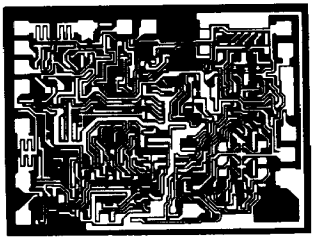
ULN-2241A
A-M/F-M SIGNAL PROCESSING SYSTEM

FEATURES

- Low External Parts Count
- D-C A-M/F-M Switching
- 12 μV Limiting Threshold
- 5 μV A-M Sensitivity
- Low Harmonic Distortion
- Balanced A-M Mixer
- Internal Regulator
- 16-Pin Dual In-Line Plastic Package

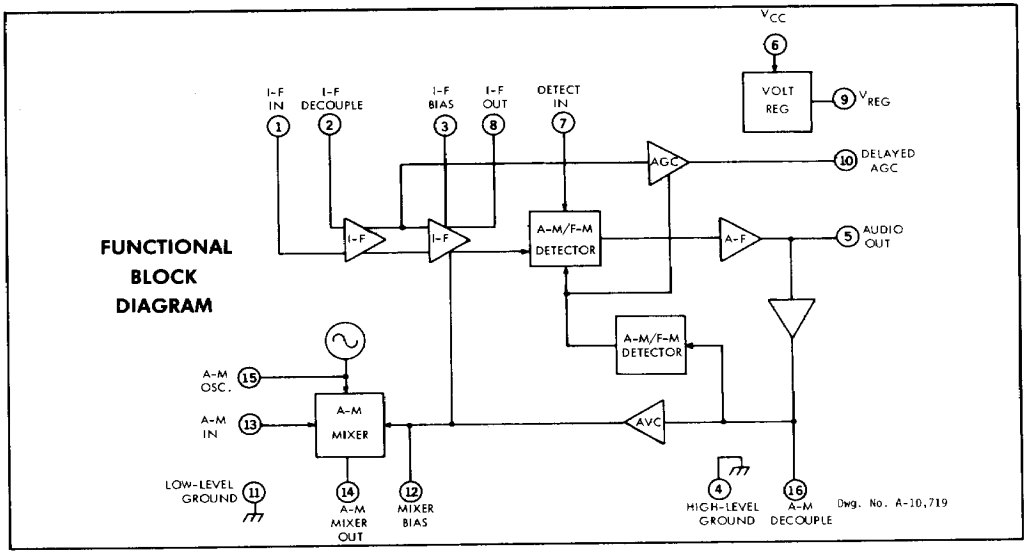


THIS SIGNAL PROCESSING SYSTEM was designed with careful attention to the total system costs and performance requirements of modern automotive and high-quality home entertainment broadcast receivers. All F-M I-F functions and all A-M functions are provided by Sprague Type ULN-2241A with a minimal external parts count.

The use of an analog multiplier as a balanced low-current mixer results in freedom from spurious responses and gives the system high tweet rejection, low feedthrough (I-F rejection), and low noise, as well as very low local oscillator feedthrough.

(Continued on next page)

FUNCTIONAL BLOCK DIAGRAM



Although primarily intended for use in A-M broadcast reception, the A-M mixer is also suitable for use at long-wave or shortwave frequencies. Delayed AGC is available for use with an optional discrete R-F stage.

A fully-balanced, four stage differential I-F amplifier gives maximum gain with freedom from interference and noise. It is used in both the A-M and F-M modes of operation with approximately 82 dB gain in the F-M mode and controlled AGC gain of 26 dB in the A-M mode.

The detector in the F-M mode is a four-quadrant analog multiplier operating in the high-level injection mode. Again, interference and noise are rejected through the use of balanced current-mirror outputs.

The delayed AGC output provides a d-c voltage for control of signal level-related functions. The detector is biased to a no-signal value of 4.7 V, that approaches 0 V with increasing signal input.

In the A-M mode of operation, the detector is configured as a balanced peak detector resulting in low audio distortion. A-M gain control is achieved with AVC applied to the I-F and with delayed AVC applied to the mixer.

