

LOW POWER DUAL OPERATIONAL AMPLIFIERS

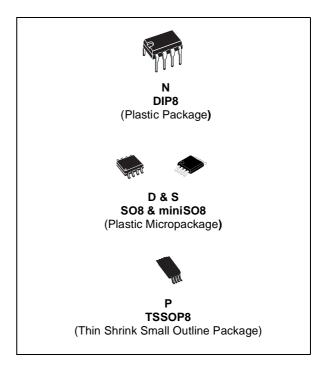
- INTERNALLY FREQUENCY COMPENSATED
- LARGE DC VOLTAGE GAIN: 100dB
- WIDE BANDWIDTH (unity gain): 1.1MHz (temperature compensated)
- VERY LOW SUPPLY CURRENT/OP (500µA) ESSENTIALLY INDEPENDENT OF SUPPLY **VOLTAGE**
- LOW INPUT BIAS CURRENT: 20nA (temperature compensated)
- LOW INPUT OFFSET VOLTAGE: 2mV
- LOW INPUT OFFSET CURRENT: 2nA
- INPUT COMMON-MODE VOLTAGE RANGE **INCLUDES GROUND**
- DIFFERENTIAL INPUT VOLTAGE RANGE EQUAL TO THE POWER SUPPLY VOLTAGE
- LARGE OUTPUT VOLTAGE SWING 0V TO (Vcc - 1.5V)

DESCRIPTION

These circuits consist of two independent, high gain, internally frequency compensated which were designed specifically to operate from a single power supply over a wide range of voltages. The low power supply drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, dc gain blocks and all the conventional op-amp circuits which now can be more easily implemented in single power supply systems. For example, these circuits can be directly supplied with the standard +5V which is used in logic systems and will easily provide the required interface electronics without requiring any additional power supply.

Inthe linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage.

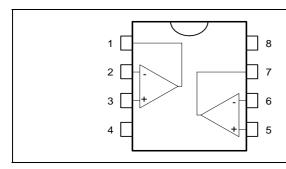


ORDER CODE

Part	Temperature	Package					
Number	Range	N	s	D	Р		
LM158,A	-55°C, +125°C	•		•	•		
LM258,A	-40°C, +105°C	•		•	•		
LM358,A	0°C, +70°C	•	•	•	•		
Example : LI	Example: LM258N						

- N = Dual in Line Package (DIP)
 D = Small Outline Package (SO) also available in Tape & Reel (DT)
 S = Small Outline Package (miniSO) only available in Tape & Reel (DT)
 P = Thin Shrink Small Outline Package (TSSOP) only available in Tape &Reel (PT)

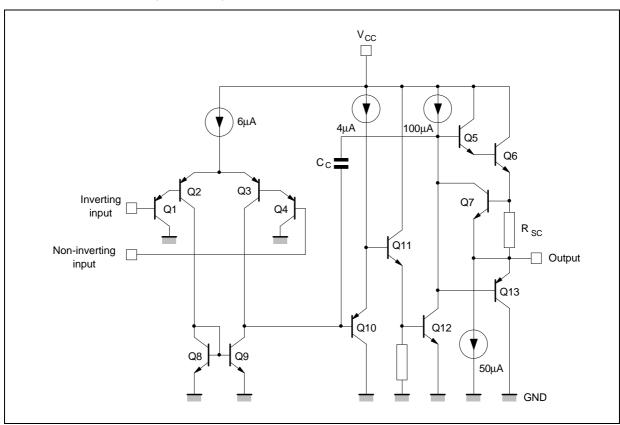
PIN CONNECTIONS (top view)



- 1 Output 1
- 2 Inverting input
- 3 Non-inverting input
- 4 V_{CC}
- 5 Non-inverting input 2
- 6 Inverting input 2
- 7 Output 2
- 8 V_{CC}+

July 2003 1/12

SCHEMATIC DIAGRAM (1/2 LM158)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LM158,A	LM258,A	LM358,A	Unit
V _{CC}	Supply voltage		+/-16 or 32		V
V _i	Input Voltage			V	
V _{id}	Differential Input Voltage		V		
P _{tot}	Power Dissipation 1)		mW		
	Output Short-circuit Duration ²⁾				
I _{in}	Input Current 3)	50			mA
T _{oper}	Opearting Free-air Temperature Range	-55 to +125	°C		
T _{stg}	Storage Temperature Range		°C		

^{1.} Power dissipation must be considered to ensure maximum junction temperature (Tj) is not exceeded.

