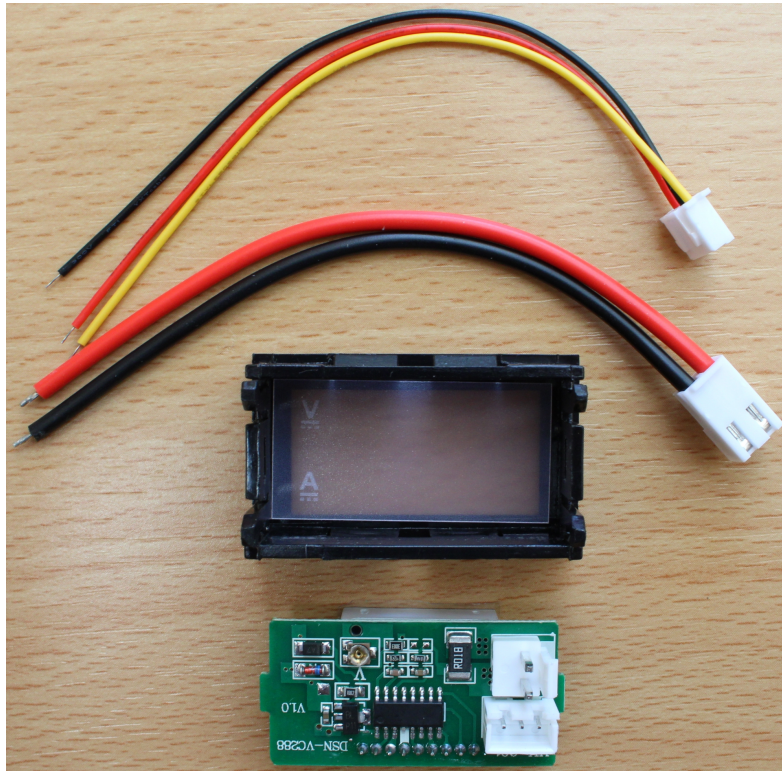
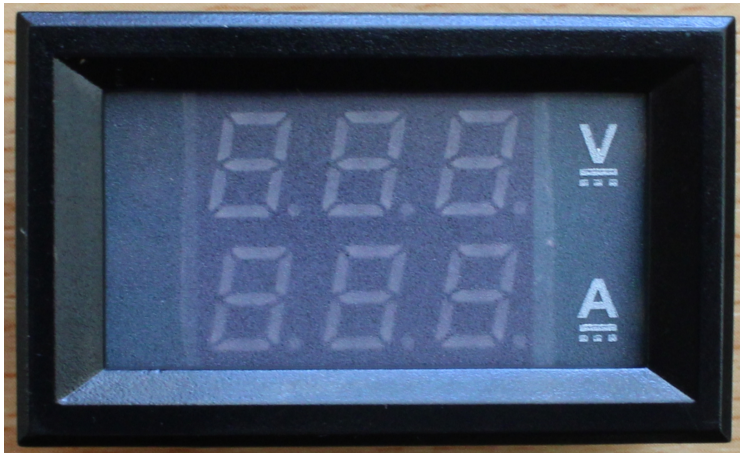


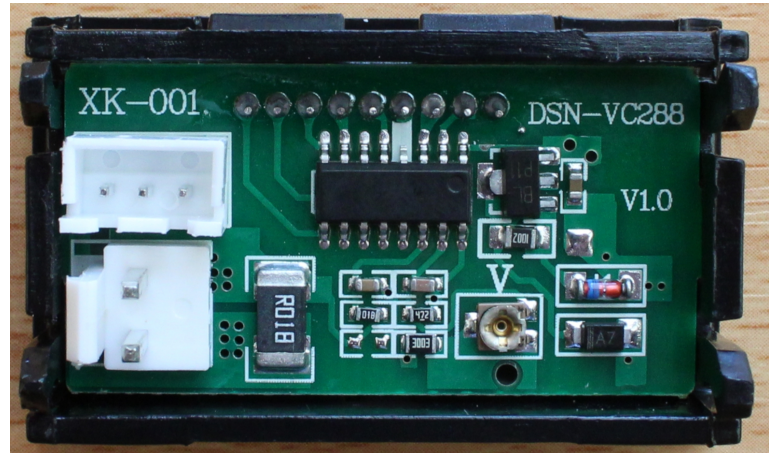
Digital Voltmeter Ammeter



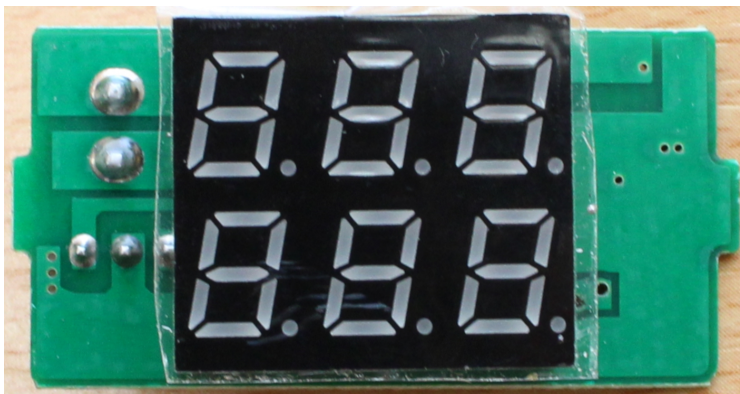
Whole parts (Wires; Thick RD, Thick BK, Thin RD, Thin BK, Thin YE, Case, Board with LED flat panel)



