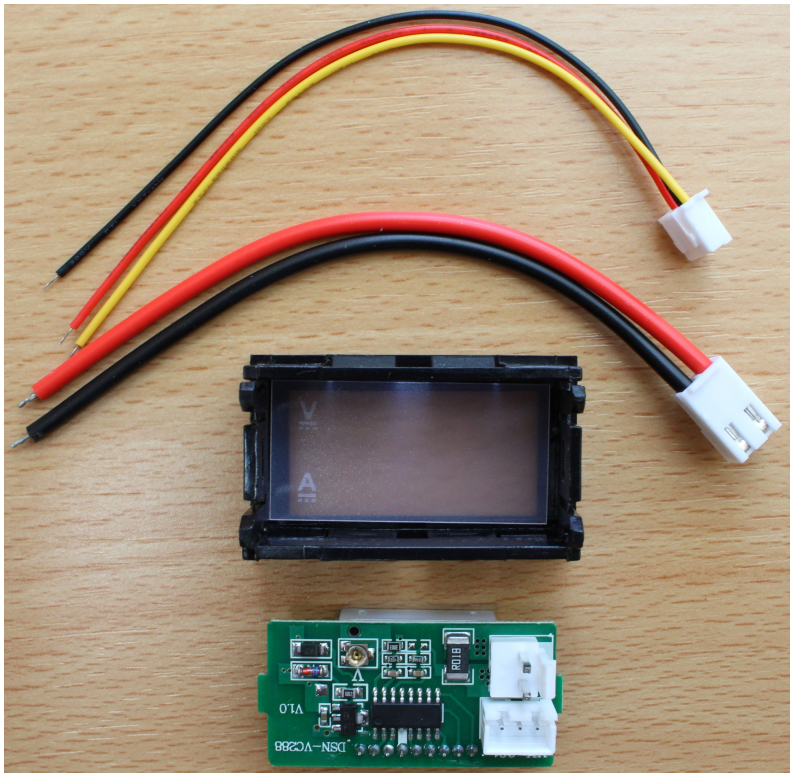
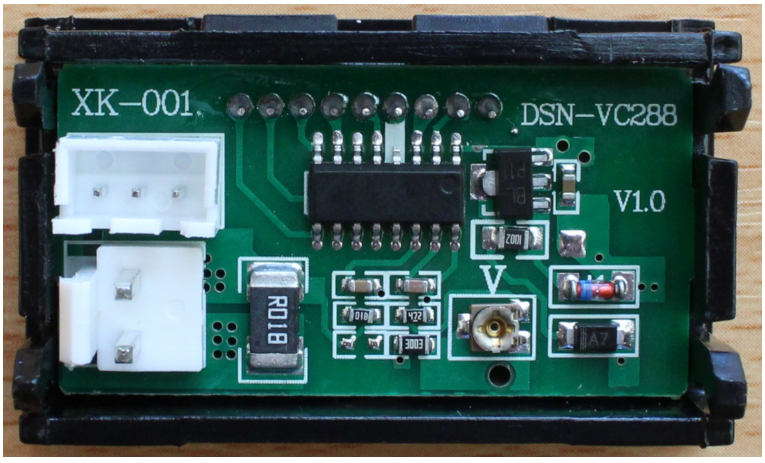
Digital Voltmeter Ammeter



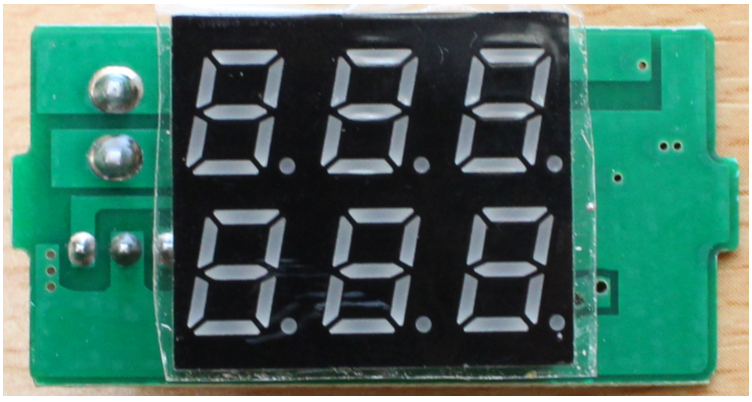
Whole parts (Wires; Thick RD, Thick BK, Thin RD, Thin BK, Thin YE, Case, Board with LED flat panel)