Short-circuits from the output to V_{CC} can cause excessive heating if V_{CC} > 15V. The maximum output current is approximately 40mA independent
of the magnitude of V_{CC}. Destructive dissipation can result from simultaneous short-circuit on all amplifiers.

^{3.} This input current only exists when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistor becoming forward biased and thereby acting as input diodes clamps. In addition to this diode action, there is also NPN parasitic action on the IC chip. this transistor action can cause the output voltages of the Op-amps to go to the V_{CC} voltage level (or to ground for a large overdrive) for the time duration than an input is driven negative.

This is not destructive and normal output will set up again for input voltage higher than -0.3V.

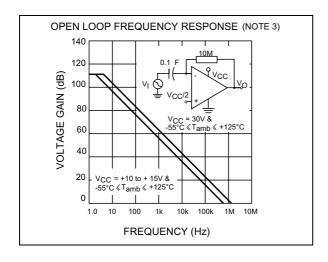
ELECTRICAL CHARACTERISTICS

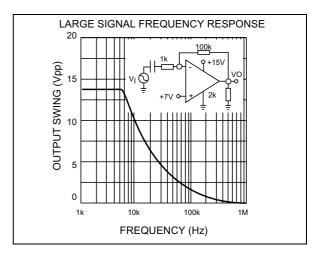
 V_{CC}^+ = +5V, V_{CC}^- = Ground, V_0 = 1.4V, T_{amb} = +25°C (unless otherwise specified)

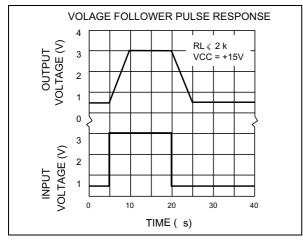
Symbol	Parameter	LM158A-LM258A LM358A			LM158-LM258 LM358			Unit
		Min.	Тур.	Max.	Min.	Тур.	Max.	
V _{io}	Input Offset Voltage - note $^{1)}$ T_{amb} = +25°C LM158, LM258 LM158A $T_{min} \le T_{amb} \le T_{max}$ LM158, LM258		1	3 2 4		2	7 5 9 7	mV
I _{io}	Input Offset Current $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$		2	10 30		2	30 40	nA
I _{ib}	Input Bias Current - note $^{2)}$ $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$		20	50 100		20	150 200	nA
A _{vd}	Large Signal Voltage Gain $\begin{aligned} &V_{CC} = +15\text{V}, \text{ R}_{L} = 2\text{k}\Omega, \text{ V}_{o} = 1.4\text{V to } 11.4\text{V} \\ &T_{amb} = +25^{\circ}\text{C} \\ &T_{min} \leq T_{amb} \leq T_{max} \end{aligned}$	50 25	100		50 25	100		V/mV
SVR	Supply Voltage Rejection Ratio ($R_s \le 10 k\Omega$) $V_{CC}^+ = 5V$ to $30V$ $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$	65 65	100		65 65	100		dB
I _{cc}	$ \begin{aligned} & \text{Supply Current, all Amp, no load} \\ & & T_{min} \leq T_{amb} \ \leq T_{max} & V_{CC} = +5V \\ & & T_{min} \leq T_{amb} \ \leq T_{max} & V_{CC} = +30V \end{aligned} $		0.7	1.2 1		0.7	1.2 2	mA
V _{icm}	Input Common Mode Voltage Range $V_{CC} = +30V - note^{3)}$ $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$	0 0		V _{CC} ⁺ -1.5 V _{CC} ⁺ -2	0		V _{CC} ⁺ -1.5 V _{CC} ⁺ -2	V
CMR	Common Mode Rejection Ratio ($R_s \le 10k\Omega$) $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$	70 60	85		70 60	85		dB
I _{source}	Output Current Source $V_{CC} = +15V$, $V_0 = +2V$, $V_{id} = +1V$	20	40	60	20	40	60	mA
I _{sink}	Output Sink Current ($V_{id} = -1V$) $V_{CC} = +15V$, $V_{o} = +2V$ $V_{CC} = +15V$, $V_{o} = +0.2V$	10 12	20 50		10 12	20 50		mA μA
V _{OPP}	Output Voltage Swing ($R_L = 2k\Omega$) $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$	0 0		V _{CC} ⁺ -1.5 V _{CC} ⁺ -2	0		V _{CC} ⁺ -1.5 V _{CC} ⁺ -2	

