

ULN3841A

ULN3841LW

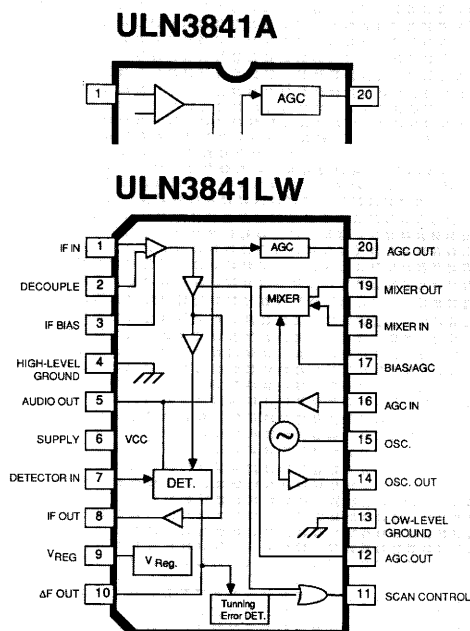


AM SIGNAL PROCESSORS

Providing the AM signal processing functions for an electronically-tuned AM receiver (ETR), the ULN3841A and ULN3841LW include a balanced mixer, buffered local oscillator, IF amplifier, AM detector, scan control detectors, and a switchable voltage regulator. The addition of a JFET matched to a whip antenna, RF tuning components, IF selectivity, and audio stages gives a complete AM radio which can be used in automotive receivers. Additional applications are in high-quality home entertainment receivers and scanning-type shortwave receivers. The frequency-detecting stop circuit is also capable of recovering narrow-band FM, making it useful for scanners or weatherband radio applications.

The ULN3841A/LW have greatly improved stop detection systems over other existing devices. They use the dual criteria of frequency and amplitude for establishing a valid stop. Tuning accuracy (frequency criteria) is established by evaluating phase shift across the detector coil. The circuitry is similar to that used in FM discriminators. Since this detection system is phase operated, it remains effective even in the presence of strong signals, which can cause false stops in systems using narrow-band filters. The amplitude criterion for stop is determined by evaluating the IF level. It includes a unique circuit that removes the effect of the AGC action. This allows the AGC tuning components to be selected for low-frequency audio performance without compromising scanning speed.

These AM signal processors are packaged in 20-pin plastic DIPs (suffix A) or 20-lead surface-mountable wide-body SOICs (suffix LW), and are rated for operation over the temperature range of -40°C to $+85^{\circ}\text{C}$.



FEATURES

- Low Noise Figure
- Balanced Mixer
- Buffered Local Oscillator
- Improved Stop Detector
- Wide-Band AGC
- Delayed AGC
- Narrow-Band FM Output
- Low Supply Current
- 7 to 16 Volt Operation

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V_{CC}	18 V
Package Power	
Dissipation, P_D	See Graph
Operating Temperature	
Range, T_A	-40°C to $+85^{\circ}\text{C}$
Storage Temperature	
Range, T_S	-65°C to $+150^{\circ}\text{C}$

Note that the ULN3841A (dual in-line package) and ULN3841LW (small-outline IC package) are electrically identical and share a common pin number assignment.

ULN3841A and ULN3841LW

Small-Signal AC Parameters at $T_A = 25^\circ\text{C}$, $V_{CC} = 14.4\text{ V}$, $f_o = 1\text{ MHz}$, $f_{if} = 450\text{ kHz}$

Characteristic	Pins	Typical Value
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MIXER

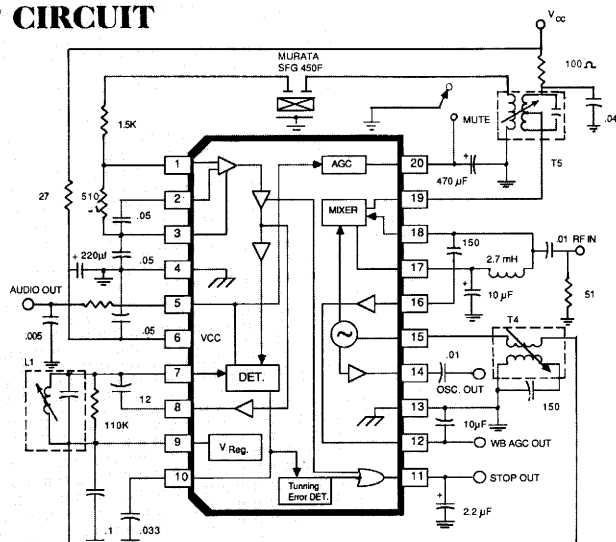
Input Resistance	18	5 k Ω
Input Capacitance	18	20 pF
Transconductance	18 to 19	4 mmho
Output Resistance	19	75 k Ω
Output Capacitance	19	4 pF

IF

Input Resistance	1	8 k Ω
Input Capacitance	1	7 pF
Voltage Gain	1 to 8	54 dB
Output Resistance	8	45 Ω

Typical values are given for circuit design information only.

