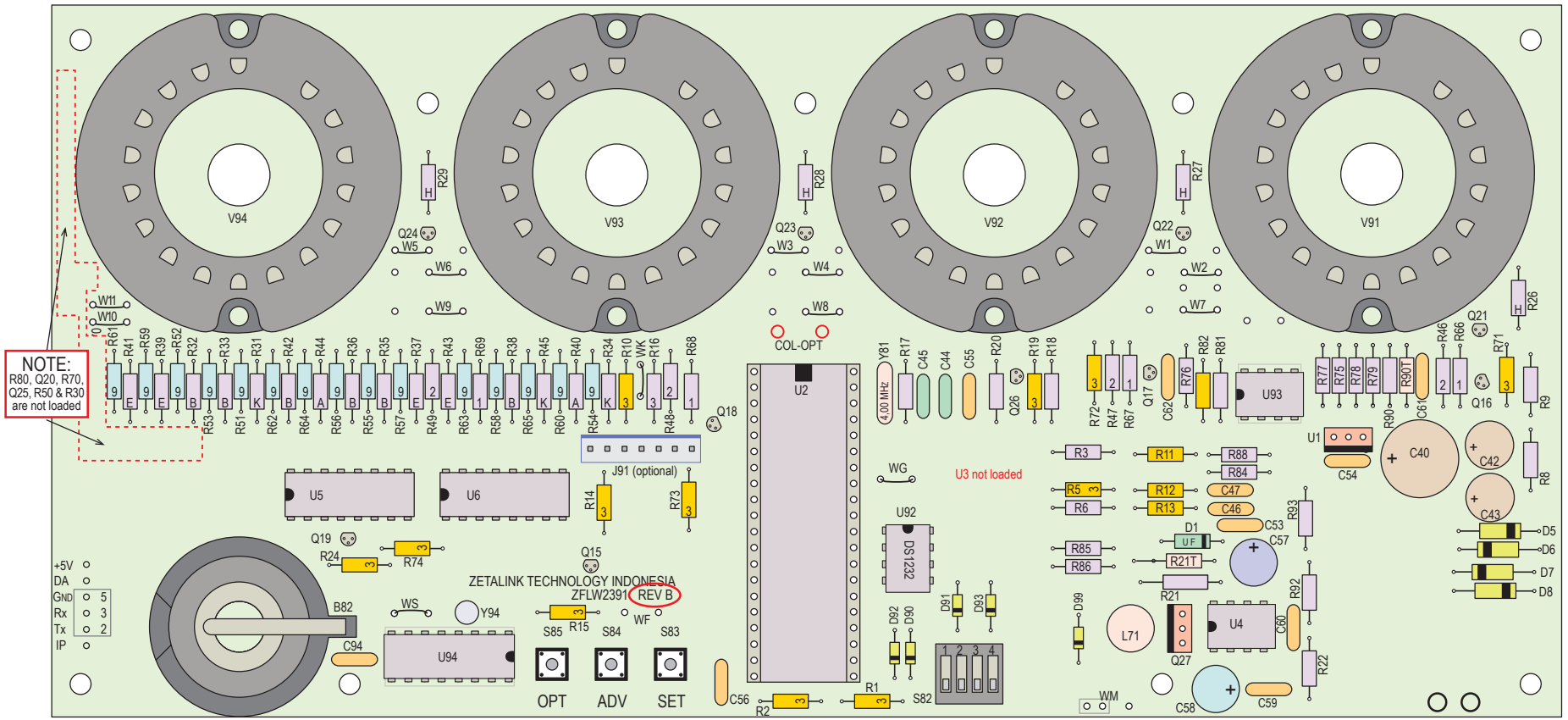
6. A segment is always on in all tubes (and probably brighter than it should be). This indicates that the cathode for that segment is permanently shorted to ground. Inspect all solder joints to be sure that no solder bridges to other components or to the ground plane exist. The driver transistor might be shorted or defective. One can't rule out a copper whisker from a track or pad to the ground plane, which is a PCB manufacturing defect. The boards are visually inspected for these defects, but they can escape cursory visual detection, yet cause problems.

7. One tube never shows anything, but all others are working OK. Check to make sure that the four anode drivers (Q22, Q23, Q24, Q21/Q25) are type MPSA92 and not MPSA42. Also check the intermediate transistors that precede these (Q17, Q18, Q19, Q16/Q20), or related resistors. Check the numbered W or X jumpers.