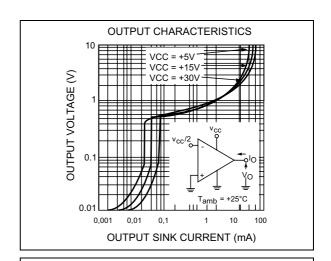
Symbol	Parameter		LM158A-LM258A LM358A			LM158-LM258 LM358		
		Min.	Тур.	Max.	Min.	Тур.	Max.	
V _{OH}	$\begin{split} & \text{High Level Output Voltage } (\text{V}_{\text{CC}}^{+} = 30\text{V}) \\ & \text{T}_{amb} = +25^{\circ}\text{C} & \text{R}_{L} = 2\text{k}\Omega \\ & \text{T}_{min} \leq \text{T}_{amb} \leq \text{T}_{max} \\ & \text{T}_{amb} = +25^{\circ}\text{C} & \text{R}_{L} = 10\text{k}\Omega \\ & \text{T}_{min} \leq \text{T}_{amb} \leq \text{T}_{max} \end{split}$	26 26 27 27	27 28		26 26 27 27	27 28		V
V _{OL}	Low Level Output Voltage ($R_L = 10k\Omega$) $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$		5	20 20		5	20 20	mV
SR	Slew Rate V_{CC} = 15V, V_i = 0.5 to 3V, R_L = 2k Ω , C_L = 100pF, unity Gain	0.3	0.6		0.3	0.6		V/μs
GBP	Gain Bandwidth Product V_{CC} = 30V, f =100kHz, V_{in} = 10mV, R_L = 2k Ω , C_L = 100pF	0.7	1.1		0.7	1.1		MHz
THD	Total Harmonic Distortion $f = 1 \text{kHz}, A_V = 20 \text{dB}, R_L = 2 \text{k}\Omega, V_O = 2 \text{V}_{pp}, C_L = 100 \text{pF}, V_O = 2 \text{Vpp}$		0.02			0.02		%
e _n	Equivalent Input Noise Voltage $f = 1 \text{kHz}, R_s = 100\Omega, V_{CC} = 30 \text{V}$		55			55		nV √Hz
DV _{io}	Input Offset Voltage Drift		7	15		7	30	μV/°C
DI _{lio}	Input Offset Current Drift		10	200		10	300	pA/°C
V ₀₁ /V ₀₂	Channel Separation - note ⁴⁾ $1kHz \le f \le 20kHZ$		120			120		dB

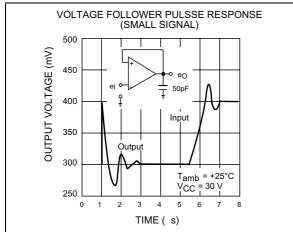
- 1. $V_0 = 1.4V$, $R_s = 0\Omega$, $5V < V_{CC}^+ < 30V$, $0 < V_{ic} < V_{CC}^+ 1.5V$
- 2. The direction of the input current is out of the IC. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
- The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is V_{CC}⁺ 1.5V, but either or both inputs can go to +32V without damage.
- 4. Due to the proximity of external components insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of capacitance increases at higher frequences.