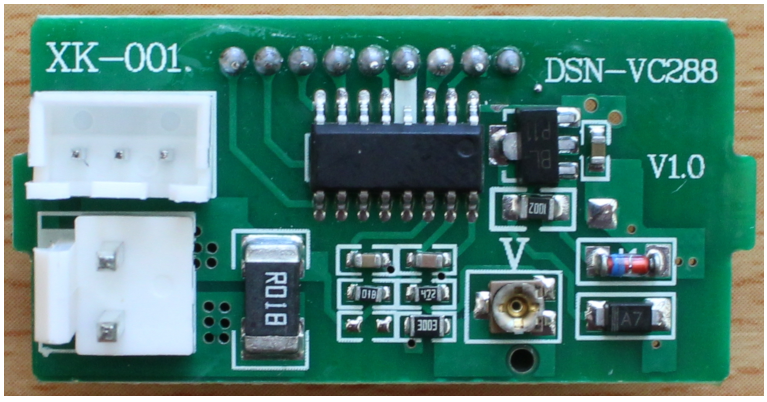
Display panel with case



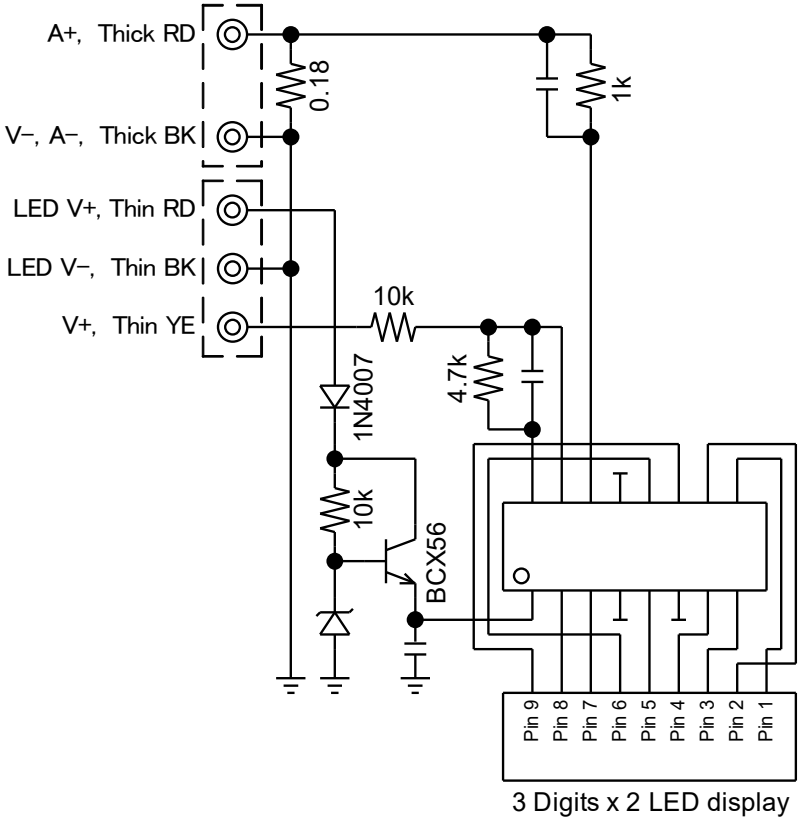
Board with case



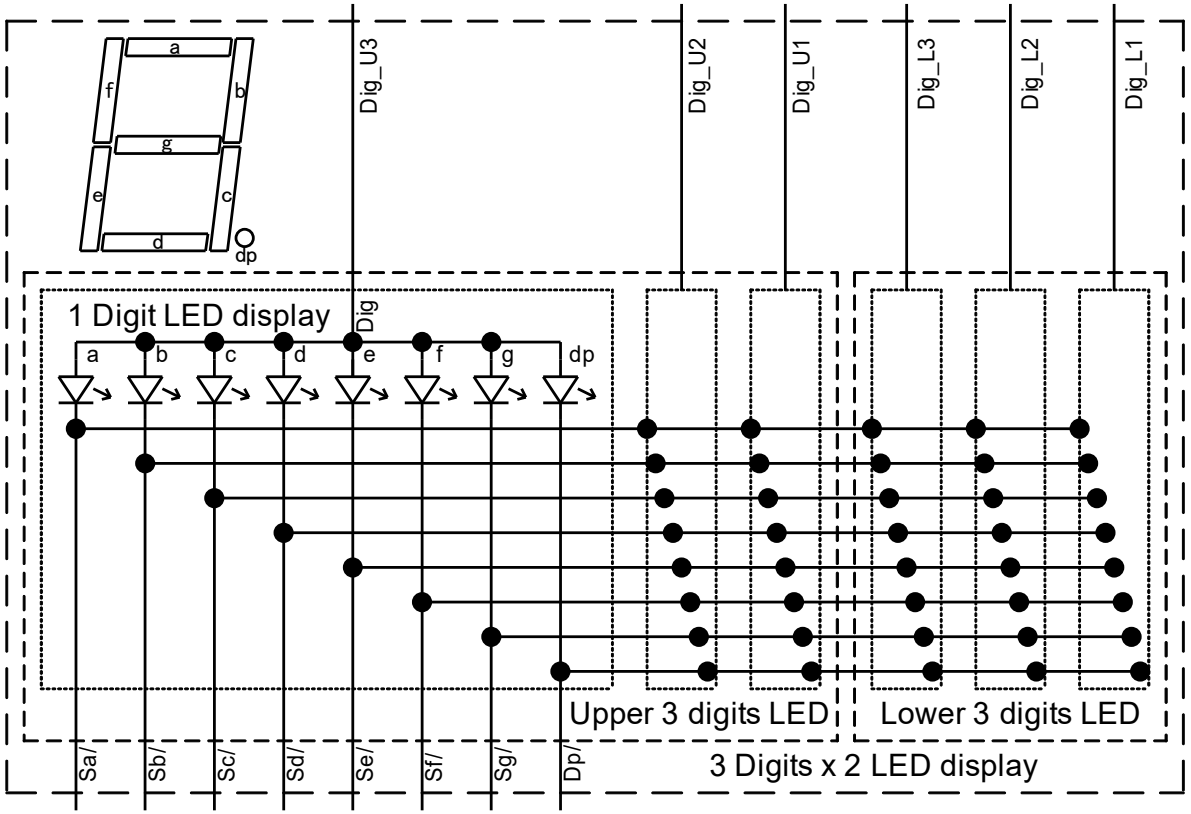
Board (LED flat panel side)



Board (Parts and connectors side)