8. One tube is brighter than the others and the character includes segments from other positions. This indicates that one anode is always on. The MPSA92 might be shorted or the base drive from its MPSA42 might be shorted to ground.

9. One or more DIP switch options/modes do not work. Check to be sure diodes D90 to D93 are correctly installed. Make sure the switch is in holes 1–4. With power turned off, check the switch itself to see if that it is zero ohms when set to ON.

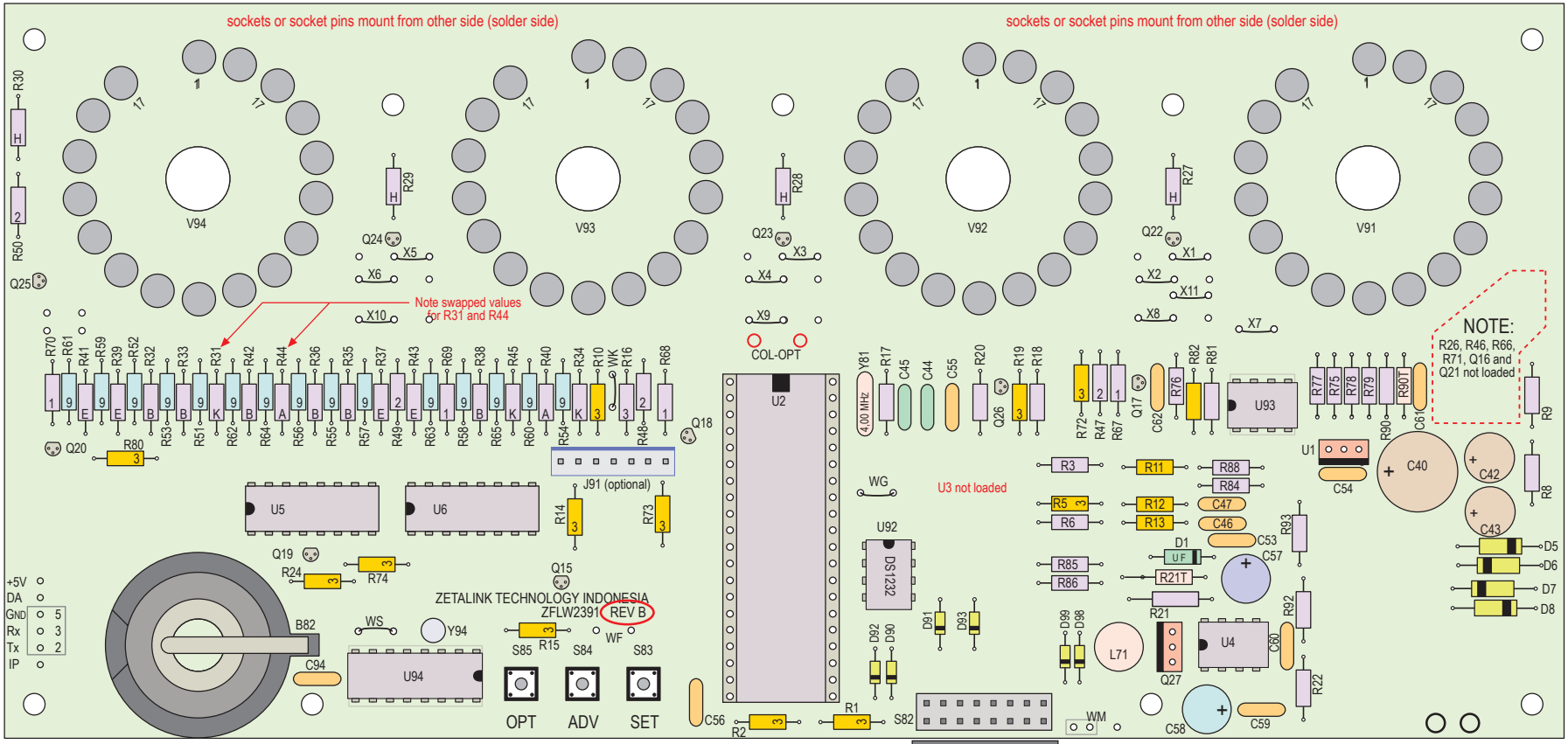
10. Time advances OK, but after power is removed and reapplied, the time and date is wrong. Be sure that the battery is installed and its power is reaching U94. The crystal, Y94, may not be oscillating. If U94 is in a socket, this may be the reason. U94 should not use a socket (it says this in the parts list). If the board is not clean around Y94, it can also cause problems. Solder flux should be removed, or use a very low flux solder. If a socket was used, before removing the socket, remove U94, bend its pins 3 and 4 outward, unsolder Y94 from the board and solder it temporarily to U94 pins 3 and 4. Then insert the IC into the socket with the pins bent outward. Set Register CU to zero. This will cause U94 to generate 1 Hz pulses on U94 pin 6, which goes to the interrupt pin of U2 (IRQ line). If register values and font settings are also not saved and restored after AC power cycling, then attention should be given to the signals on U94 pins 10, 11, 12 and 13. These are used infrequently, to move RAM and time/date information between U2 and U94. U94 register values are updated each time that the register or font editor is exited.