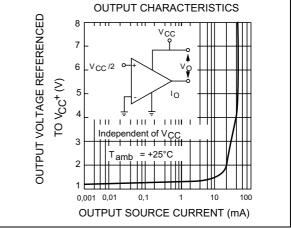


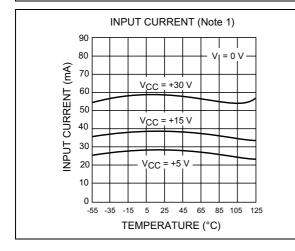


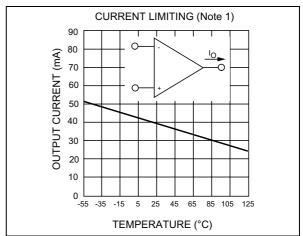


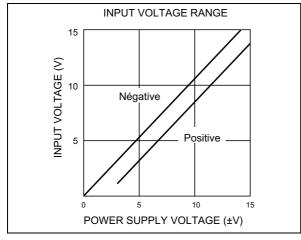


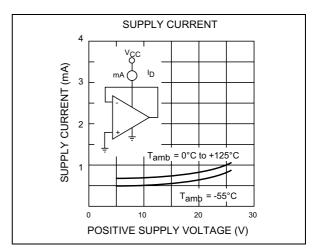


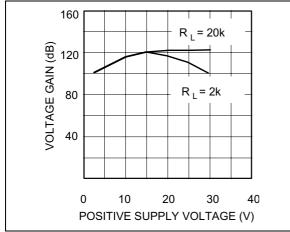


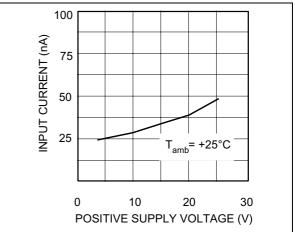


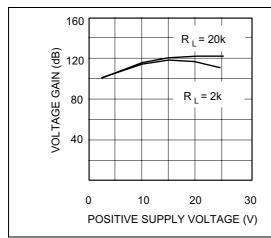


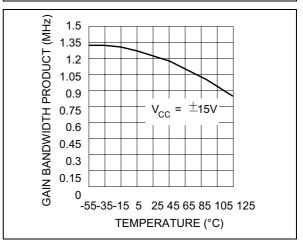


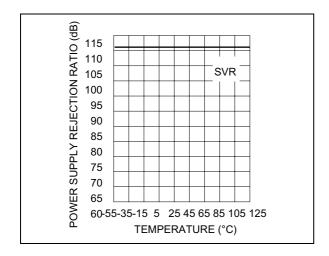


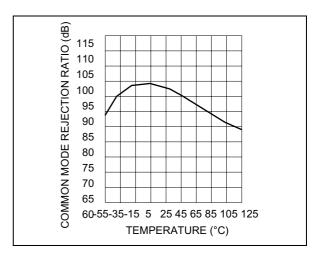






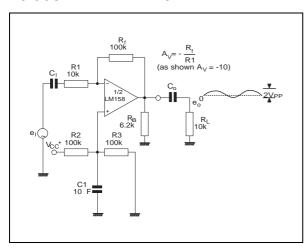




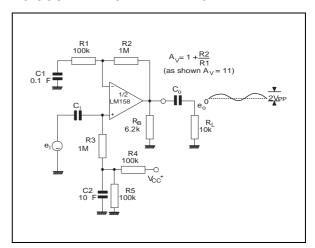


TYPICAL APPLICATIONS (single supply voltage) $V_{cc} = +5V_{dc}$

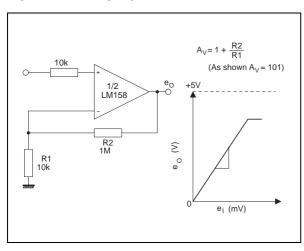
AC COUPLED INVERTING AMPLIFIER



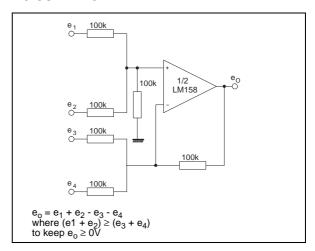
AC COUPLED NON-INVERTING AMPLIFIER



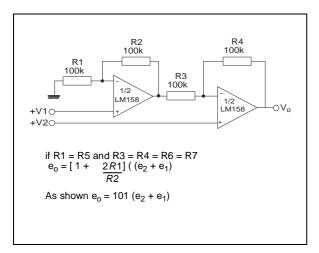
NON-INVERTING DC AMPLIFIER



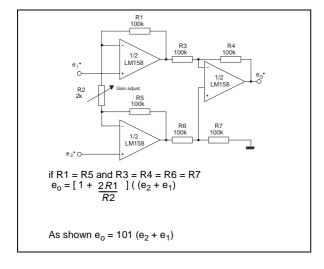
DC SUMMING AMPLIFIER



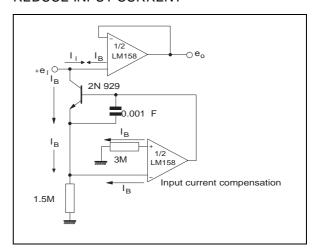
HIGH INPUT Z, DC DIFFERENTIAL AMPLIFIER



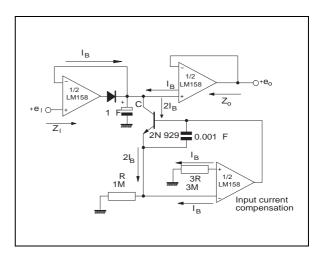
