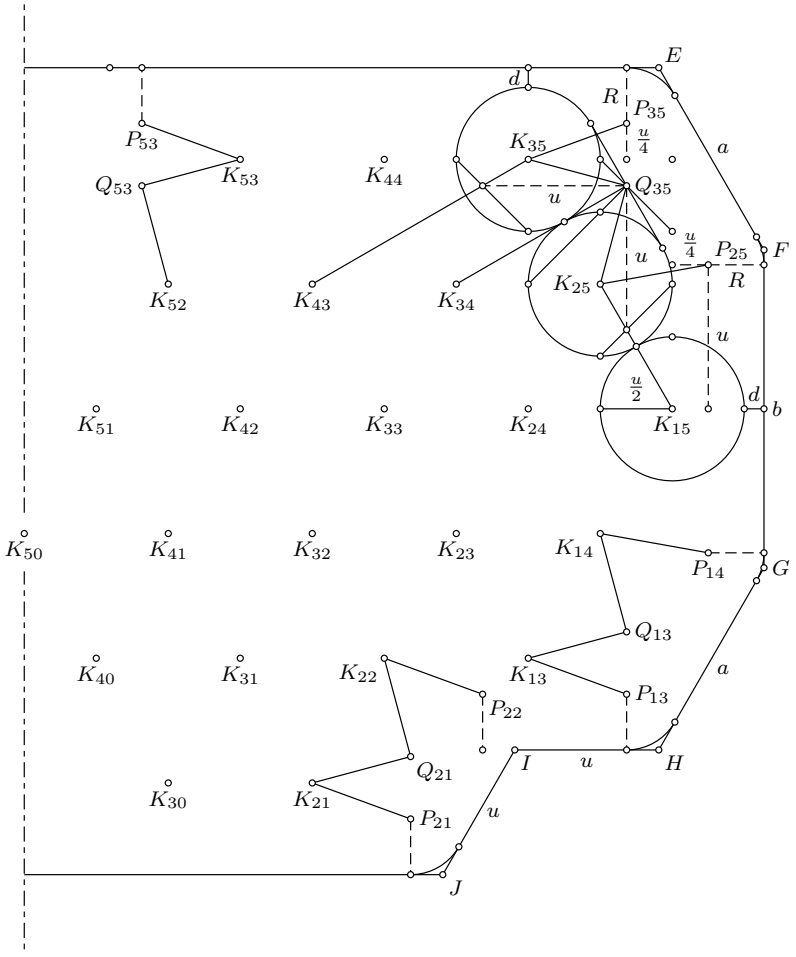
This is a specification to the CAD drawing of the chassis ver. 4 of the Forever Ambre keyboard, independent of the drawing. It can be used to check the current drawing, or to make a replica from scratch.

Ver. 4 is a refined version of ver. 1a. It is aimed at creating a more useful geometry and with a more concise description for the chassis.

The chassis consists of a bottom plate connected to a top plate across a middle plate at 12 threaded spacers. A PCB is mounted to the middle plate at 8 threaded self-clinching standoffs. The chassis is symmetrical and as such it is depicted here with only one half, namely, the right-hand one. The outline of the bottom plate is identical to that of the top plate, but the top plate has (up to) 45 round or hexagonal holes for keycaps to slide through while the bottom plate has not. Correspondingly, on the middle plate there are 45 square holes for mounting keyswitches. In the assembled chassis (in 2D view) a keycap hole and the respective keyswitch hole are cocentric.



Let holes of the keyboard's chassis be identified by their centers. A key (switch or cap) hole is denoted by K_{ij} where i is a row index and j is a column index, for example, K_{50}. All K_{ij} are nodes of an equilateral triangular grid, as depicted

above, with pitch $u = 0.75''$. A hole for a spacer is denoted by P_{ij} where indices i and j are from a nearby keyhole. Every P_{ij}, except P_{22}, identifies a spacer's hole. A hole for a self-clinching standoff is denoted similarly, by Q_{ij}. The mirror image of a right-hand point across the center line, i.e. the vertical line through K_{50}, is denoted with an apostrophe, for example, E' is the left-hand counterpart of E.