TEST CIRCUIT



Electrical Characteristics at $T_A = 25^\circ\text{C}$, $V_{CC} = 14.4\text{ V}$, $f_o = 1\text{ MHz}$, $f_{if} = 450\text{ kHz}$, $f_m = 1\text{ kHz}$ at 30% AM, unless otherwise specified.

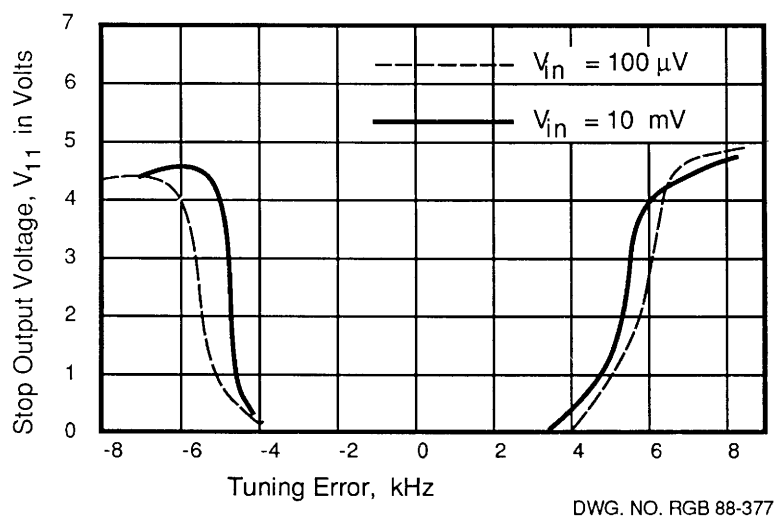
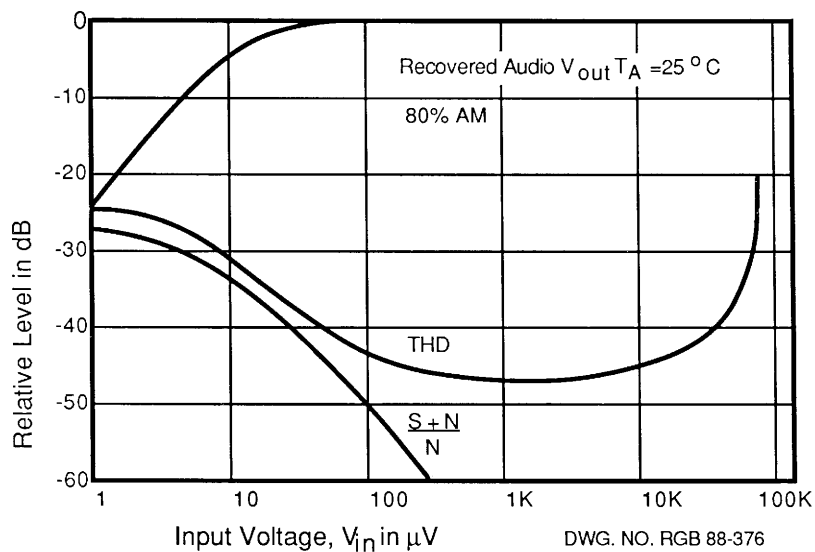
Characteristic	Symbol	Test Condition	Limits			
			Min.	Typ.	Max.	Units
Minimum Operating Voltage	V_6		—	7.0	—	V
Quiescent Supply Current	I_{CC}	No Signal	—	25	33	mA
Sensitivity	V_{in}	$V_{OUT} = 50\text{ mV}$	—	6.0	10	μV
		$V_{CC} = 11\text{ V}$	—	6.0	12	μV
Usable Sensitivity	V_{in}	$S + N/N = 20\text{ dB}$	—	6.0	10	μV
Recovered Audio	V_{out}	$V_{in} = 1\text{ mV}$	173	245	346	mV
Total Harmonic Distortion	THD	$V_{in} = 1\text{ mV}, 80\% \text{ AM}$	—	0.4	3.0	%
Oscillator Output Voltage	V_{out}		150	200	400	mV
Stop Output Voltage	V_{11}	$V_{in} = 0$	4.3	4.6	—	V
		$V_{in} = 1\text{ mV}$	—	—	0.25	V
Stop Sensitivity	V_{in}	$V_{11} = 1.5\text{ V}, 0\% \text{ AM}$	27	35	80	μV
Stop Bandwidth		$V_{in} = 10\text{ mV}, V_{11} = 1.5\text{ V}, 0\% \text{ AM}$	8.0	10.2	13.5	kHz
Wide-Band AGC	V_{agc}	$V_{in} = 0$	—	—	0.2	V
		$V_{in} = 60\text{ mV}$	2.0	—	—	V
Overload	V_{in}	THD = 10%, 80% AM	25	70	—	mV
Input Limiting Threshold	V_{TH}	Pin 10, $\Delta f = \pm 3\text{ kHz}, -3\text{ dB}$	—	12	—	μV
FM Recovered Audio	V_{10}	$\Delta f = \pm 3\text{ kHz}, f_m = 50\text{ Hz}$	—	380	—	mV
Signal-to-Noise Ratio	$S + N/N$	$V_{in} = 250\text{ }\mu\text{V}$	45	50	—	dB
		$V_{in} = 10\text{ mV}$	—	60	—	dB
AGC Figure of Merit	V_{in}	$\Delta V_{out} = -10\text{ dB ref. } V_{in} = 5\text{ mV}$	4.2	6.0	8.4	μV
Delayed AGC Voltage	V_{17}	$V_{in} = 0$	1.5	1.65	1.8	V
		$V_{in} = 1\text{ mV}$	0.6	0.85	1.2	V
Regulator Voltage	V_9		—	5.1	—	V
		Pin 20 Grounded (Muted)	—	—	0.6	V

