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INTEGRATED CIRCUIT
ENGINEERING BULLETIN

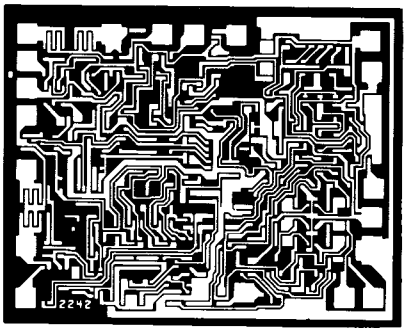
**ULN-2242A**
**TDA1090**

ULN-2242A/TDA1090
A-M/F-M SIGNAL PROCESSING SYSTEM

# ULN-2242A/TDA1090
# A-M/F-M SIGNAL PROCESSING SYSTEM

## FEATURES

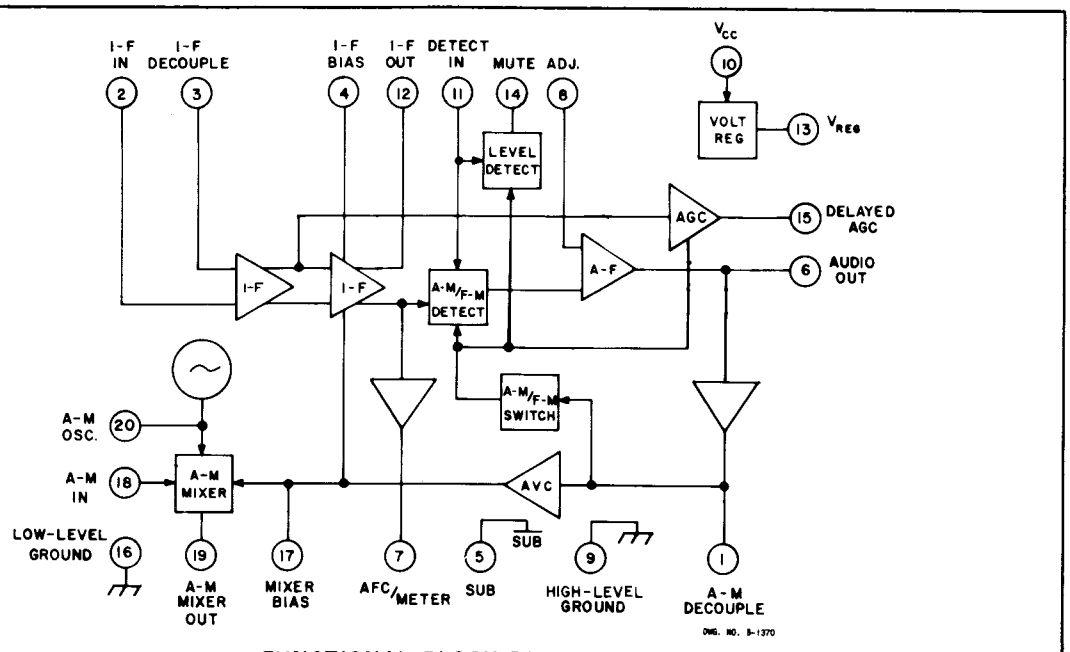
- D-C A-M/F-M Switching
- 12 $\mu$V Limiting Threshold
- 5 $\mu$V A-M Sensitivity
- Low Harmonic Distortion
- Balanced A-M Mixer
- Meter Drive
- Internal Regulator
- Self-Contained Muting (Squelch)



SUBSTANTIAL SIMPLIFICATION of A-M/F-M receiver design is possible with Type ULN-2242A signal processing system with improved system performance and a minimal external parts count. All F-M I-F functions and all A-M functions are provided by this integrated circuit.

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

(Continued next page)




FUNCTIONAL BLOCK DIAGRAM

SEMICONDUCTOR DIVISION
SPRAGUE ELECTRIC COMPANY
115 Northeast Cutoff, WORCESTER, MASS. 01606

ENGINEERING BULLETIN 27121.60A

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 common-mode signals. 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 to 82 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. Interference and noise are rejected. AFC and meter-drive signals (pin 7) are generated for use with any reference voltage between $V_{CC}$ and ground, with AFC gain determined by the choice of load resistor.

The mute and delayed AGC outputs provide d-c voltages for control of signal-level-related functions. Both detectors are biased to a no-signal value of 4.7 V and approach zero with increasing signal input.

In the A-M mode of operation, the detector is configured as a balanced peak detector for low audio distortion. A-M gain control is achieved with AVC applied to the I-F and 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 (Sprague Type ULN-3703Z or 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.

Type ULN-2242A A-M/F-M signal processing system is housed in a 20-pin dual in-line plastic package. Parts are marked with the Sprague Electric part number (ULN-2242A) unless the Pro-Electron marking (TDA1090) is requested.

## ABSOLUTE MAXIMUM RATINGS

| | |
|---|---|
| Supply Voltage, $V_{CC}$ | 18 V |
| Mute Input Voltage, $V_8$ | 5.0 V |
| Package Power Dissipation, $P_D$ (see note) | 750 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 9.4 mW/°C above $T_A$ = +70°C.