Digital voltmeter ammeter schematic

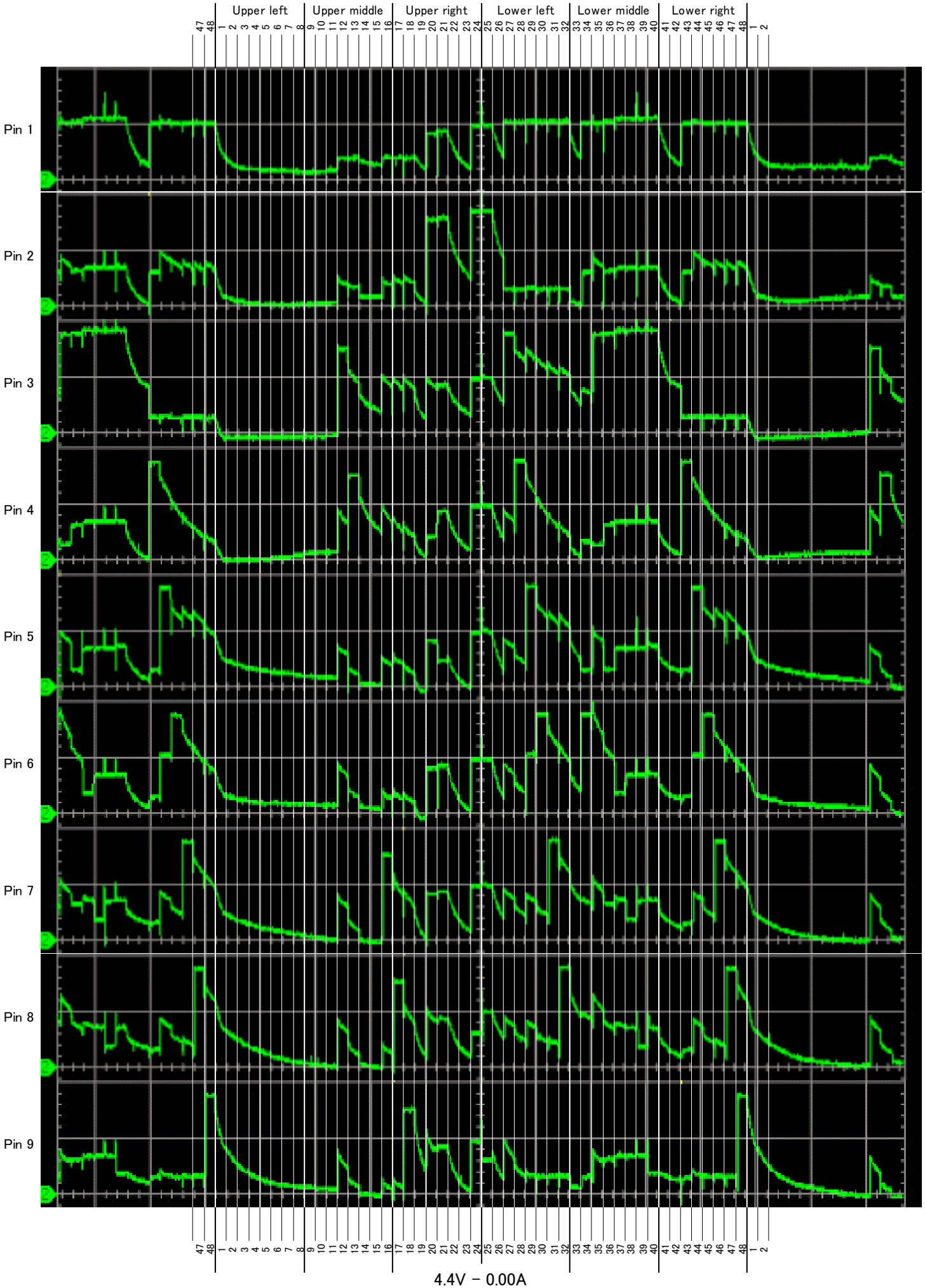


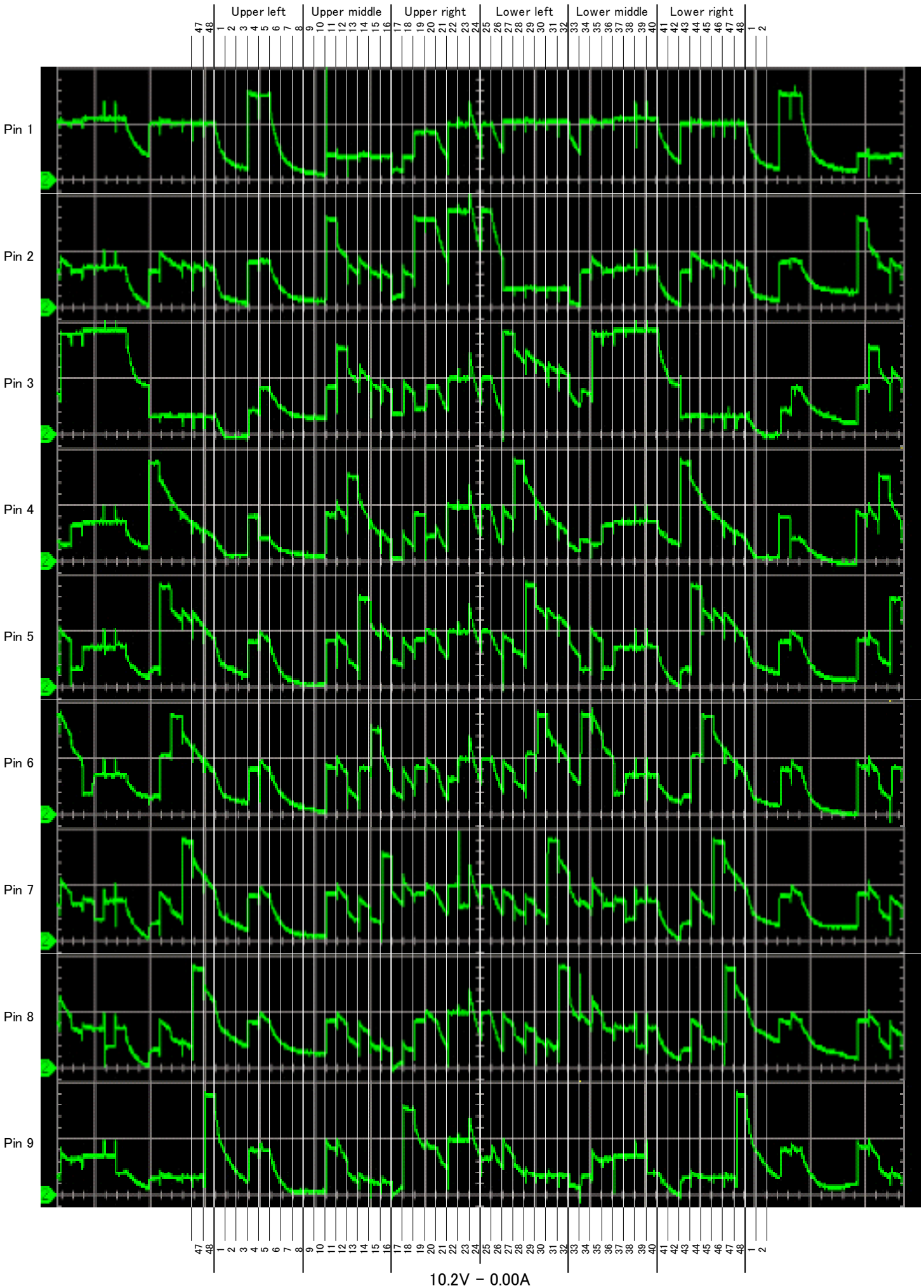
Conventional 3 digits x 2 7 segments LED display module schematic