Switching between modes can be accomplished with a simple single-pole d-c switch. The common low-level audio output can be used to drive any suitable audio power amplifier or stereo decoder (e.g. Sprague Types ULN-3701Z and ULN-3810A, respectively).

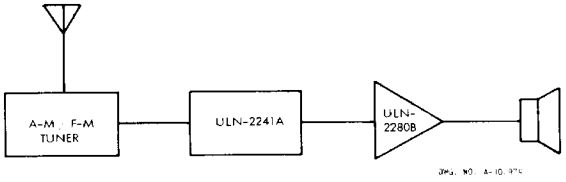
Internal voltage regulators and bias supplies assure premium performance despite variations in external supply voltage (8.5 to 16 V) or temperature (−20°C to +85°C). Separate ground leads minimize possible decoupling problems.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V_{CC}	18 V
Regulator Current, I_{REG}	5.0 mA
Package Power Dissipation, P_D (see note)	640 mW
Operating Temperature Range, T_A	−20°C to +85°C
Storage Temperature Range, T_S	−65°C to +150°C

NOTE: P_D is derated at the rate of 8.0 mW/°C above $T_A = +70°C$.

TYPICAL APPLICATION
(High-Performance Table Radio)



ELECTRICAL CHARACTERISTICS at $T_A = +25°C$, $V_{CC} = 12.8$ V

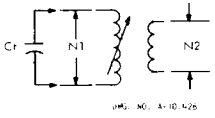
Characteristic	Symbol	Test Pin	Test Conditions	Limits Min.	Typ.	Max.	Units
Operating Voltage Range	V_{CC}	6		10	12.8	16	V
Differential Audio Output	V_{out}	5	See Note 1	–	–	±3.0	dB
Audio Ouput Voltage	V_5	5	No Signal	–	5.8	–	V
Avail. Reg. Output Voltage	V_{REG}	9	No Signal	–	6.4	–	V
Avail. Reg. Output Current	I_{REG}	9		2.0	–	–	mA
F-M MODE: $f_o = 10.7$ MHz, $f_m = 400$ Hz, $f_d = \pm 75$ kHz, $V_{in} = 10$ mV_{rms}, Non-Muted (unless otherwise specified)							
Input Limiting Threshold	V_{TH}	1		–	12	25	μV
Recovered Audio	V_{out}	5		350	425	600	mV
Output Distortion	THD	5		–	0.3	0.7	%
A-M Rejection	AMR	5	See Note 2	40	>55	–	dB
I-F Input Voltage	V_1	1	No Signal	–	3.5	–	V
AGC Output Voltage	V_{10}	10	No Signal	4.2	4.8	5.5	V
			$V_{in} = 10$ mV_{rms}	–	–	0.5	V
Avail. AGC Output Current	I_{10}	10	No Signal	1.0	–	–	mA
Supply Current	I_{CC}		No Signal	–	23	35	mA
A-M MODE: $f_o = 1$ MHz, $f_{if} = 455$ kHz, $f_m = 400$ Hz, 30% A-M, $V_{in} = 1.0$ mV_{rms} (unless otherwise specified)							
Sensitivity	V_{in}	13	$V_{out} = 50$ mV_{rms}	–	5.0	8.5	μV
Useable Sensitivity		13	20 dB S + N/N	–	6.0	–	μV
Recovered Audio	V_{out}	5	80% A-M	250	325	550	mV
Input Overload	V_{in}	13	80% A-M, THD = 10%	25	50	–	mV
A-M Decoupling Voltage	V_{16}	16	No Signal	–	1.0	–	V
I-F Input Voltage	V_1	1	No Signal	–	3.7	–	V
AGC Output Voltage	V_{10}	10	No Signal	–	–	0.5	V
A-M Input Voltage	V_{12}	12	No Signal	1.6	1.8	2.1	V
Supply Current	I_{CC}		No Signal	–	16	30	mA

Notes: 1. Differential Audio Output is specified as $20 \log \frac{V_{out} \text{ for 10 mV F-M } V_{in}}{V_{out} \text{ for 1.0 mV A-M } V_{in}}$