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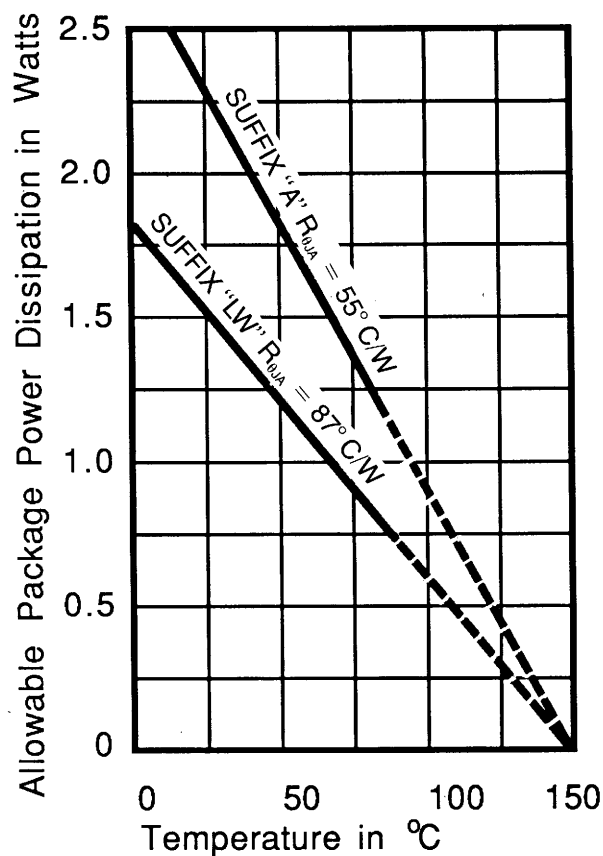
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ULN3841A and ULN3841LW AM SIGNAL PROCESSORS

