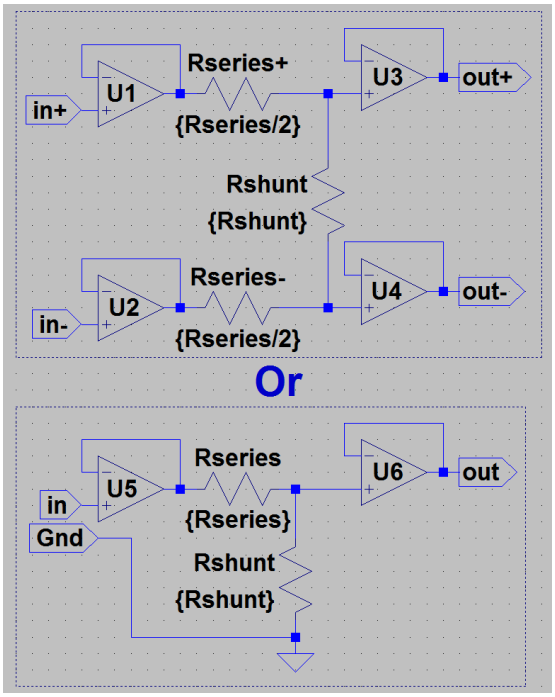
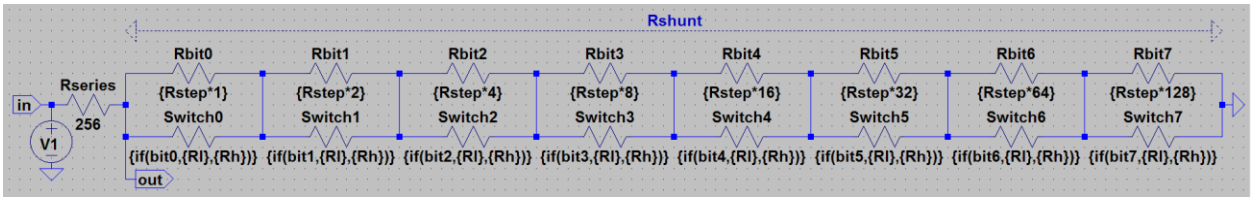
Shunt Potentiometer Calculator Excel-sheet.

This thread makes a excel sheet available that is intended to calculate the binary values needed to create a resistor ladder network emulating a logarithmic potentiometer with a fixed series element.



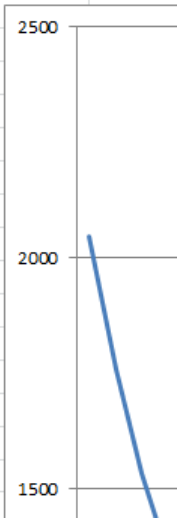
The above picture shows the configurations (among others) that can be implemented using a shunt potentiometer and a fixed-value series resistor.

By using one of these configurations you remove the potentiometer from the signal path (mostly) and, when at maximum value, only the fixed series resistor stays in the signal path. When implemented with switching elements (relays, fets, mosfets or other) these switches are all open when the shunt resistor is at maximum value and thus, the quality of the switches is not influencing the signal (mostly).



The above picture shows a ladder network that is supported by the excel sheet. The simulation file (LTspice) for this ladder network in included in the .zip-file that is made available.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1			Step	Log(Step)	R(Step)	Bin1	Diff1	Check	Manual	Bin2	Diff2	Error	Rfinal		
2			0	1.000000	2047.000000	1023	143			1023	143		2046		
3	Log(Step)	1.054	1	0.948767	1761.377624	880	113			880	113		1760		
4	R(Series)	1022	2	0.900158	1535.549142	767	92			767	92		1534		
5	R(Shunt)	2047	3	0.854040	1352.746203	675	75			675	75		1350		
6	Rstep	2	4	0.810285	1201.932703	600	64			600	64		1200		
7	Nsteps	64	5	0.768771	1075.548055	536	54			536	54		1072		
8	Round	0	6	0.729384	968.238781	482	46			482	46		964		
9			7	0.692015	876.107819	436	40			436	40		872		
10	MaxVin	1.49926722	8	0.656561	796.250711	396	35			396	35		792		
11	MaxVout	1	9	0.622923	726.458430	361	31			361	31		722		
12	Remainder	25.4265	10	0.591009	665.020936	330	27			330	27		660		
13	Bits	10	11	0.560729	610.593772	303	25			303	25		606		
14	Checks	3	12	0.532001	562.105281	278	22			278	22		556		
15	Errors	None	13	0.504745	518.690723	256	19			256	19		512		
16			14	0.478885	479.644602	237	18			237	18		474		
17			15	0.454350	444.385601	219	16			219	16		438		



Here I describe (in short you can always use the spread-sheet to experiment with) the parameters used in the spread-sheet. All parameters are in the black-bordered cells (B3…B8)

- Log(Step)[B3] Sets the slope(steepness) of the curve. Try to find a value that gives the lowest value in Remainder[B12] to start with.
- R(Series)[B4] The fixed series resistance used in the potentiometer.
- R(Shunt)[B5] The maximum value for the shunt resistance of the ladder network.
- Rstep[B6] The step size of the ladder network. This determines the number of switches needed to implement the ladder network. The number of switches(Bits) is shown in the cell Bits[B13].
- Nsteps[B7] The number of steps(separate resistance values) used to go from the minimum to the maximum value of the calculated shunt(ladder network) resistance.
- Round[B8] The rounding factor used to calculate column Bin1[F] from column R(Step)[E]. This value is normally zero.

The calculated values are

- MaxVin[B10] The maximum input voltage for an output voltage of 1V.
- MaxVout[B11] The maximum output voltage for the calculated input voltage (always 1V).
- Remainder[B12] The value of the last cell in column R(Step)[E].
- Bits[B13] The number of bits(switches) needed to implement the ladder network.
- Checks[B14] The number of generated binary values in column Bin1[F] that need to be adjusted by user input in column Manual[I]. These are values where the difference between binary values is smaller than previous difference. E.g. the generated slope is not very smooth.
- Errors[B15] The number of uncorrected Checks[B14].