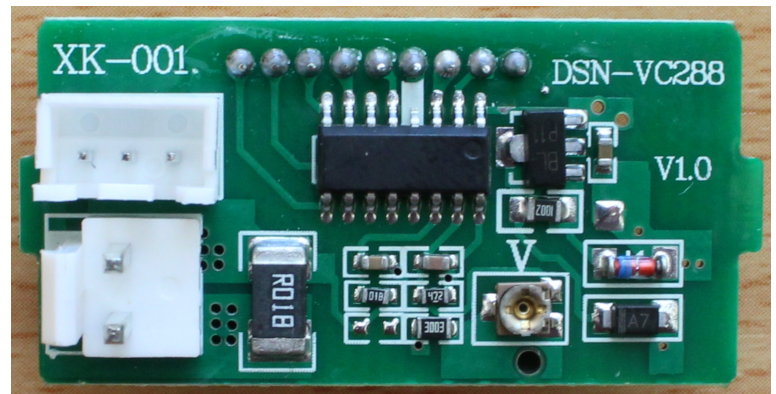
Display panel with case



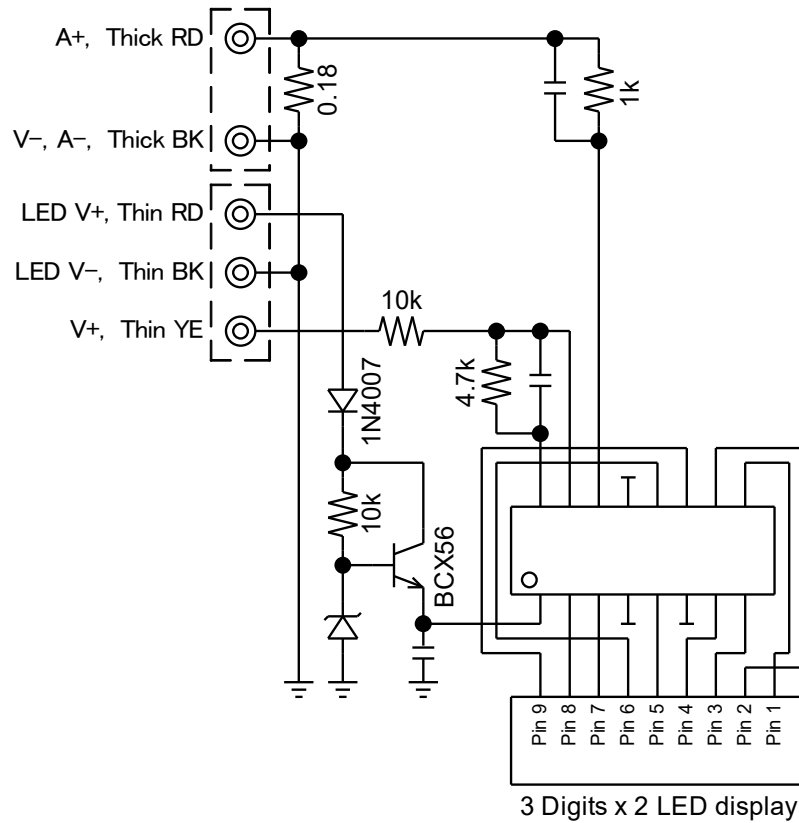
Board with case



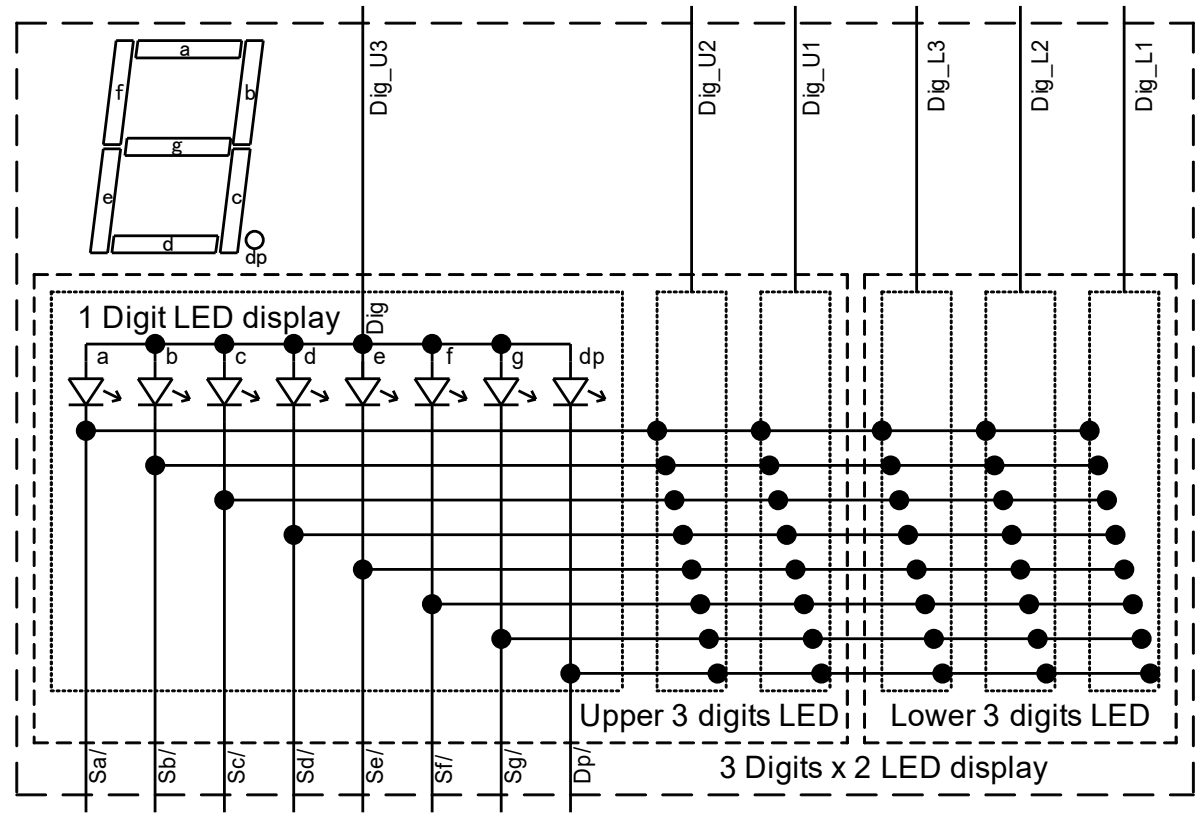
Board (LED flat panel side)