HIGH INPUT Z ADJUSTABLE GAIN DC INSTRUMENTATION AMPLIFIER



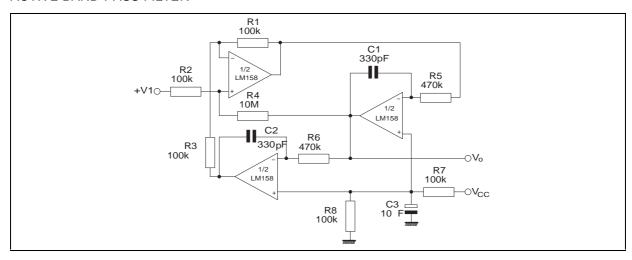
USING SYMMETRICAL AMPLIFIERS TO REDUCE INPUT CURRENT



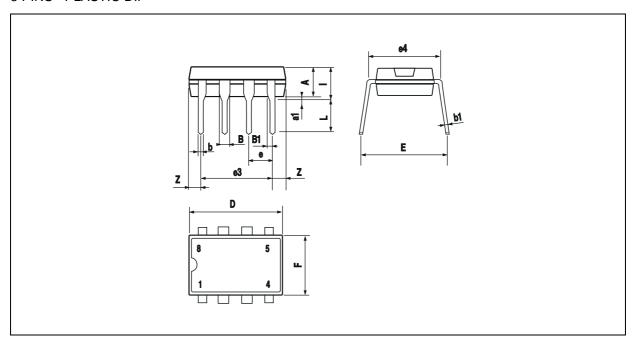
LOW DRIFT PEAK DETECTOR



ACTIVE BAND-PASS FILTER

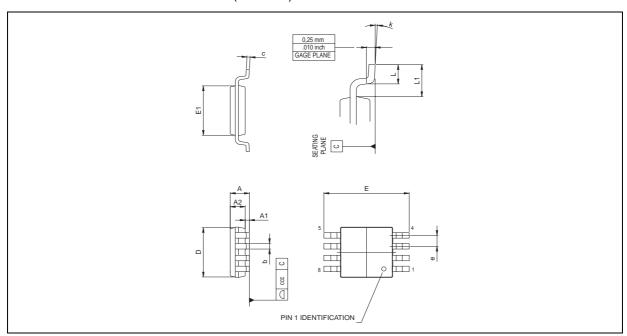


8 PINS - PLASTIC DIP



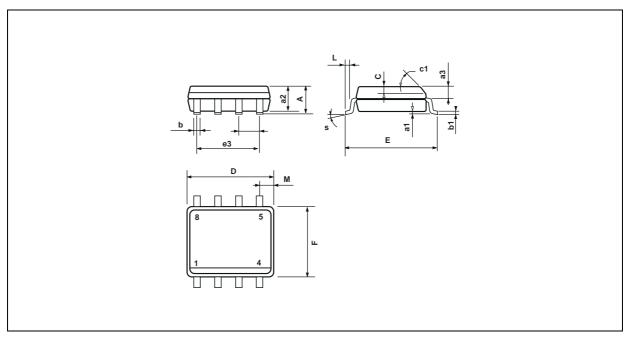
Dim		Millimeters		Inches		
Dim.	Min.	Тур.	Max.	Min.	Тур.	Max.
Α		3.32			0.131	
a1	0.51			0.020		
В	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
Е	7.95		9.75	0.313		0.384
е		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

8 PINS - PLASTIC MICROPACKAGE (miniSO)



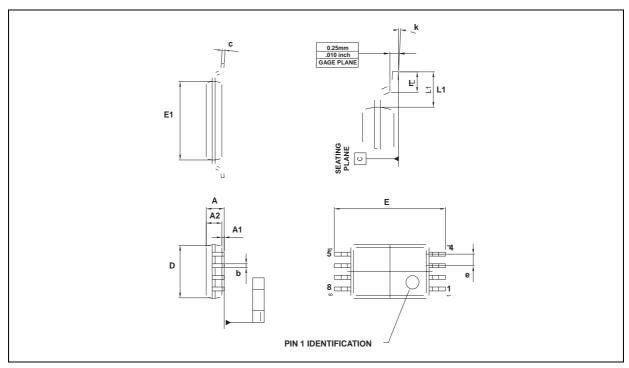
Dim.		Millimeters			Inches	
	Min.	Тур.	Max.	Min.	Тур.	Max.
Α			1.100			0.043
A1	0.050	0.100	0.150	0.002	0.004	0.006
A2	0.780	0.860	0.940	0.031	0.034	0.037
b	0.250	0.330	0.400	0.010	0.013	0.016
С	0.130	0.180	0.230	0.005	0.007	0.009
D	2.900	3.000	3.100	0.114	0.118	0.122
E	4.750	4.900	5.050	0.187	0.193	0.199
E1	2.900	3.000	3.100	0.114	0.118	0.122
е		0.650			0.026	