GeekKlok

Normal Nixie Mounting — CUTU

Only for PCB ZFLW2391 Revision B

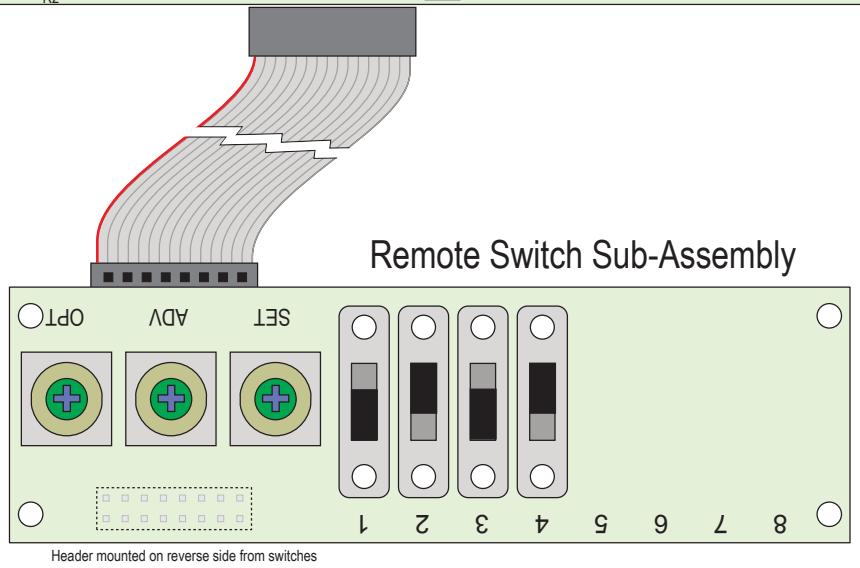


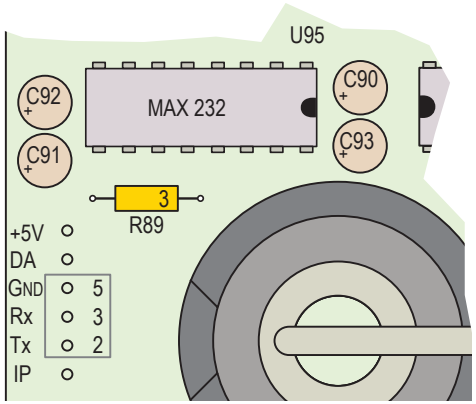
GeekKlok

Reverse-Side Nixie Mounting — CDTU

Remote Switch Sub-Assembly

Only for PCB ZFLW2391 Revision B

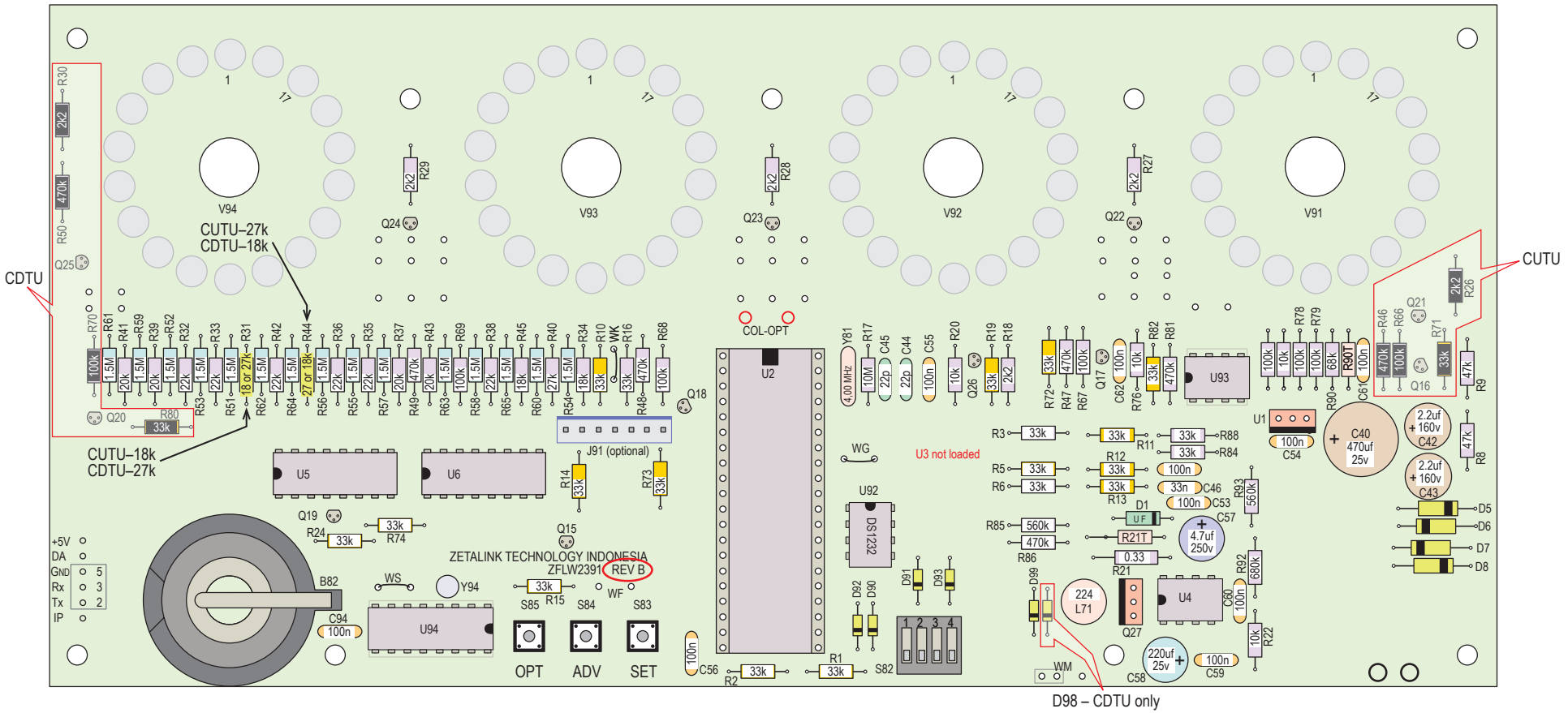




Serial RS-232 Input Option

detail of affected components only

Components supplied by user.