2. Amplitude Modulation Rejection is specified as $20 \log \frac{V_{out} \text{ for 100% F-M } V_{in}}{V_{out} \text{ for 30% A-M } V_{in}}$

COIL WINDING INFORMATION

T1 A-M I-F 455 kHz	Qu = 45 Ct = 1000 pF	General Instrument Part No. EX 27765	Toko Part No. RXN-6A6909HM
T2 F-M Detector 10.7 MHz	Qu = 60 Ct = 82 pF	General Instrument Part No. EX 27975	Toko Part No. TKAC-17044Z
L1 A-M Oscillator 1455 kHz	Qu = 50 N1:N2 = 11:1 Ct = 39 pF	General Instrument Part No. EX 27641	Toko Part No. RWO-6A7640BM
L2 F-M Detector 10.7 MHz	L = 27 μH Qu = 55 @ 2.5 MHz	General Instrument Part No. EX 27764	Toko Part No. 154A0-7A6115HM

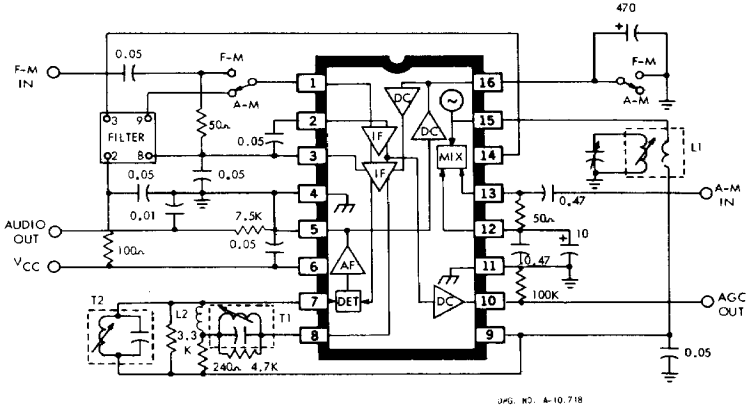


SMALL-SIGNAL A-C CHARACTERISTICS at $T_A = +25°C$

Characteristic	Symbol	Test Pin	Test Conditions	Limits Min.	Typ.	Max.	Units
I-F Input Capacitance	C_1	1		–	6.0	–	pF
I-F Output Resistance	R_8	8		–	250	–	kΩ
I-F Output Capacitance	C_8	8		–	2.5	–	pF
Audio Output Impedance	Z_5	5		–	860	–	Ω
F-M MODE: f_o = 10.7 MHz							
I-F Input Resistance	R_1	1		–	10	–	kΩ
I-F Transconductance	g_m	1-8		–	8.0	–	mho*
Detector Input Resistance	R_7	7		–	100	–	kΩ
Detector Input Capacitance	C_7	7		–	1.5	–	pF
A-M MODE: f_o = 1 MHz, f_{IF} = 455 kHz							
A-M Input Resistance	R_{13}	13		–	5.0	–	kΩ
A-M Input Capacitance	C_{13}	13		–	20	–	pF
Mixer Transconductance	g_m	13-14		–	15	–	mmho*
Mixer Output Resistance	R_{14}	14		–	500	–	kΩ
Mixer Output Capacitance	C_{14}	14		–	5.0	–	pF
I-F Input Resistance	R_1	1		–	15	–	kΩ
I-F Transconductance	g_m	1-8		–	160	–	mmho*
Detector Input Resistance	R_7	7		–	250	–	kΩ
Detector Input Capacitance	C_7	7		–	1.0	–	pF

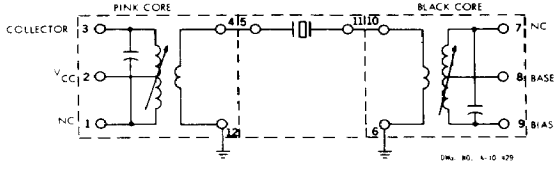
*The International Electrotechnical Commission recommends the use of siemens (S) as the standard international unit of conductance, admittance and susceptance.