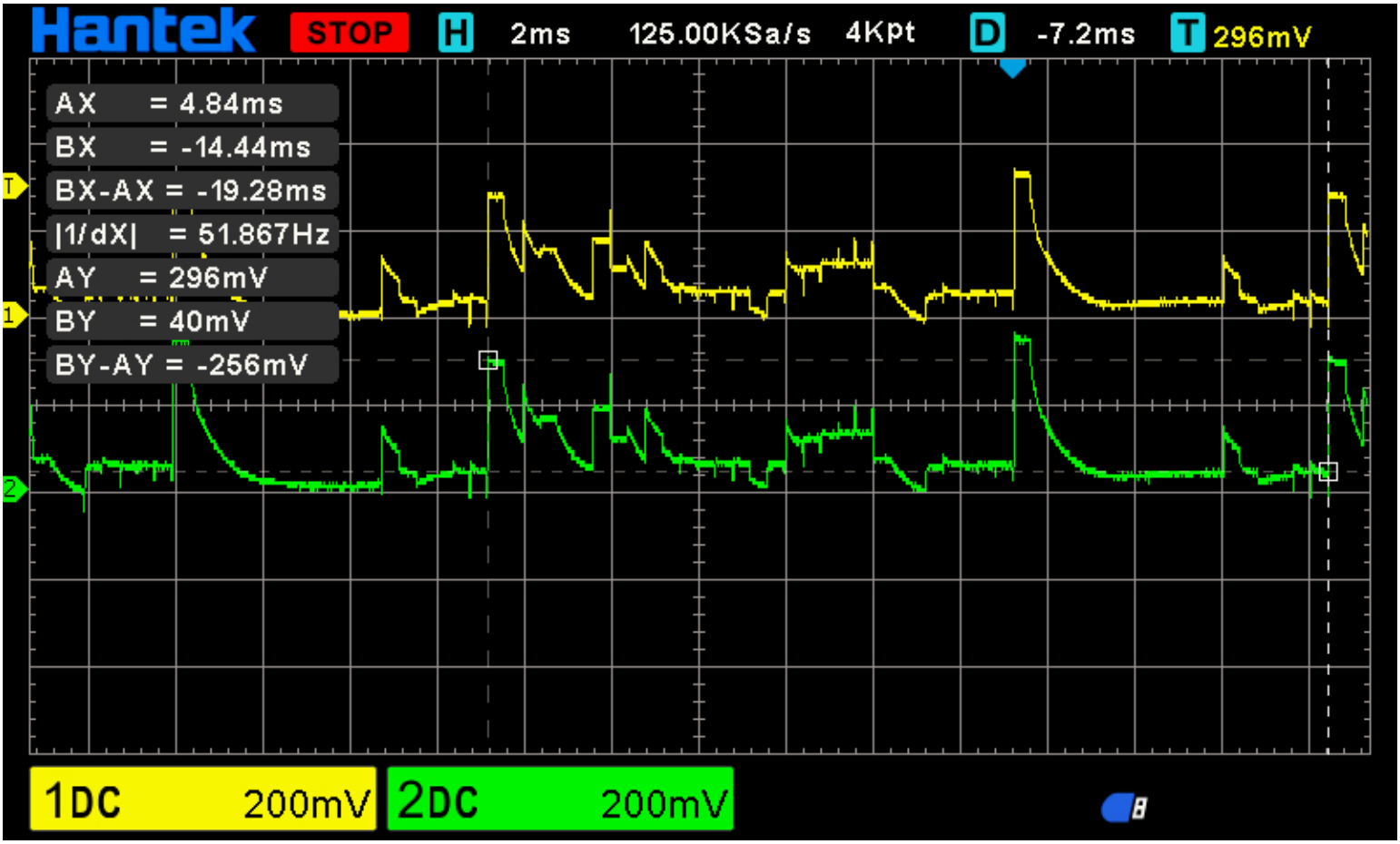
Refer to a datasheet of key components.
(1) 1N4007, 1000V 1A Rectifier.
(2) BCX56, 80V 1A NPN Power Transister.

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.