Board (Parts and connectors side)



Digital voltmeter ammeter schematic



Conventional 3 digits x 2 7 segments LED display module schematic

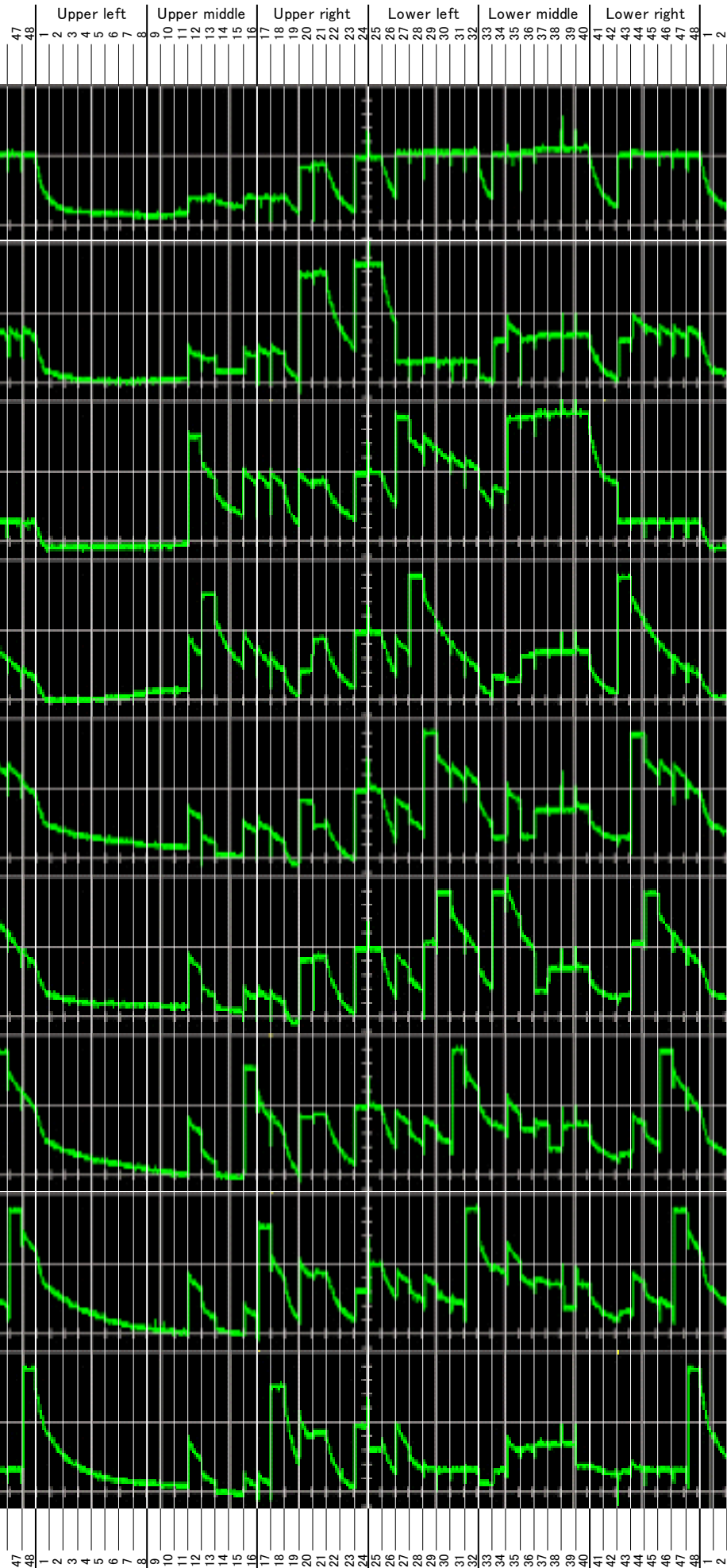
Refer to a datasheet of key components.

- (1) [1N4007](#), 1000V 1A Rectifier.
- (2) [BCX56](#), 80V 1A NPN Power Transistor.

This digital voltmeter does not use conventional LED display module shown above to eliminate external LED drivers (integrating on-chip LED drivers) and to reduce pin counts from 14 to 9 utilizing advanced technology.

48 LEDs are independently turned on sequentially by the combination of 9 serial input signals (Pin 1 through 9) provided by the controller which implements both analog to digital converters for voltmeter and ammeter as well as a processor to generate the display serial signals providing High, Low, and tri-state (LED turns off).