TYPICAL CHARACTERISTICS

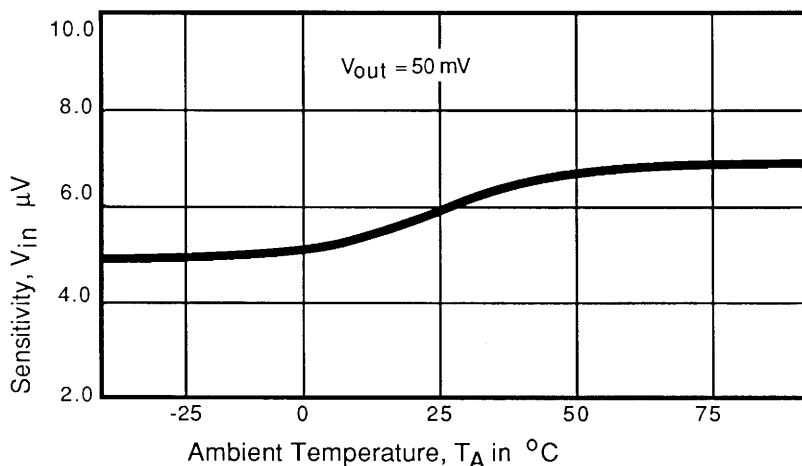
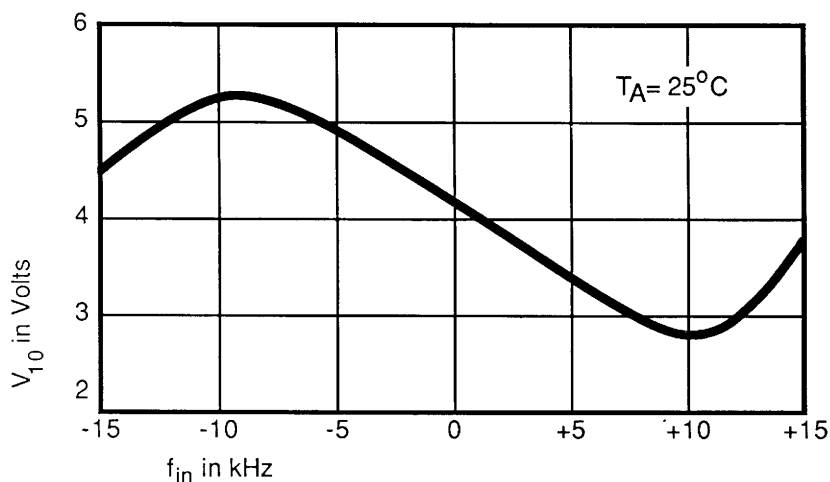
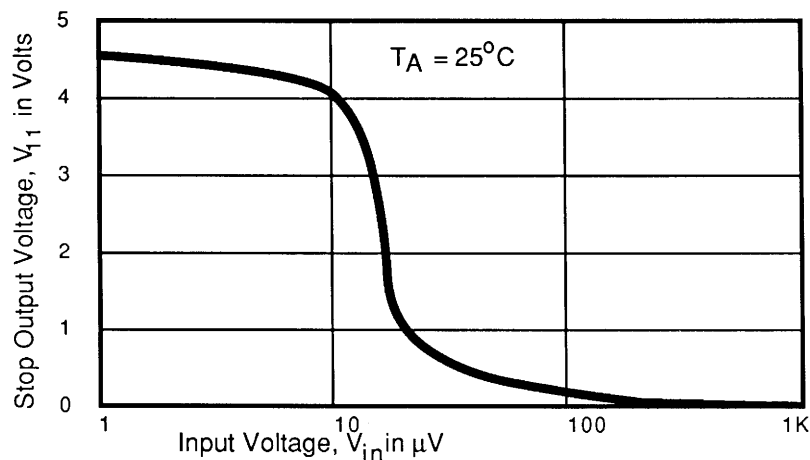


ALLOWABLE PACKAGE POWER DISSIPATION AS A FUNCTION OF TEMPERATURE



ULN3841A and ULN3841LW AM SIGNAL PROCESSORS

TYPICAL CHARACTERISTICS



A HIGH-PERFORMANCE ELECTRONICALLY-TUNED AM STEREO RECEIVER FOR AUTOMOTIVE APPLICATION

The advent of AM stereo has changed the perception of AM as a low-fidelity medium. This has caused a revaluation of AM receiver performance objectives, particularly minimum audio bandwidth. To achieve satisfactory stereo imaging, a minimum high-frequency response of 4 kHz has been shown to be necessary. Additionally, AM stereo has imposed the totally new requirements of phase linearity and freedom from incidental phase noise and modulation.

RF SECTION

RF gain is provided by a large-area JFET, selected for high gate-to-channel capacity to provide a capacitive match to the broad-band antenna. To further improve this match, a wide-band step-up transformer T1 is also included. The inductance of this transformer was selected to resonate with typically 90 pF cable capacity at the lower band edge to improve across the band gain uniformity. T1 improves usable sensitivity, typically 3 dB. A cascode bipolar stage is also included to prevent Miller effect from loading the antenna, providing typically 2 dB improvement in usable sensitivity at 1400 kHz.

Overall gain of the RF stage is low to minimize cross-modulation, made possible by a low noise figure mixer. At moderate signal levels, cross-modulation, is primarily limited by the performance of the JFET. At higher levels, wide-band AGC is applied to a clamp transistor at the antenna. This signal is derived from the secondary of T2 and is rectified and amplified by the ULN3841A/LW.