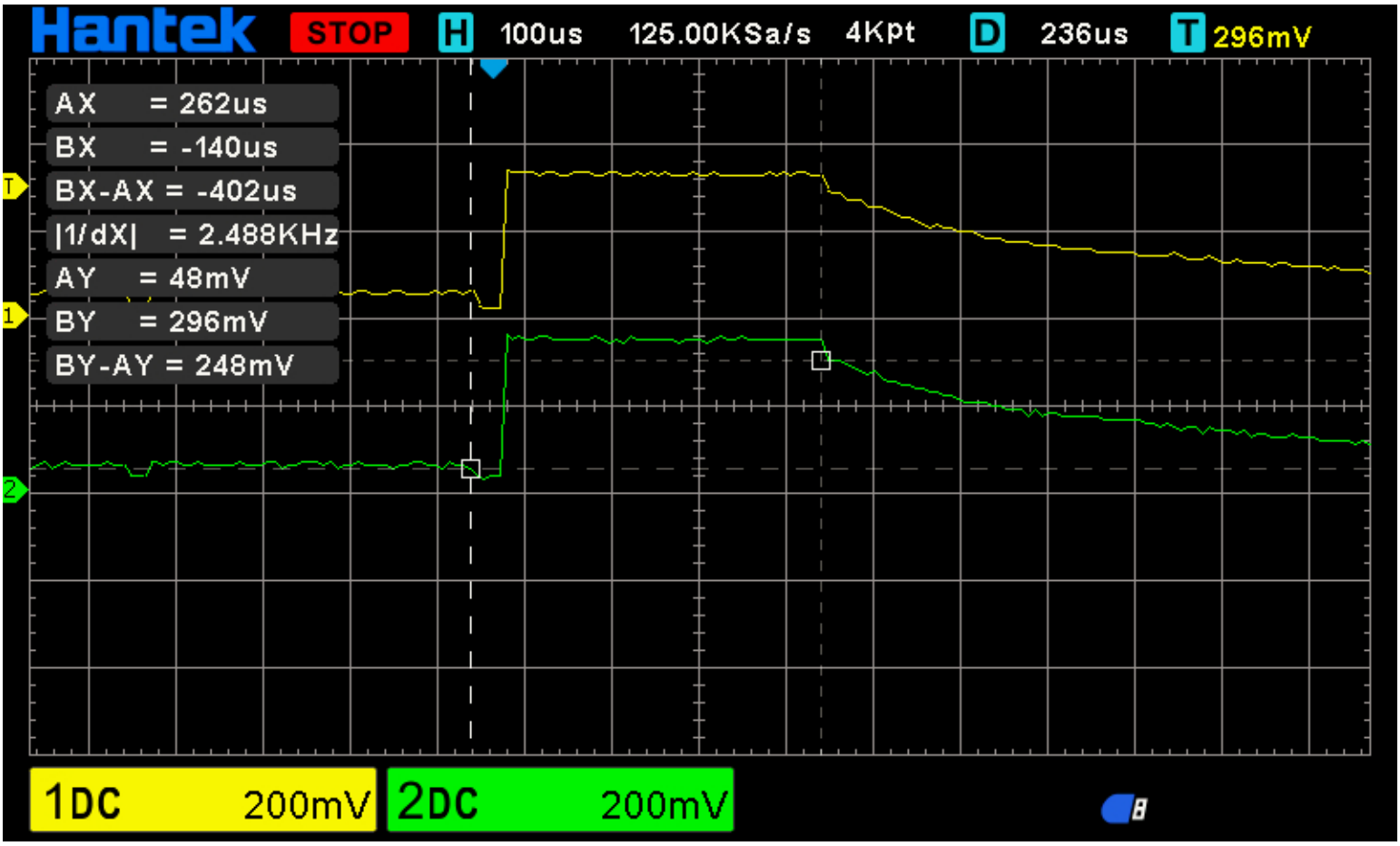
48 LEDs are independently turned on sequentially by the combination of 9 serial input signals (Pin 1 through 9) provided by the controller which implements both analog to digital converters for voltmeter and ammeter as well as a processor to generate the display serial signals providing High, Low, and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


Upper left
Upper middle
Upper right
Lower left
Lower middle
Lower right
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
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
4.4V ~ 0.00A


Upper left
Upper middle
Upper right
Lower left
Lower middle
Lower right
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
Pin 1
Pin 2
Pin 3
Pin 4
Pin 5
Pin 6
Pin 7
Pin 8
Pin 9
10.2V – 0.00A

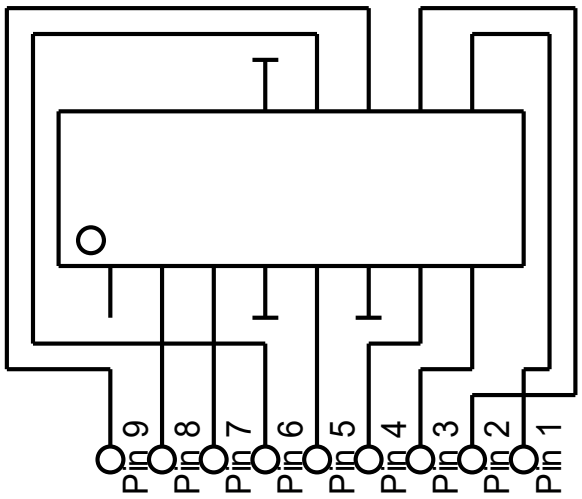


Cycle time is 19.28 mSec (51.867 Hz).

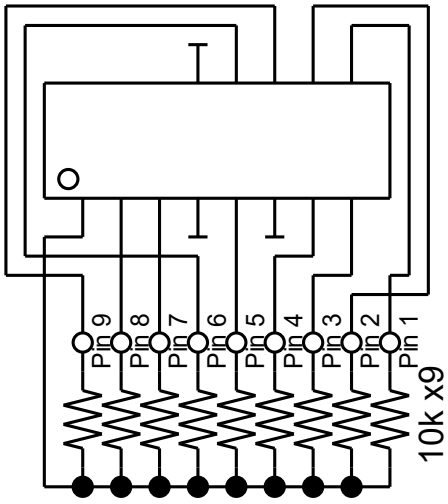


Signal changes every 0.402 mSec. 19.28 / 0.402 ≅ 48.

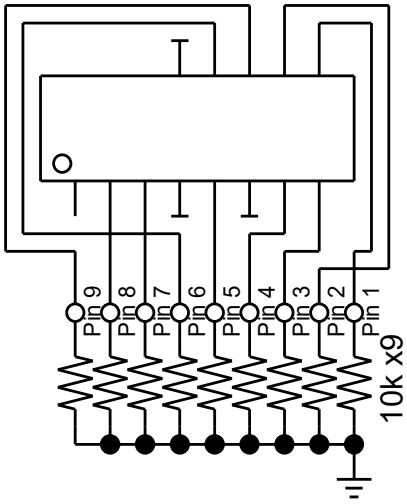
The data stream flows total 48 bits in one cycle which are equivalent with 8 segments x 6 digits (Total number of LEDs implemented in LED display module).