Pin 1
Pin 2
Pin 3
Pin 4
Pin 5
Pin 6
Pin 7
Pin 8
Pin 9



Pin 1

Pin 2

Pin 3

Pin 4

Pin 5

Pin 6

Pin 7

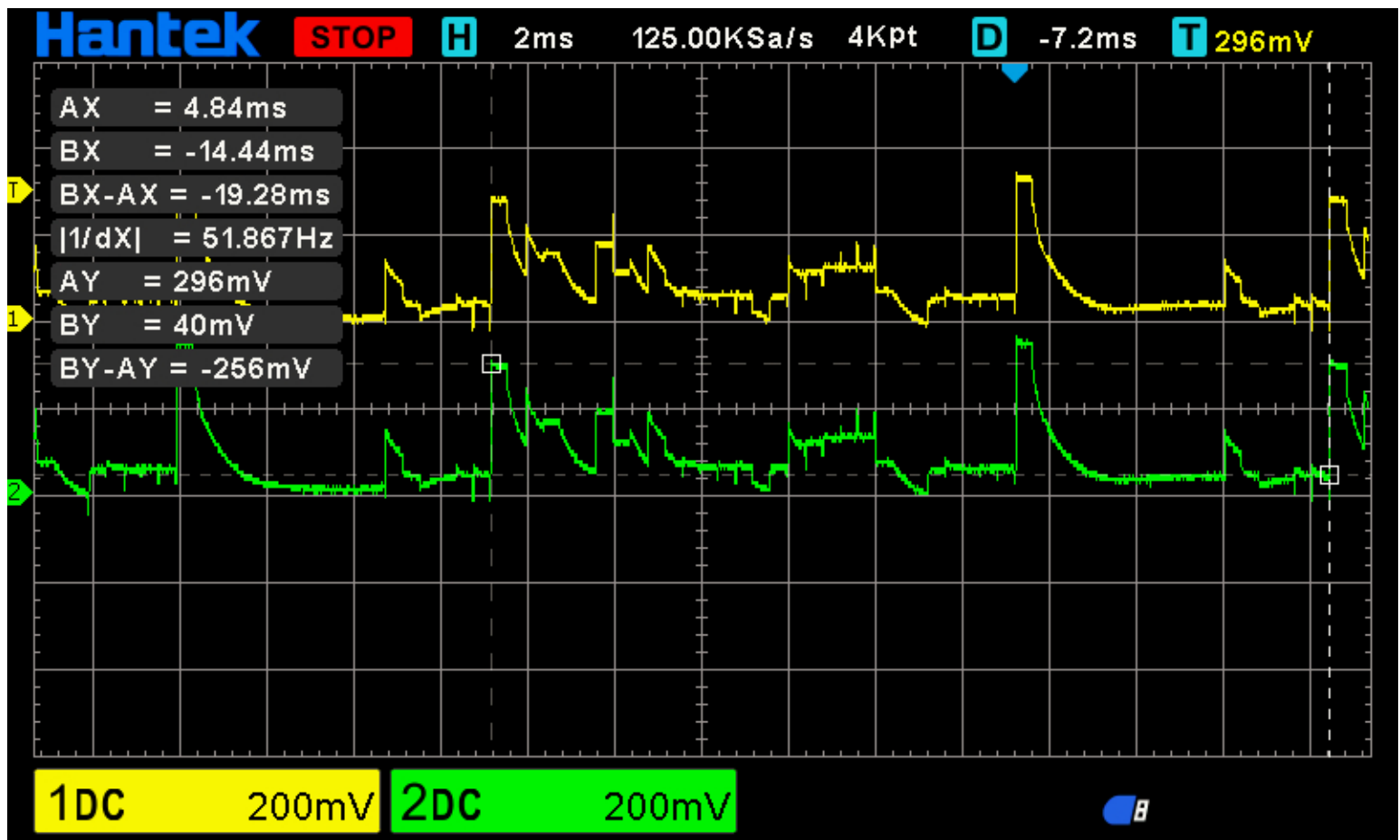
Pin 8

Pin 9

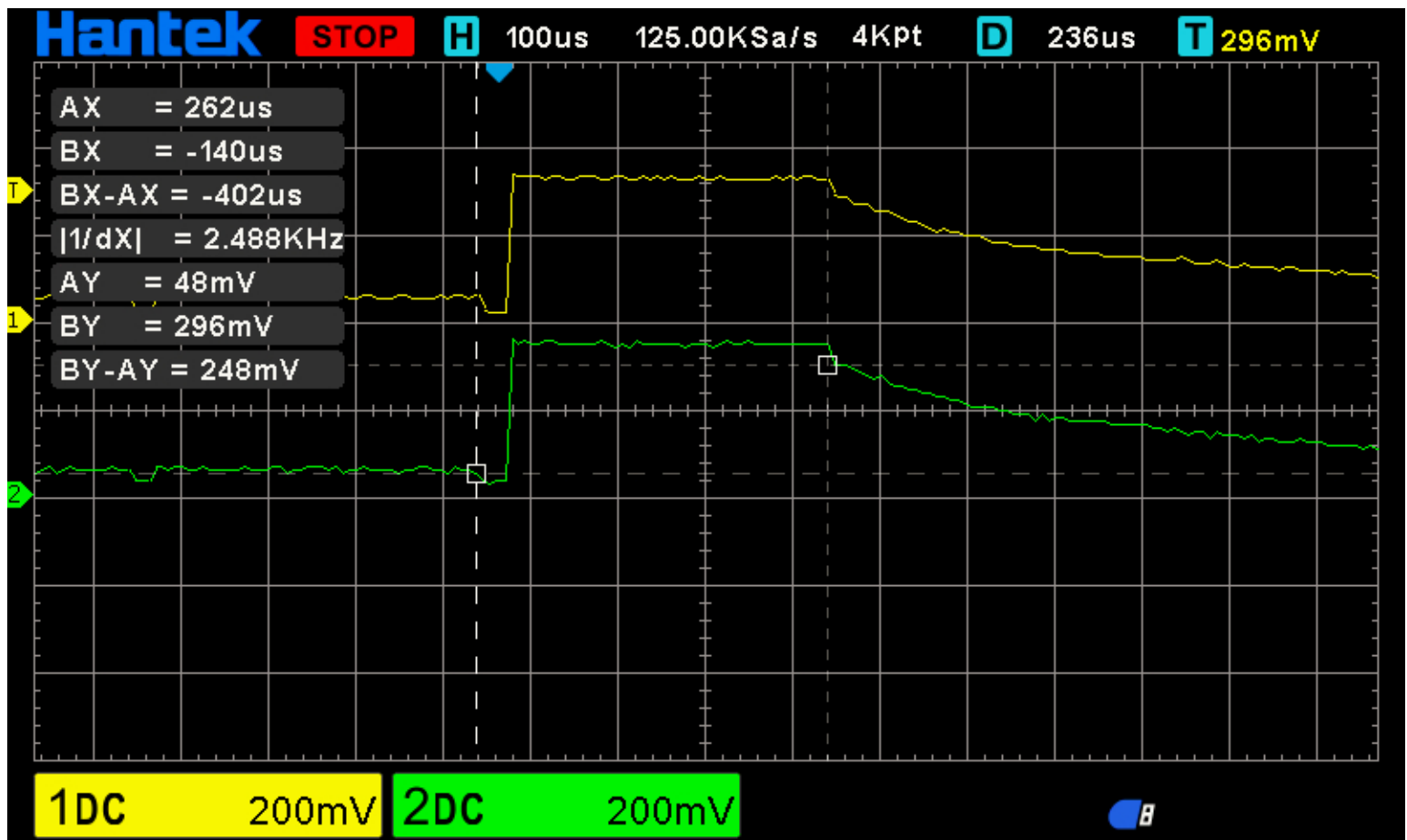
47 48 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 1 2