A wider RF bandwidth is used to reduce the effects of mistracking and misalignment on stereo separation and distortion. The overall bandwidth (audio response) and band shape of the receiver should be determined by the IF selectivity.

To achieve widest bandwidth with minimum sacrifice in out-band selectivity, a double-tuned section was selected, T2 and

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T3. To further enhance bandwidth vs. selectivity performance across the band, a combination of frequency-dependent loading and coupling is used. The 330 μH choke is used as top coupling and is constant across the band; the .047 μF capacitor is a bottom-coupling element which decreases coupling with increasing frequency. The varactor diode series-loading resistors (6.8 Ω) are also employed to reduce Q at the lower end of the band. This produces typical 6 dB bandwidths of 18.6 kHz at 600 kHz and 24 kHz at 1400 kHz. Variable coupling also reduces gain variation across the band (ref. 1).

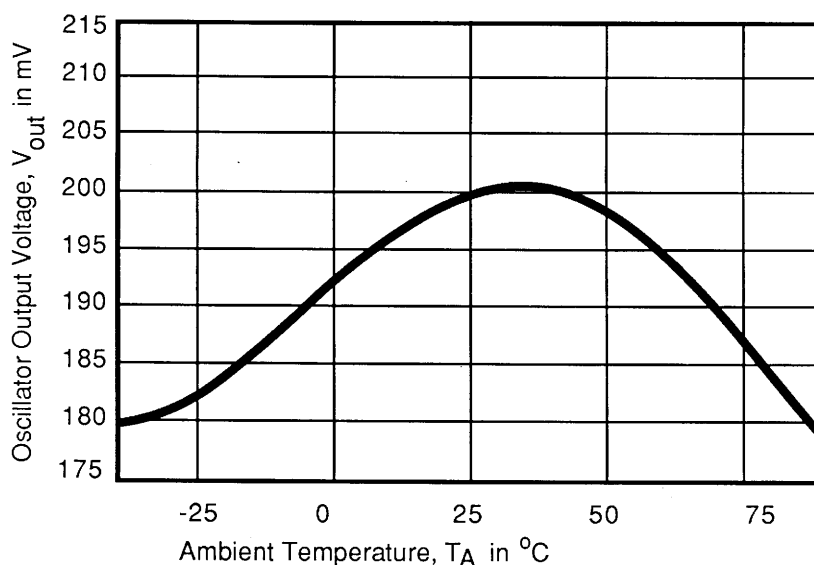
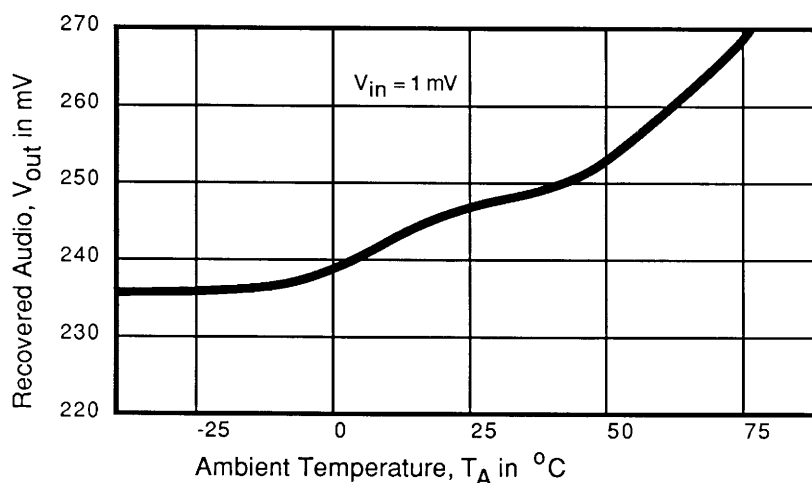
MIXER AND IF

The output from the double-tuned RF is applied to the balanced mixer, pin 18, which is biased from pin 17. Output from the mixer is taken via T5. The primary impedance is 15 k Ω . Secondary and Q are selected for the ceramic filter which was chosen for stereo performance and bandwidth. This filter has a quasi-parabolic band pass and reasonably constant group delay. Termination resistors at pin 1 are configured as a pad to permit adjustment of overall gain.

The detector coil (L1) serves as the AM detector and also establishes the stop bandwidth. Tuning accuracy is established by evaluating phase shift across the detector coil employing circuitry similar to that used in FM discriminators. Stop phase criteria is internally set to one-half the 3 dB bandwidth ($f_{if}/2 \times \text{loaded Q}$) of L1. The value in the application is 20. This circuit also recovers narrow-band FM at pin 10.