High level, Low level, and Tri-state are mixed



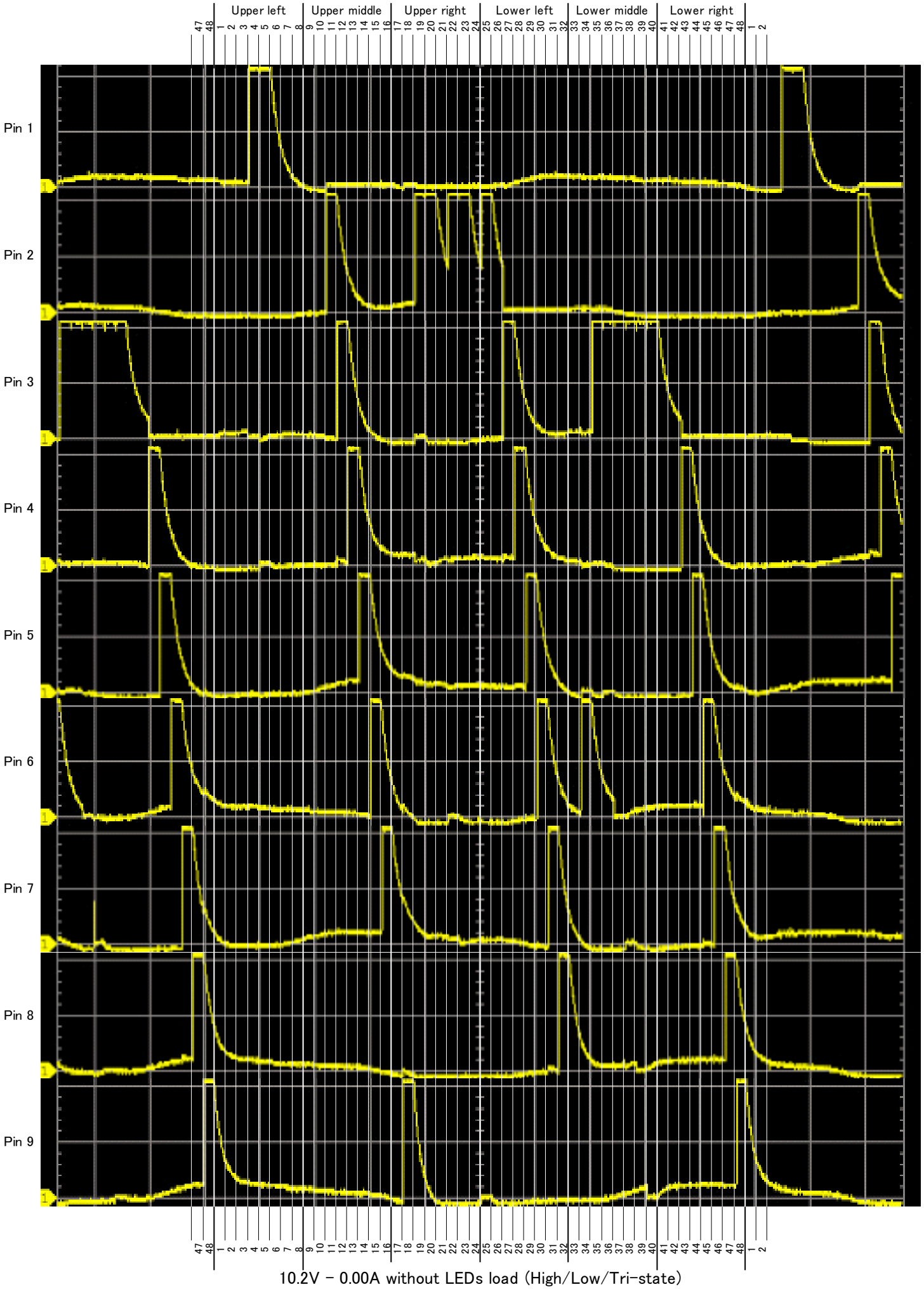
Force tri-state to H (Pull up)



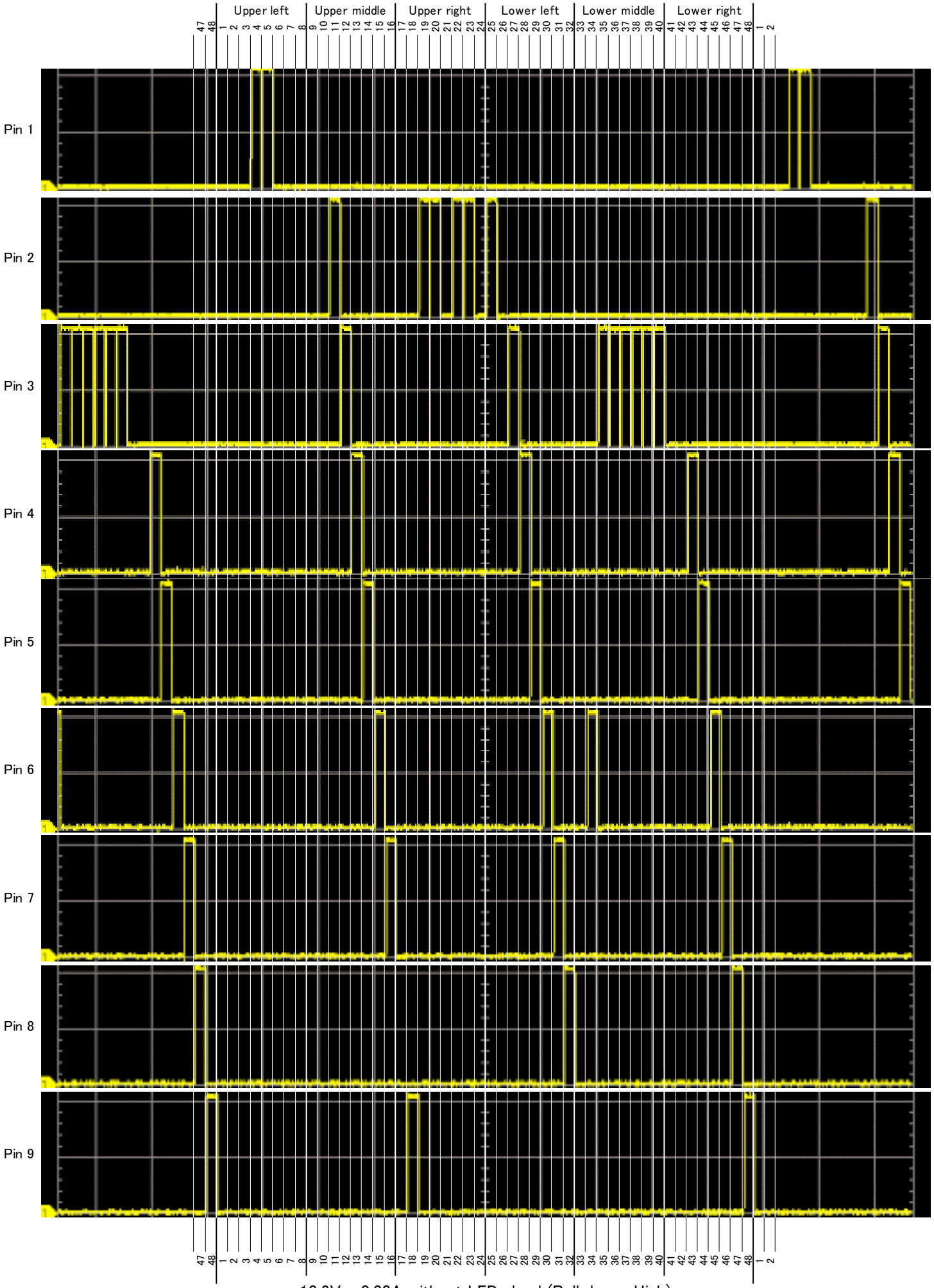
Force tri-state to L (Pull down)