GeekKlok

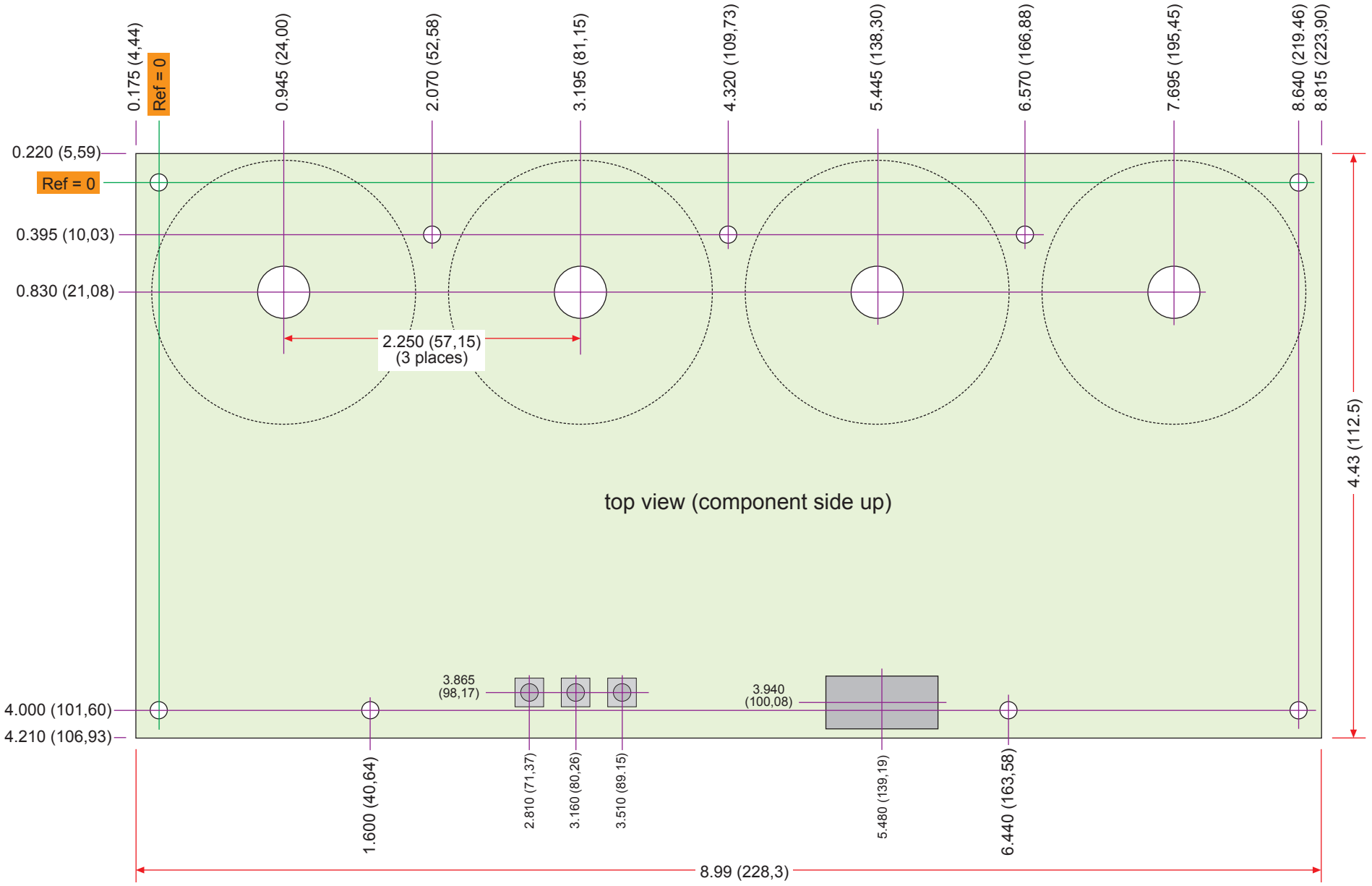
Component values shown.
Value that are white on black
are for CUTU or CDTU mounting.
Refer to CUTU or CDTU parts lists
and component designation drawings.