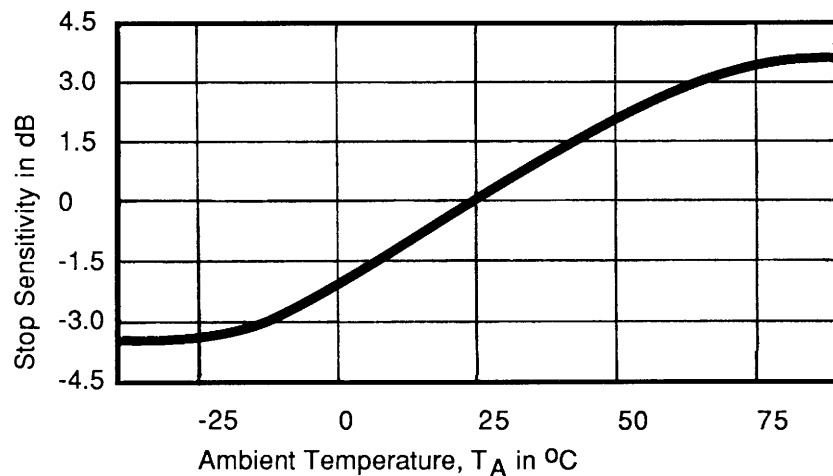
AGC rate is selected for audio performance. AGC action is removed from the stop circuit, which effectively eliminates the trade-off between AGC performance and permitted scanning rate. Monaural output is provided in this application for alignment and evaluation. If the monaural output is not required, the 10 k Ω and .005 μF components can be deleted without affecting stereo performance. In this application the ULN3841A/LW stop detector output (pin 11) is applied through a time delay to the MC13020P/D force monaural input (pin 9) to reset the decoder counters during the tuning. The IF signal for the decoder is taken out at the detector coil.

TYPICAL CHARACTERISTICS



ULN3841A and ULN3841LW AM SIGNAL PROCESSORS

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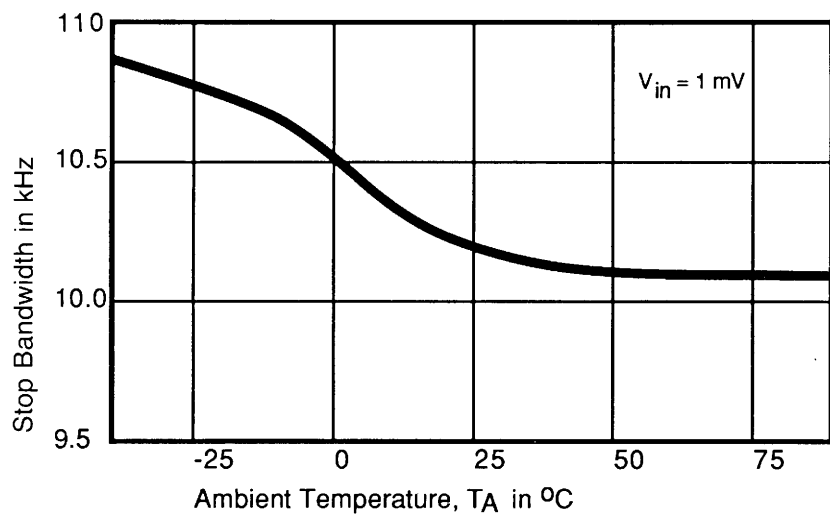


STEREO DECODER

The component values used with the AM stereo decoder are based on the applications information for the MC13020P/D as given elsewhere. Note that the pilot-tone and co-channel components should be precision as shown (ref. 2, 3).

REFERENCES

1. "Development of High Quality Receiver for AM Stereo" by Jon P. Grosjean and Oliver Richards, Sprague publication TP80-5.
2. "Pilot-Tone Band-Pass Filter Circuit Component Tolerance Considerations," Motorola, publication M68465.
3. "VCO and Phase-Lock Loop Performance," Motorola publication M684131.