Probed Pin 1 to Pin 9 (LED drive serial signals output from 16 pin controller IC) under three connections above

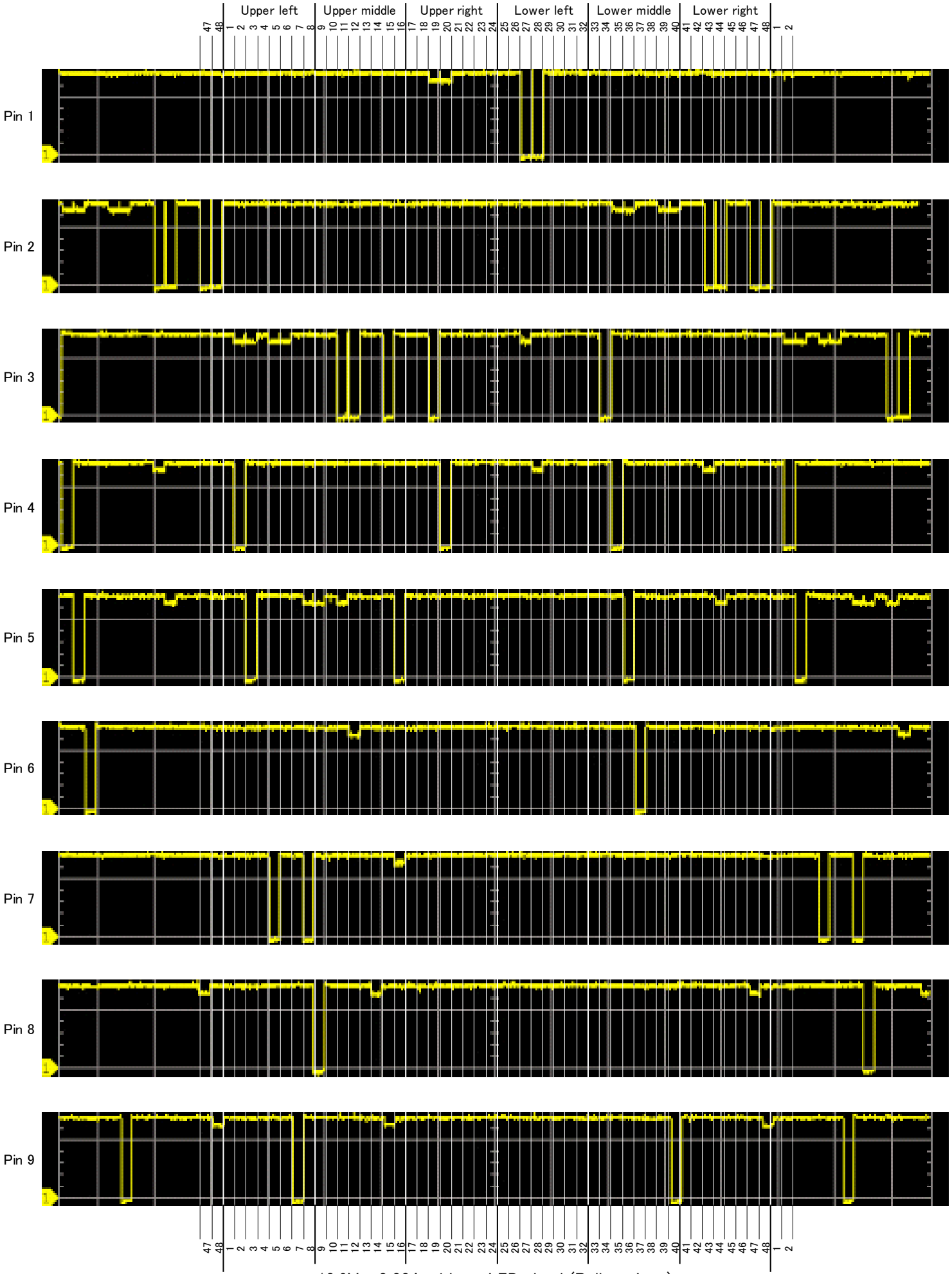
In order to verify if the High/Low combination (LED turns on) extracted from the waveform attached at following pages is right, provide High level from red probe and Low level from black probe of voltmeter under diode/beep position to LED display module pins. When High/Low combination noted on the table exhibited at page 10 is touched, corresponding segment of the digit must turn on.