L	0.400	0.550	0.700	0.016	0.022	0.028
L1		0.950			0.037	
k	0d	3d	6d	0d	3d	6d
CCC			0.100			0.004

8 PINS - PLASTIC MICROPACKAGE (SO)



Dim.		Millimeters			ches			
Dim.	Min.	Тур.	Max.	Min.	Тур.	Max.		
Α			1.75			0.069		
a1	0.1		0.25	0.004		0.010		
a2			1.65			0.065		
a3	0.65		0.85	0.026		0.033		
b	0.35		0.48	0.014		0.019		
b1	0.19		0.25	0.007		0.010		
С	0.25		0.5	0.010		0.020		
c1			45°	(typ.)				
D	4.8		5.0	0.189		0.197		
E	5.8		6.2	0.228		0.244		
е		1.27			0.050			
e3		3.81			0.150			
F	3.8		4.0	0.150		0.157		
L	0.4		1.27	0.016		0.050		
М			0.6			0.024		
S		8° (max.)						

8 PINS - THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP)



D:		Millimeters				
Dim.	Min.	Тур.	Max.	Min.	Тур.	Max.
А			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
С	0.09		0.20	0.003		0.012
D	2.90	3.00	3.10	0.114	0.118	0.122
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
е		0.65			0.025	
k	0°		8°	0°		8°
I	0.50	0.60	0.75	0.09	0.0236	0.030
L	0.45	0.600	0.75	0.018	0.024	0.030
L1		1.000			0.039	

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