TEST CIRCUIT



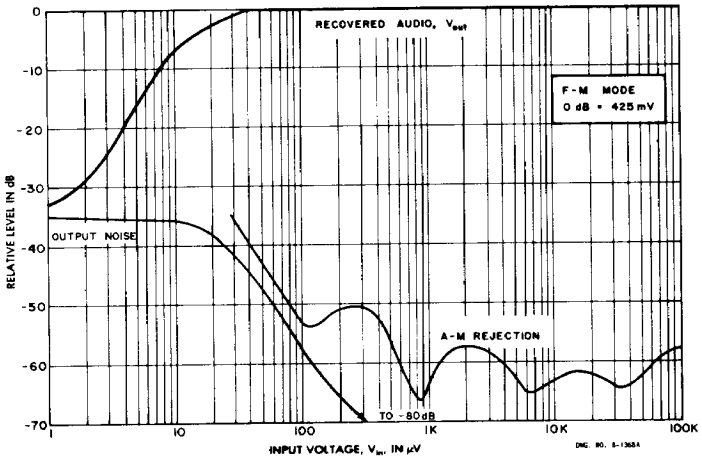
DWG. NO. A-10,718

Filter Assembly:
Toko Part No. CFU455C-82BR

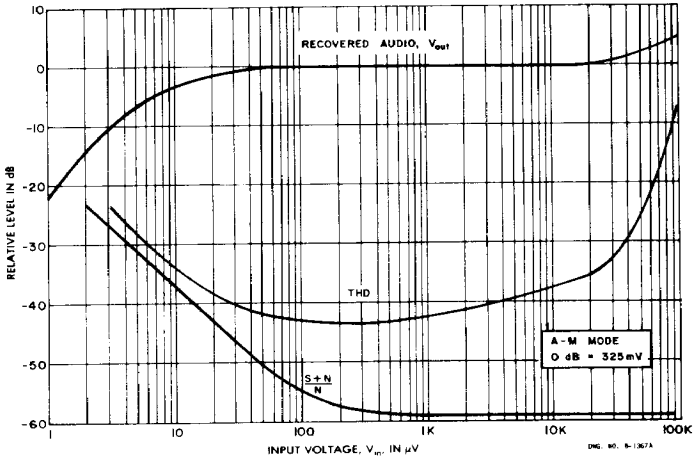


DWG. NO. A-10,629

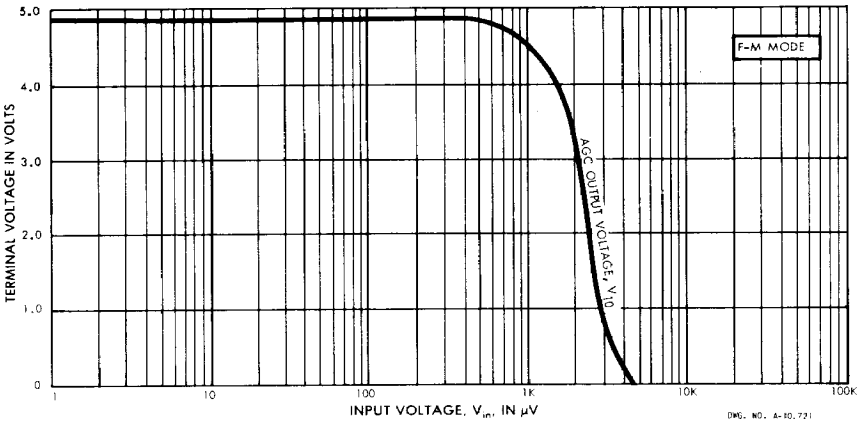
F-M CHARACTERISTICS AS FUNCTIONS OF INPUT VOLTAGE



A-M CHARACTERISTICS AS FUNCTIONS OF INPUT VOLTAGE



AGC OUTPUT VOLTAGE AS A FUNCTION OF INPUT VOLTAGE



AVC VOLTAGE AS A FUNCTION OF INPUT VOLTAGE