The chassis is constrained by the following:

(1) Q_{35} is equidistant from K_{35} and K_{25}.
(2) Q_{35} is equidistant from the horizontal line through K_{25} and the vertical line through K_{35}.
(3) P_{25} is $\frac{u}{4}$ away from the vertical line through K_{15}.
(4) P_{25} is u away from the horizontal line through K_{15}.
(5) P_{35} is on the vertical line through Q_{35}.
(6) P_{35} is $\frac{u}{4}$ away from the horizontal line through K_{35}.
(7) P_{13} is the mirror image of P_{35} in the same mirror that would give K_{13} from K_{35}. Similarly, P_{53}, P_{14}, Q_{13}, Q_{53} is mirror image of P_{35}, P_{25}, Q_{35}, Q_{35}, respectively. Likewise, P_{21} is the shift image of P_{13} in the same translation that would give K_{21} from K_{13}, and similarly P_{22}, Q_{21} is the shift image of P_{13}, Q_{13}, respectively.
(8) The bounding polygon of the top plate consists of the polyline $P_{53} \dots P_{21}$ joined with $P'_{53} \dots P'_{21}$, offsetted outwards by a distance R such that the ratio of length (L) per width (H) of its bounding rectangle is $\frac{L}{H} = \frac{16\sqrt{3}}{15}$.
(9) The bounding polygon of the middle plate is obtained similarly, but with an offset distance r such that the ratio of length (l) per width (h) of its bounding rectangle is $\frac{l}{h} = \frac{13\sqrt{3}}{12}$.

NOTES. Table 1 lists some metrics that are derived from the specification. There the *base rectangle* is the bounding rectangle of the set of all K_{ij}; a *keycap zone* is a circle centered at K_{ij} with the maximal size that does not overlap neighbor keycap zones; a *keyswitch zone* is a similarly defined square; a *standoff zone* is a circle centered at Q_{ij} with the maximal size that does not overlap neighbor keyswitch zones; a *spacer zone* is a circle centered at P_{ij} with the maximal size that does not overlap the neighbor standoff zone (if any).

A rectangular piece of material may be cut out from center top of the middle plate, leaving a semi-hole. The *center top zone* is the rectangle at the center top of the plate with maximal size leaving a distance of at least e (defined by Table 1) to neighbor keyswitch/standoff/spacer zones.

The distance R is also the radius of fillet for convex vertices of the top plate, i.e. vertex E, F, G, H, J. And similar is the distance r for the middle plate.

Q_{35} is $\frac{\sqrt{2}}{2}u$ away from K_{35} (and K_{25}) and is $\frac{1+\sqrt{3}}{4}u$ away from the vertical line through K_{35} (and the horizontal line through K_{25}). The Figure also suggests other ways of locating Q_{35}, including one using distance u.

The straight line $P_{25}P_{35}$ is parallel to $K_{25}K_{35}$.

Specified are location and size of zones around holes. The size of holes is unspecified. Similarly, the size of the rectangular semi-hole of the middle plate is unspecified.

TABLE 1. Metrics.

Description	Denotation	Value
Diameter of a keycap zone	u	u
Edge length of a keyswitch zone	v	$\frac{\sqrt{3}}{2}u$
Length of the base rectangle	l_0	$9u$
Width of the base rectangle	h_0	$5v$
Length of top plate	L	$l_0 + u + 2d$
Width of top plate	H	$h_0 + u + 2d$
Side width of top plate, i.e. length of EH	H'	$H - v$
Length of middle plate	l	$l_0 + v + 2e$
Width of middle plate	h	$h_0 + v + 2e$
Side width of middle plate	h'	$h - v$
Height of the center top zone	p	$2v$
Width of the center top zone	q	$2u - v - 2e$
Offset from keycap zones to plate's edge	d	$\frac{80v-53u}{181}$
Offset from keyswitch zones to plate's edge	e	$\frac{21u-15v}{121}$
Radius of a spacer zone	P	$\frac{v}{2} - Q$
Radius of a standoff zone	Q	$\frac{u}{4}$
Radius of fillet at top plate	R	$\frac{u}{2} - Q + d$
Radius of fillet at middle plate	r	$\frac{v}{2} - Q + e$
Distance between P_{25} and P_{35}	f	$2u - v$
Distance between P_{25} and P_{14}	g	$2u$
Distance between Q_{35} and Q_{13}	i	$\frac{1}{2}u + 3v$
Distance between P_{35} and P_{13}	j	$\frac{1}{2}u + 4v$
Distance between P_{35} and P_{53} (Q_{35} and Q_{53})	k	$\frac{5}{2}u + v$
Distance between P_{21} (Q_{21}) and P'_{21} (Q'_{21})	m	$\frac{9}{2}u + v$
Distance between P_{53} (Q_{53}) and P'_{53} (Q'_{53})	n	$\frac{5}{2}u - v$
Length of a chamfer edge, i.e. EF and GH	a	$f + 2R(1 - \frac{\sqrt{3}}{3})$
Length of right edge, i.e. FG	b	$g + 2R(2 - \sqrt{3})$
Length of top edge, i.e. EE'	t	$L - a$
Length of bottom edge, i.e. JJ'	c	$t - 3u$