47 48 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 1 2

10.2V - 0.00A

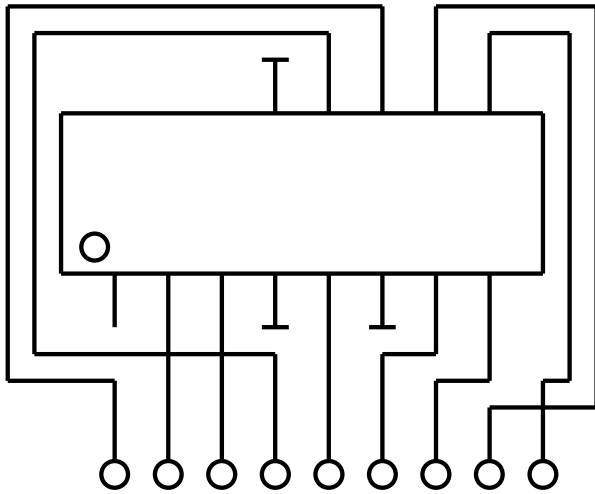


Cycle time is 19.28 mSec (51.867 Hz).

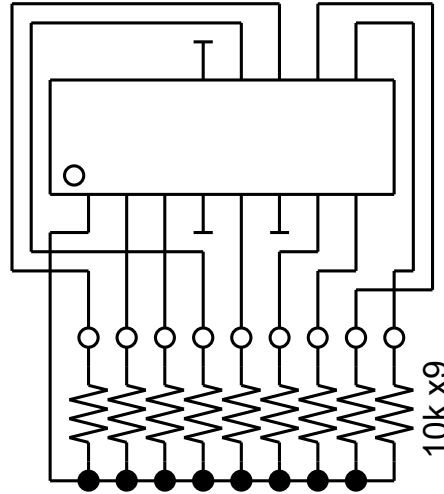


Signal changes every 0.402 mSec. $19.28 / 0.402 \cong 48$.

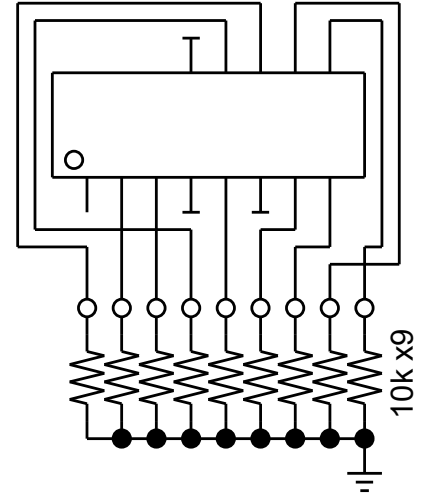
The data stream flows total 48 bits in one cycle which are equivalent with 8 segments x 6 digits.



H/L/Tri-state Mixed



Force tri-state to H (Pull up)



Force tri-state to L (Pull down)

with no LEDs load (o; probing points)

In order to verify if the H-L combination extracted from the waveform is right, provide H level from red probe and L level from black probe of voltmeter under diode/beep position to pins of an LED display module detached. When H-L combination noted on the table exhibited at page 10 is touched, corresponding segment of the digit must turn on.