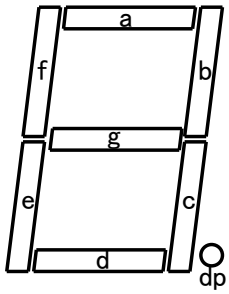
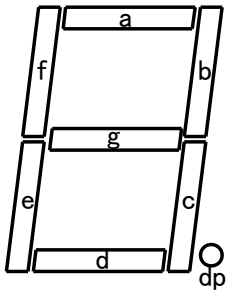
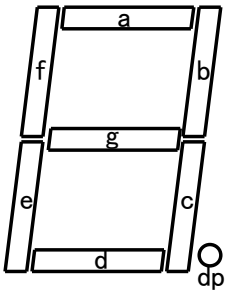
10.2V – 0.00A without LEDs load (High/Low/Tri-state)

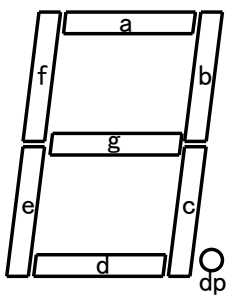
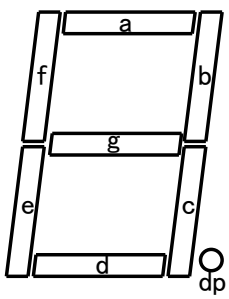
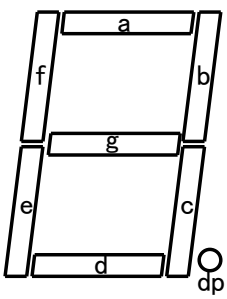


10.2V – 0.00A without LEDs load (Pull down; High)

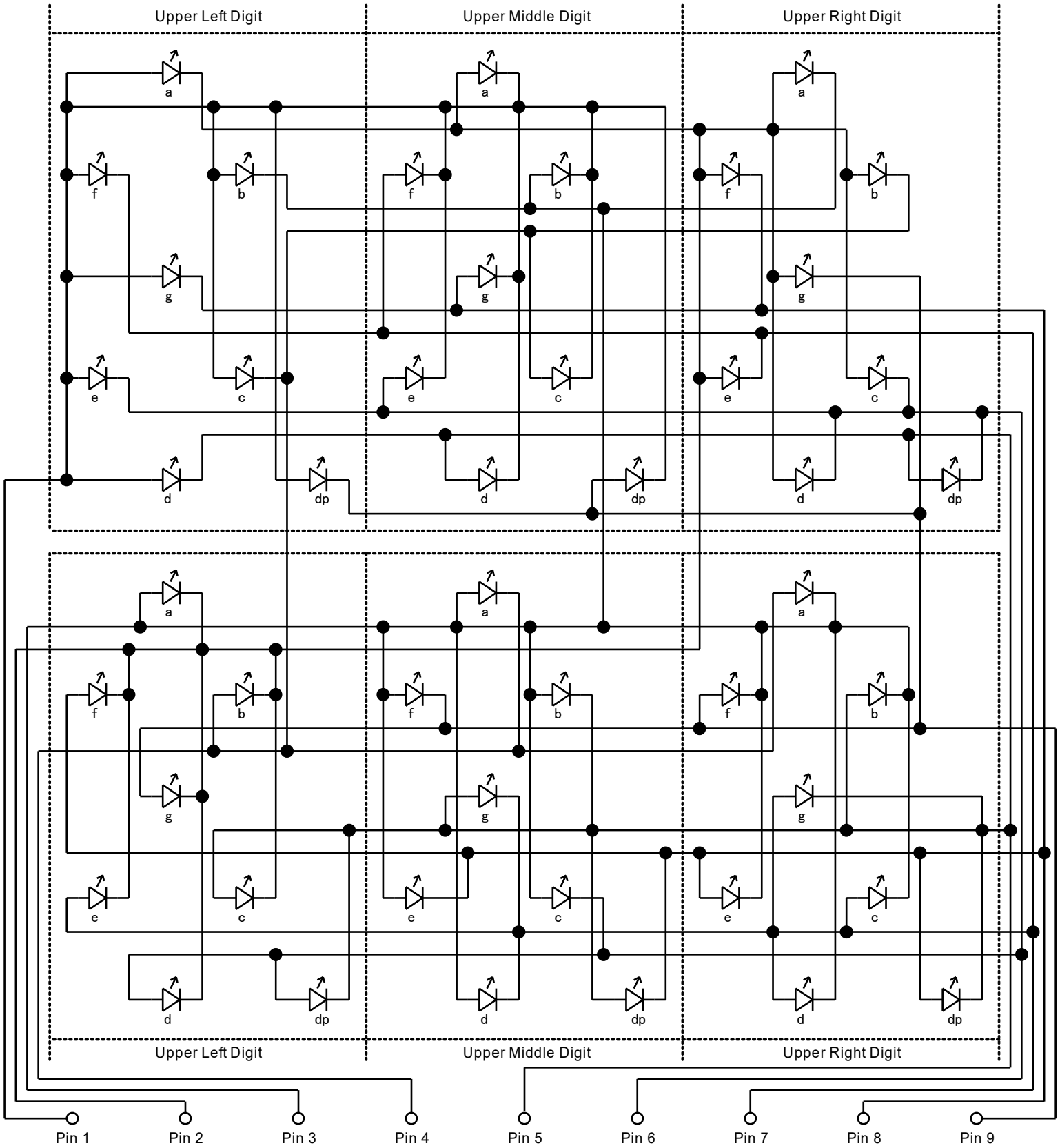


10.2V – 0.00A without LEDs load (Pull up; Low)

		Upper Left Digit								Upper Middle Digit								Upper Right Digit							
Sequence		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	1	**H**	**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	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	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	x	**H**	x	x	x	x	x	x	**L**	x	x	x	x
Pin	5	x	x	x	x	x	**L**	x	x	x	x	x	x	x	**H**	x	x	**H**	x	x	x	**L**	x	x	x	x
	6	x	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	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	x	**H**	x	x	x	x	x	x	x	x	x	x	x	x	x	**L**
	9	**L**	x	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																									

		Lower Left Digit								Lower Middle Digit								Lower Right Digit							
Sequence		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	x	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**	**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	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	x	**L**	x	x	x	x	x	x	x	**H**	x	x	x	x	x
Pin	5	**L**	x	x	x	**H**	x	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	x	**L**	x	x	x	x	x	x	x	**H**	x	x	x
	7	x	x	x	x	x	x	**H**	x	x	**L**	x	x	x	**L**	x	x	x	**H**	x	x	x	**H**	x	x
	8	x	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	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