Only for PCB ZFLW2391 Revision B

Main PCB Mounting

for PCB ZFLW2391 Rev A and Rev B

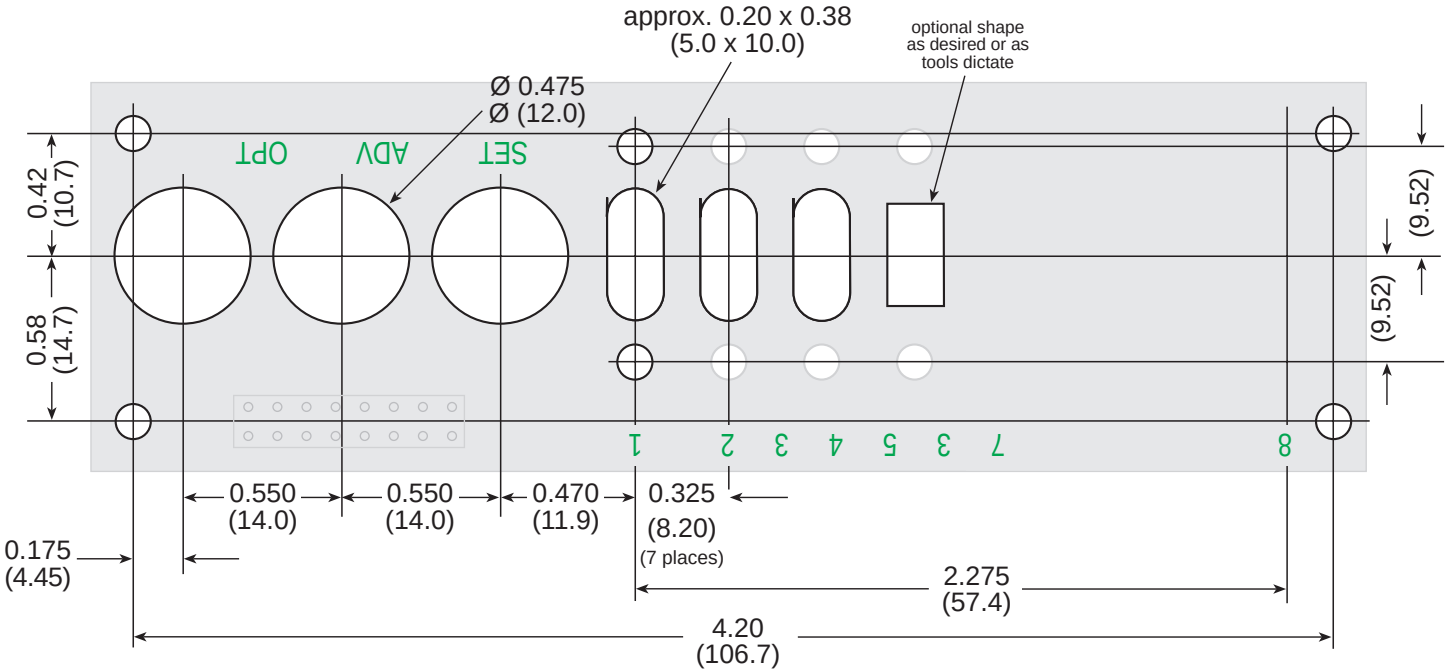
Used in Four Letter Word, GeekKlok, Four Character Display