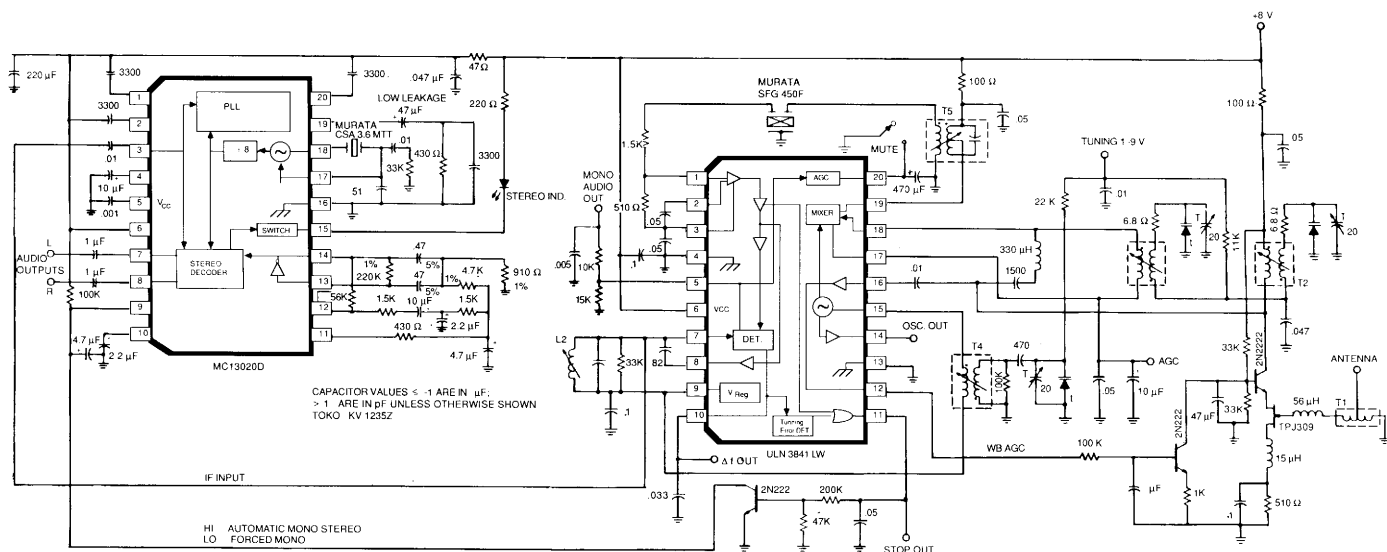


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ULN3841A and ULN3841LW AM SIGNAL PROCESSORS

AM STEREO RECEIVER FOR AUTOMOTIVE APPLICATION



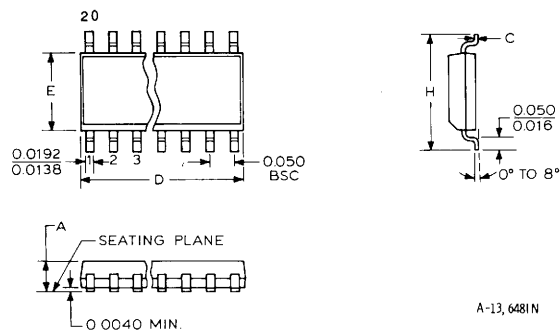
COIL INFORMATION FOR TEST CIRCUIT AND HIGH-PERFORMANCE ETR AM STEREO RECEIVER

	Symbol	Q	N ₁ /N ₂	N ₁ /N ₃	Toko Part Number
Antenna	T1		1:1.6		7HN-60064CY
RF	T2, T3	120		10:1	RWOS-6A7894A0, L = 178 μH
Local Osc.	T4	120		5:1	7TRS-A5609A0
Mixer	T5		2:1	8.9:1	7LC-502112N4, C _T = 180 pF
Detector (test)	L1	100			7NRES-A5622AAG, C _T = 100 pF
(application)	L2	100			A7BRS-T1041Z, C _T = 1000 pF

ULN3841A and ULN3841LW AM SIGNAL PROCESSORS

PLASTIC SOIC

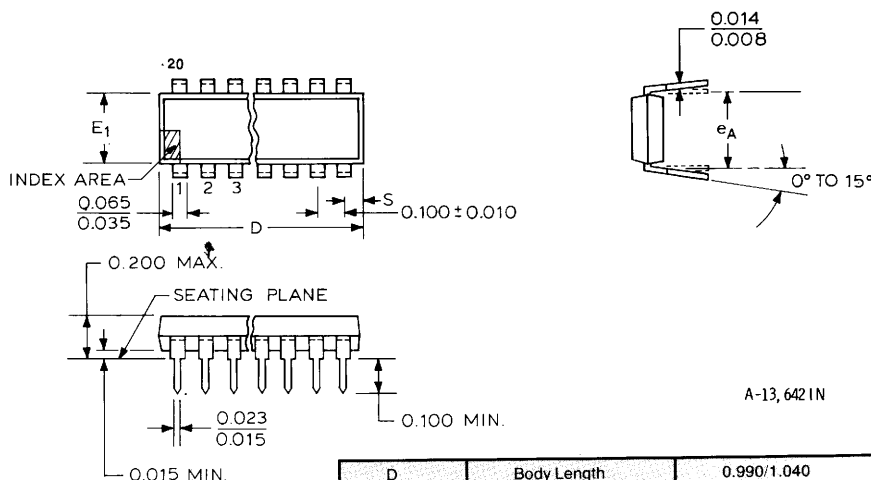
DIMENSIONS IN INCHES
(BASED ON 1 mm = 0.03937")