Pin 1

Pin 2

Pin 3

Pin 4

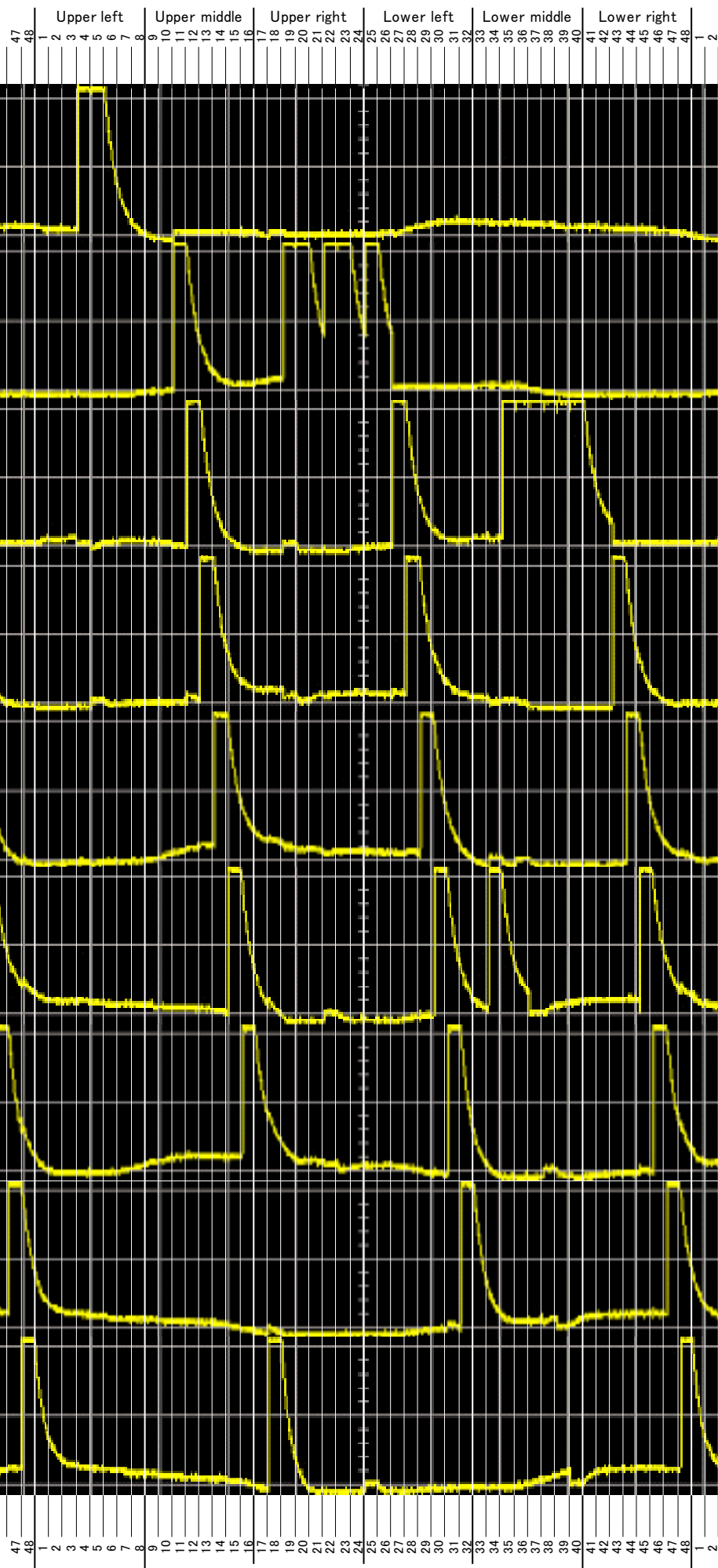
Pin 5

Pin 6

Pin 7

Pin 8

Pin 9



10.2V - 0.00A without LEDs load (High/Low/Tri-state)