Remote Switch PCB Mounting

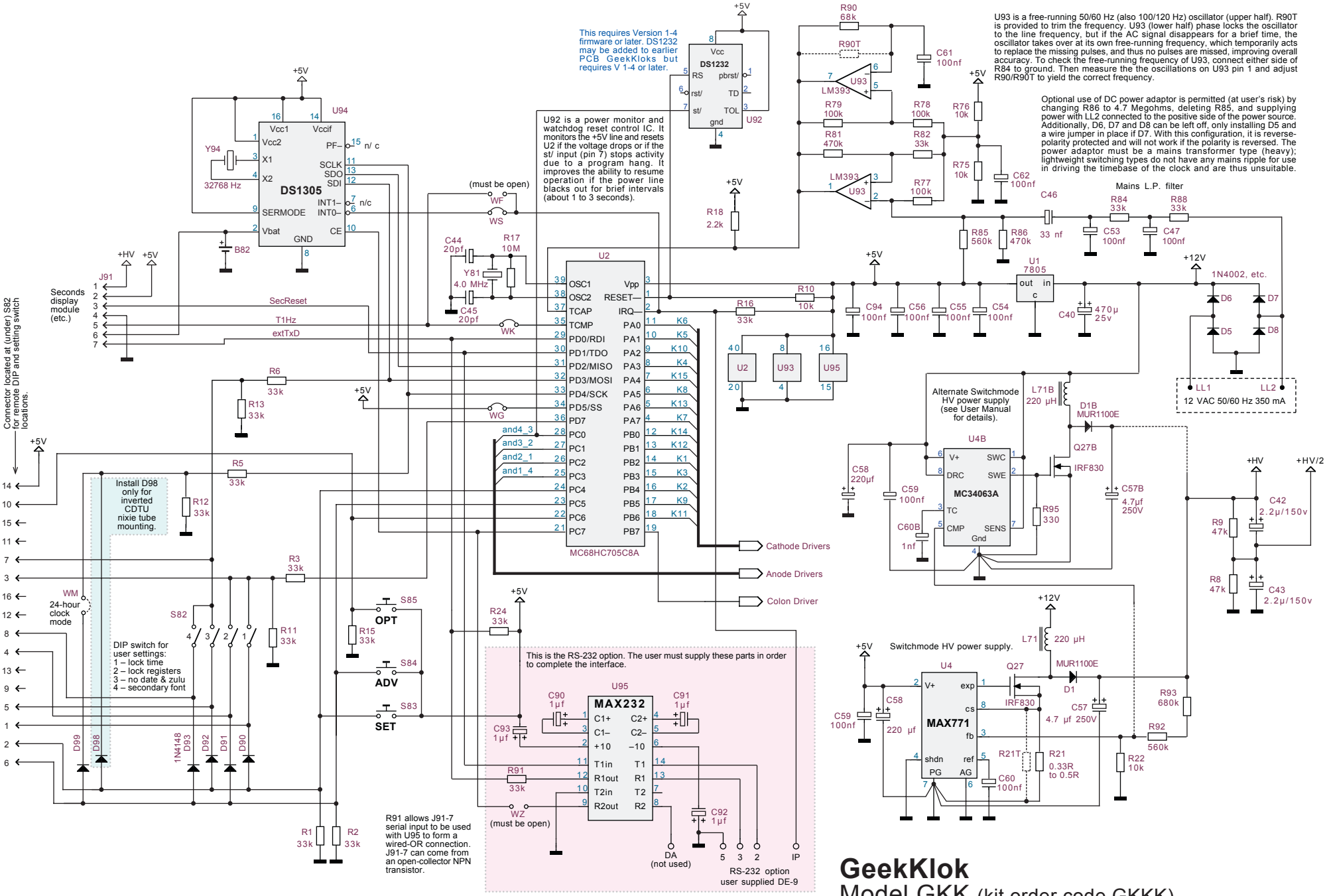
for PCB ZFLW2391 Rev A
Bonus supplied with the Four Letter Word and GeekKlok.