A	Seated Height	0.0926/0.1043
C	Lead Thickness	0.0091/0.0125
D	Body Length	0.4961/0.5118
E	Body Width	0.2914/0.2992
H	Overall Width	0.394/0.419

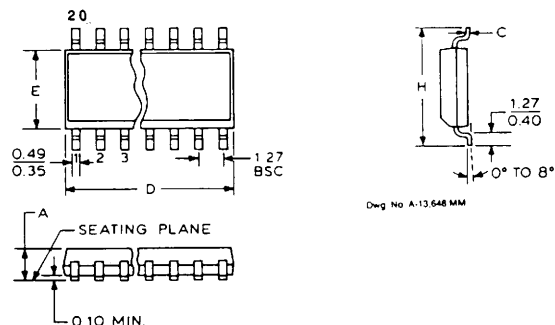
PLASTIC DIP

DIMENSIONS IN INCHES



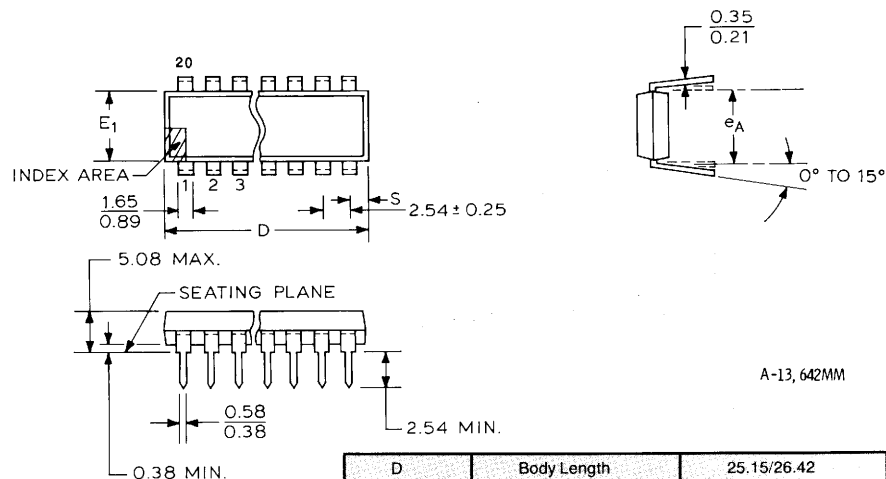
D	Body Length	0.990/1.040
E ₁	Body Width	0.240/0.260
e _A	Row Spacing	0.300 BSC
S	Lead CL to End	0.060 REF

DIMENSIONS IN MILLIMETERS



A	Seated Height	2.35/2.65
C	Lead Thickness	0.23/0.32
D	Body Length	12.60/13.00
E	Body Width	7.40/7.60
H	Overall Width	10.0/10.65

DIMENSIONS IN MILLIMETERS (BASED ON 1" = 25.40 mm)



D	Body Length	25.15/26.42
E ₁	Body Width	6.10/6.60
e _A	Row Spacing	7.62 BSC
S	Lead CL to End	1.52 REF

In the construction of the components described, the full intent of the specification will be met. The Sprague Electric Company, however, reserves the right to make, from time to time, such departures from the detail specifications as may be required to permit improvements in the design of its products. Components made under military approvals will be in accordance with the approval requirements.

The information included herein is believed to be accurate and reliable. However, the Sprague Electric Company assumes no responsibility for its use; nor for any infringements of patents or other rights of third parties which may result from its use.

- A. Dimensions shown as ____ / ____ are Min./Max.
- B. Lead thickness is measured at seating plane or below.
- C. Lead spacing tolerance is non-cumulative.
- D. Exact body and lead configuration at vendor's option within limits shown.
- E. Lead gauge plane is 0.030" (0.762 mm) max. below seating plane.

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