Pin 1

Pin 2

Pin 3

Pin 4

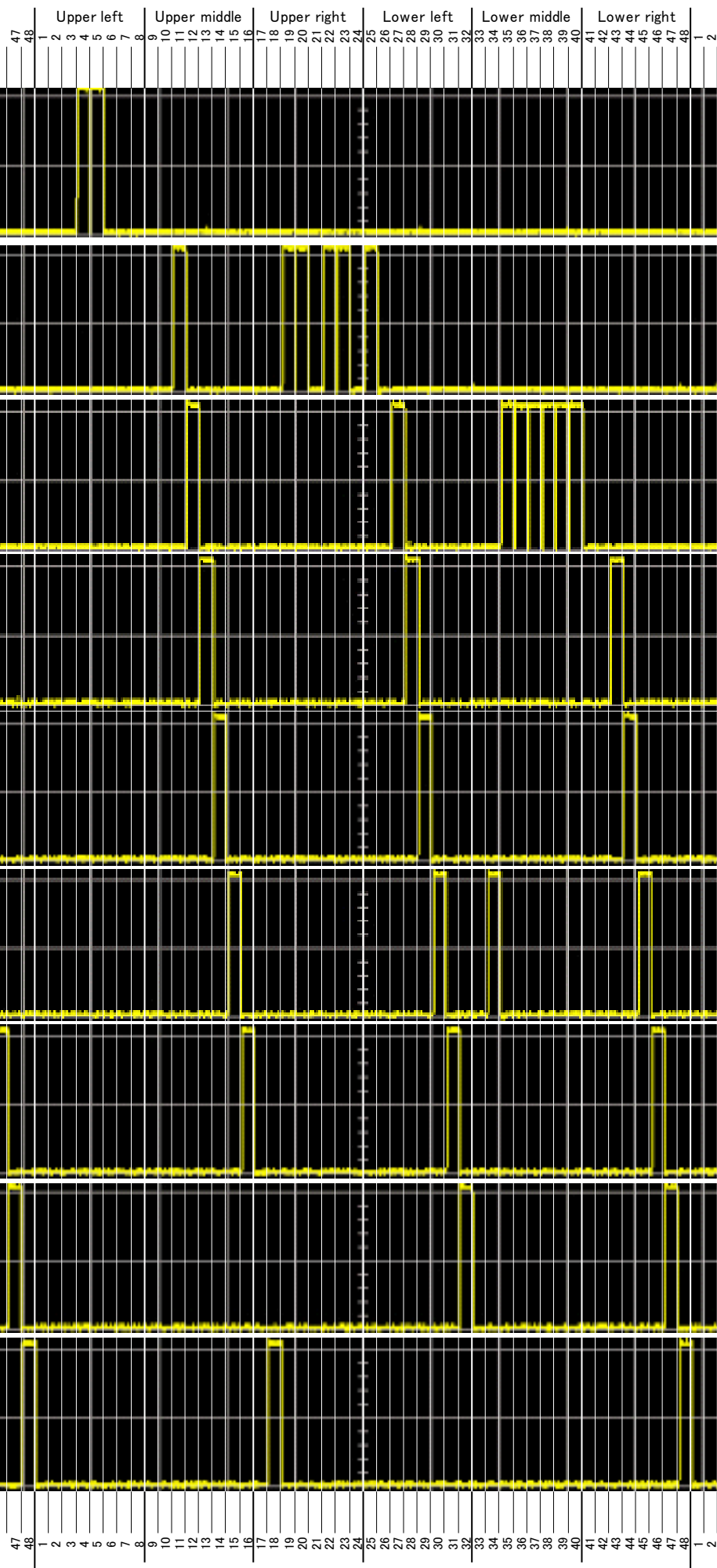
Pin 5

Pin 6

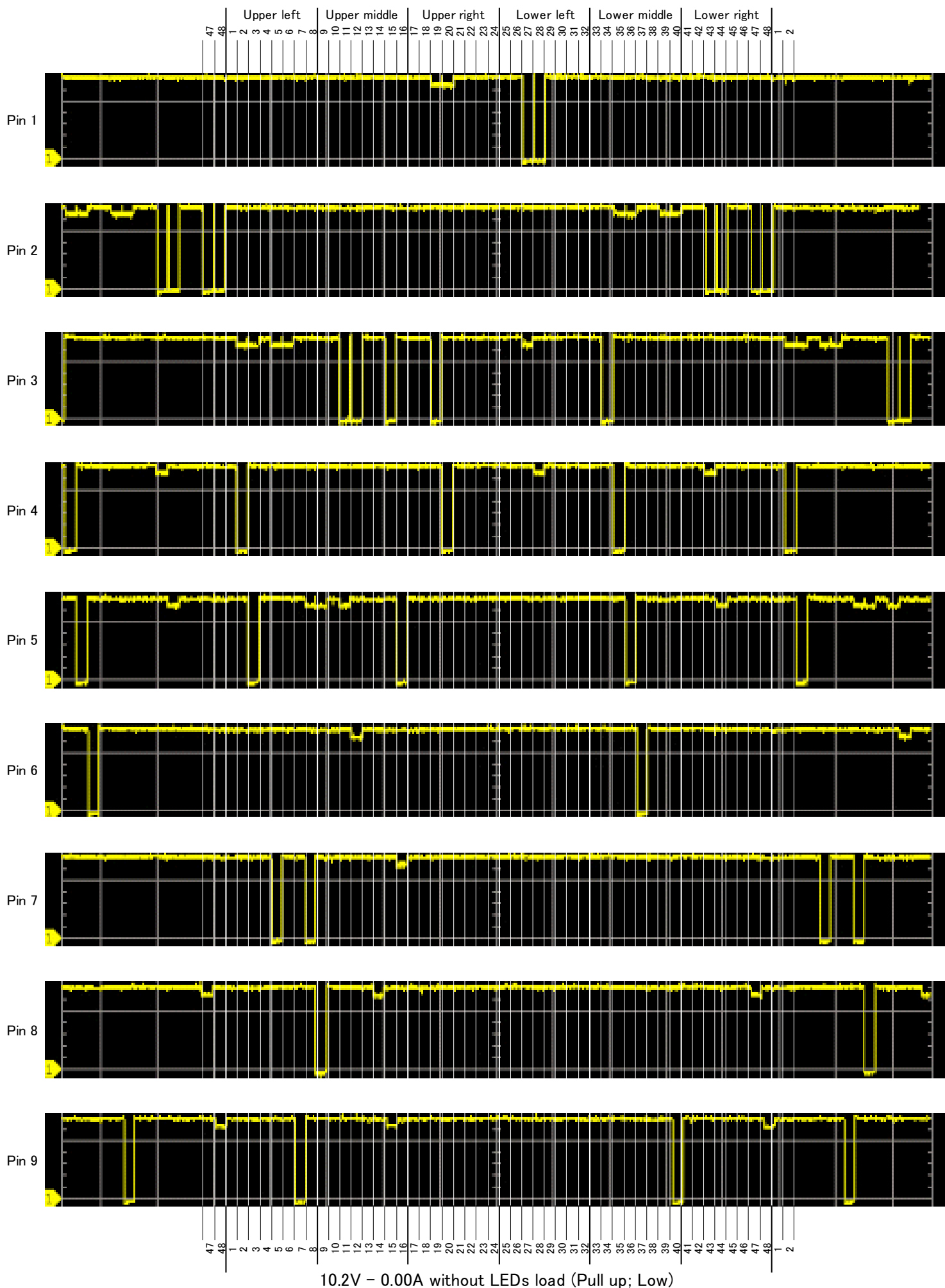
Pin 7

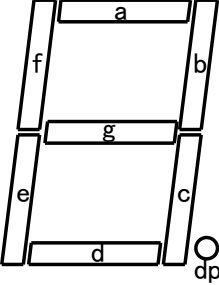
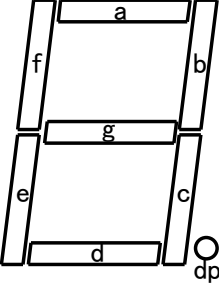
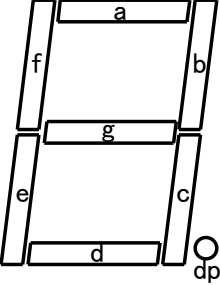
Pin 8

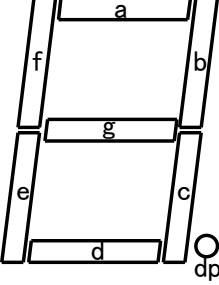
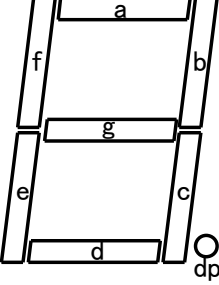
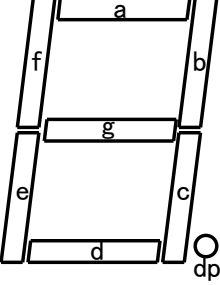
Pin 9