This drawing specifically for GeekKlok use.



Note 1: Switches and connector may be mounted from either side of the board, but connector should always be mounted on the opposite side from the switches since there is not enough clearance behind a panel.

Note 2: GeekKlok does not use switches in positions 5 through 8



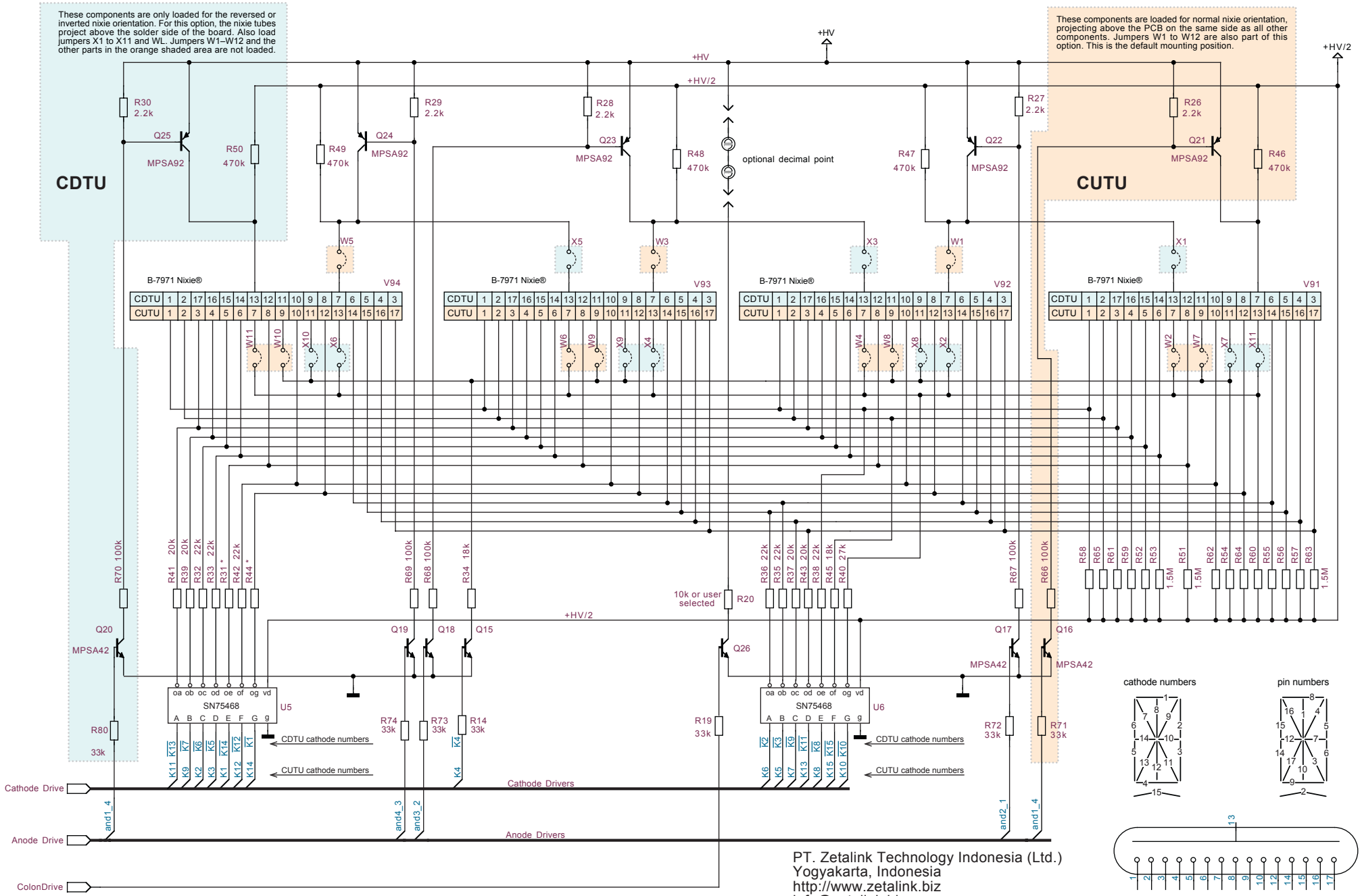
GeekKlok

Model GKK (kit order code GKKK)

Version for PCB ZFLW2391 Rev B

Microcontroller, power supply, options, etc.