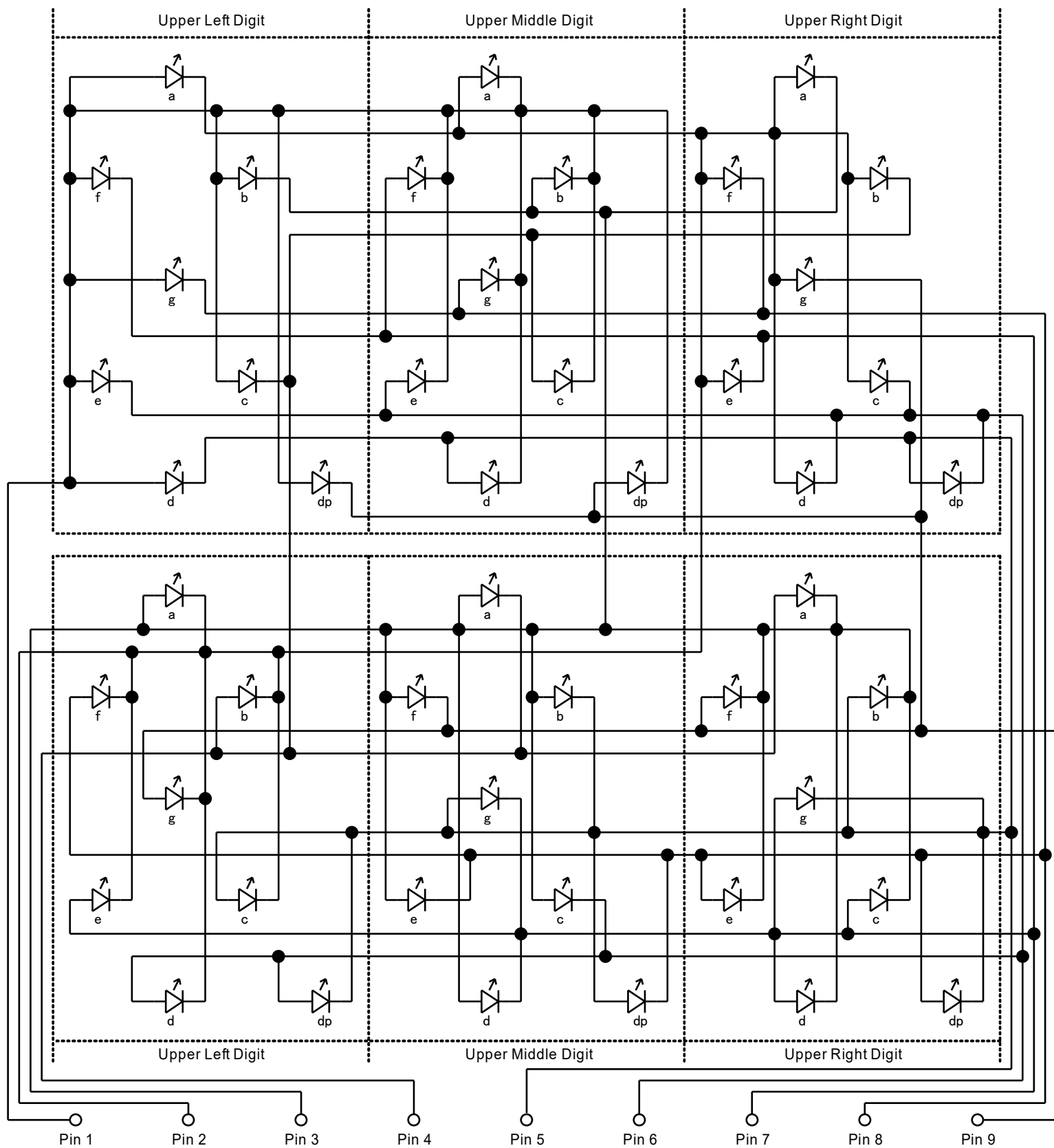
10.2V - 0.00A without LEDs load (Pull down; High)



Sequence	Upper Left Digit								Upper Middle Digit								Upper Right Digit							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Pin	1	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	x	x	x	x	x	x	x	x
	2	x	x	L	x	x	x	x	x	x	H	x	x	x	x	x	x	H	H	H	H	H	H	H
	3	x	x	x	L	x	x	x	x	x	x	H	x	x	x	x	x	x	L	x	x	x	x	x
	4	x	x	x	x	L	x	x	x	x	x	x	H	x	x	x	x	x	x	L	x	x	x	x
	5	x	x	x	x	x	L	x	x	x	x	x	x	H	x	x	H	x	x	x	L	x	x	x
	6	x	x	x	x	x	L	x	x	x	x	x	x	x	H	x	L	x	x	x	x	L	x	x
	7	x	x	x	x	x	x	L	x	x	x	x	x	x	x	H	x	x	x	x	x	x	L	x
	8	x	L	x	x	x	x	x	x	H	x	x	x	x	x	x	x	x	x	x	x	x	x	L
	9	L	x	x	x	x	x	x	H	x	x	x	x	x	x	x	x	L	x	x	x	x	x	x
Segment	dp	g	a	b	c	d	e	f	dp	g	a	b	c	d	e	f	dp	g	a	b	c	d	e	f
LEDs																								

Sequence	Lower Left Digit								Lower Middle Digit								Lower Right Digit							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Pin	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	2	x	L	L	L	L	L	L	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	3	x	x	H	x	x	x	x	x	x	H	H	H	H	H	H	x	x	L	L	L	L	L	L
	4	x	x	x	H	x	x	x	x	x	L	x	x	x	x	x	x	x	H	x	x	x	x	x
	5	L	x	x	x	H	x	x	H	H	x	L	x	x	x	x	L	L	x	H	x	x	x	x
	6	H	x	x	x	x	H	x	x	x	x	x	L	x	x	x	x	x	x	H	x	x	x	x
	7	x	x	x	x	x	x	H	x	x	L	x	x	x	L	x	x	H	x	x	x	H	x	x
	8	x	x	x	x	x	x	H	L	x	x	x	x	x	L	x	H	x	x	x	x	x	H	x
	9	x	H	x	x	x	x	x	x	x	x	x	x	x	x	L	x	x	x	x	x	x	x	H
Segment	dp	g	a	b	c	d	e	f	dp	g	a	b	c	d	e	f	dp	g	a	b	c	d	e	f
LEDs																								

Pin[9:1] output **H**, **L**, or tri-state (x) level. An LED turns on under **H-L** combination. The duty cycle is 1/48.



Expected LED board interconnects