PT. Zetalink Technology Indonesia (Ltd.)
Yogyakarta, Indonesia
http://www.zetalink.biz
info@zetalink.biz



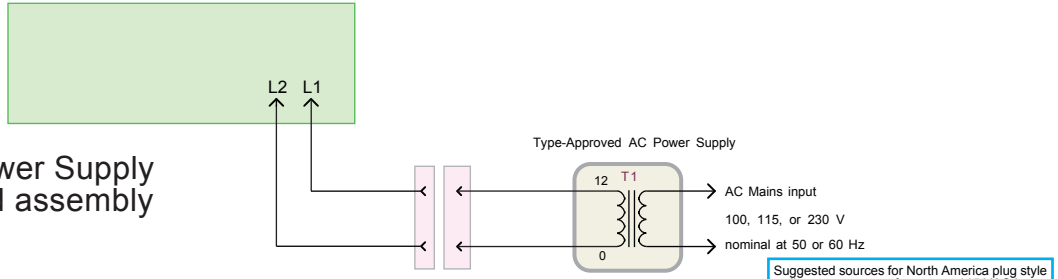
For normal B-7971 mounting on component side (CUTU), these parts are not installed: R30, R50, R70, R80, Q20, Q25, and all X-numbered jumpers.
For reverse side mounting (CDTU), these parts are not installed: R26, R46, R66, R71, Q16, Q21, and W1 to W11.

PT. Zetalink Technology Indonesia (Ltd.)
Yogyakarta, Indonesia
http://www.zetalink.biz
info@zetalink.biz

Nixie Multiplex Drivers. Model GKK, Version for PCB ZFLW2391 Rev B

Power Supply Connections

Standard AC Power Supply using unmodified assembly



This is an AC type "Wall Wart" transformer with suitable plug and ratings for your own country. These are usually made with fuses and are fully approved by regulatory agencies for the safety regulations in effect in each country.

The "Wall Wart" shown should have a nominal 12 volt output at 350 mA minimum. The transformer must output between 12 and 14 volts AC.

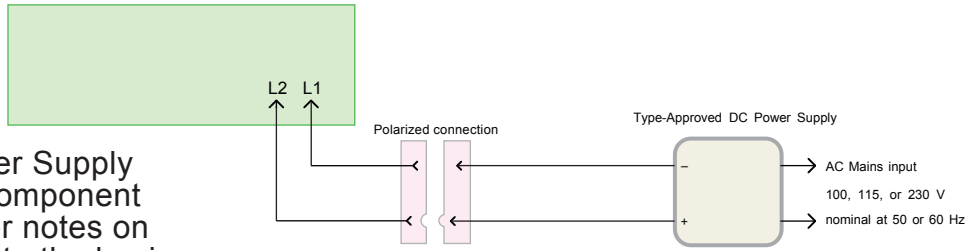
Suggested sources for North America plug style wallwart power transformers at 115 VAC input:

HI-Q AC power adaptor, rated at 12 VAC 500 mA. Mouser order number 412-212053. *Best Deal.*

CUI Stack power adaptor, rated 12 VAC 400 mA. Mfg. part no. DPA120040-S/T-SZ, Digi-Key order number T611-ND.

CUI Stack power adaptor, rated 12 VAC 500 mA. Mfg. part no. DPA120050-S/T-SZ, Digi-Key order number T612-ND.

Special DC Power Supply using modified component values. See other notes on this modification to the basic design.



The "Wall Wart" shown has a 12 volt DC output when loaded to 300 mA. Note that the voltage may be much higher than 12 VDC with no load.

This is an DC type "Wall Wart" transformer with suitable plug and ratings for your own country. These are usually made with fuses and are fully approved by regulatory agencies for the safety regulations in effect in each country.

The "Wall Wart" shown should have a nominal 12 volt DC output at 350 mA minimum. Do not use a switching type power supply, such as is commonly used for notebook computers. There should be a minimum of 25 mv ripple at 300 mA load.

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Yogyakarta, Indonesia
http://www.zetalink.biz
info@zetalink.biz