## 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 | $V_{CC}$ | 10 | | 8.5 | 12.8 | 16 | V |
| Audio Output Voltage | $V_6$ | 6 | No Signal | — | 5.8 | — | V |
| Regulator Output Voltage | $V_{REG}$ | 13 | No Signal | — | 6.4 | — | V |
| Regulator Output Current | $I_{REG}$ | 13 | | 2.0 | — | — | mA |
| **F-M MODE: $f_o = 10.7$ MHz, $f_m = 400$ Hz, $f_d = \pm 75$ kHz, $V_{in} = 10$ mVrms, Non-Muted (unless otherwise specified)** | | | | | | | |
| Input Limiting Threshold | $V_{TH}$ | 2 | | — | 12 | 25 | $\mu$V |
| Recovered Audio | $V_{out}$ | 6 | | 350 | 425 | 600 | mV |
| Output Distortion | THD | 6 | | — | 0.3 | 0.7 | % |
| A-M Rejection | AMR | 6 | See Note | 40 | > 55 | — | dB |
| Mute | $\Delta V_{out}$ | 6 | $V_{in} = 100\ \mu$V, max. mute | — | — | −1.0 | dB |
| | | | $V_{in} = 5\ \mu$V, max. mute | −45 | — | — | dB |
| AFC Output Voltage | $V_{afc}$ | 7 | | 220 | — | 600 | mV |
| I-F Input Voltage | $V_2$ | 2 | No Signal | — | 3.5 | — | V |
| Mute Output Voltage | $V_{14}$ | 14 | No Signal | 3.6 | 4.2 | — | V |
| AGC Output Voltage | $V_{15}$ | 15 | No Signal | 4.2 | 4.8 | 5.5 | V |
| | | | $V_{in} = 10$ mVrms | — | — | 0.5 | V |
| Mute Output Current | $I_{14}$ | 14 | No Signal | 0.5 | — | — | mA |
| AGC Output Current | $I_{15}$ | 15 | 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, $V_{in} = 1.0$ mVrms (unless otherwise specified)** | | | | | | | |
| Sensitivity | $V_{in}$ | 18 | $V_{out} = 50$ mVrms | — | 5.0 | 8.5 | $\mu$V |
| Usable Sensitivity | | 18 | 20 dB S+N/N | — | 6.0 | — | $\mu$V |
| Recovered Audio | $V_{out}$ | 6 | 80% A-M | 250 | 325 | 600 | mV |
| Input Overload | $V_{in}$ | 18 | 80% A-M, THD = 10% | 25 | 50 | — | mV |
| A-M Decoupling Voltage | $V_1$ | 1 | No Signal | — | 1.0 | — | V |
| I-F Input Voltage | $V_2$ | 2 | No Signal | — | 3.7 | — | V |
| Mute Output Voltage | $V_{14}$ | 14 | No Signal | — | — | 0.5 | V |
| AGC Output Voltage | $V_{15}$ | 15 | No Signal | — | — | 0.5 | V |
| A-M Input Voltage | $V_{17}$ | 17 | No Signal | 1.6 | 1.8 | 2.1 | V |
| Supply Current | $I_{CC}$ | | No Signal | — | 16 | 30 | mA |

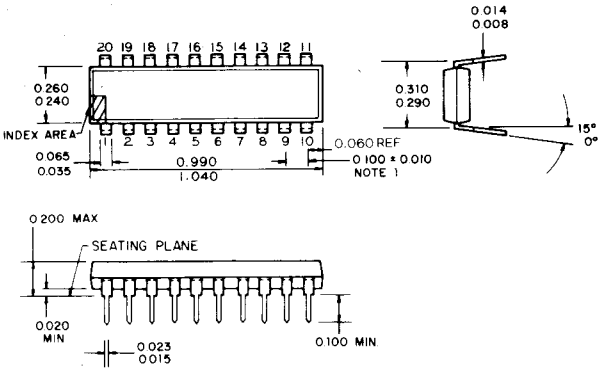
Note: Amplitude Modulation Rejection is specified as $20 \log \frac{V_{out} \text{ for } 100\% \text{ F-M } V_{in}}{V_{out} \text{ for } 30\% \text{ A-M } V_{in}}$

## 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 | $C_2$ | 2 | | — | 6.0 | — | pF |
| I-F Output Resistance | $R_{12}$ | 12 | | — | 250 | — | kΩ |
| I-F Output Capacitance | $C_{12}$ | 12 | | — | 2.5 | — | pF |
| Audio Output Impedance | $Z_6$ | 6 | | — | 860 | — | Ω |
| **F-M MODE: $f_o = 10.7$ MHz** | | | | | | | |
| I-F Input Resistance | $R_2$ | 2 | | — | 10 | — | kΩ |
| I-F Transconductance | $g_m$ | 2-12 | | — | 18 | — | mho* |
| Detector Input Resistance | $R_{11}$ | 11 | | — | 100 | — | kΩ |
| Detector Input Capacitance | $C_{11}$ | 11 | | — | 1.5 | — | pF |
| **A-M MODE: $f_o = 1$ MHz, $f_{if} = 455$ kHz** | | | | | | | |
| A-M Input Resistance | $R_{18}$ | 18 | | — | 5.0 | — | kΩ |
| A-M Input Capacitance | $C_{18}$ | 18 | | — | 20 | — | pF |
| Mixer Transconductance | $g_m$ | 18-19 | | — | 15 | — | mmho* |
| Mixer Output Resistance | $R_{19}$ | 19 | | — | 500 | — | kΩ |
| Mixer Output Capacitance | $C_{19}$ | 19 | | — | 5.0 | — | pF |
| I-F Input Resistance | $R_2$ | 2 | | — | 15 | — | kΩ |
| I-F Transconductance | $g_m$ | 2-12 | | — | 300 | — | mmho* |
| Detector Input Resistance | $R_{11}$ | 11 | | — | 250 | — | kΩ |
| Detector Input Capacitance | $C_{11}$ | 11 | | — | 1.0 | — | pF |

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

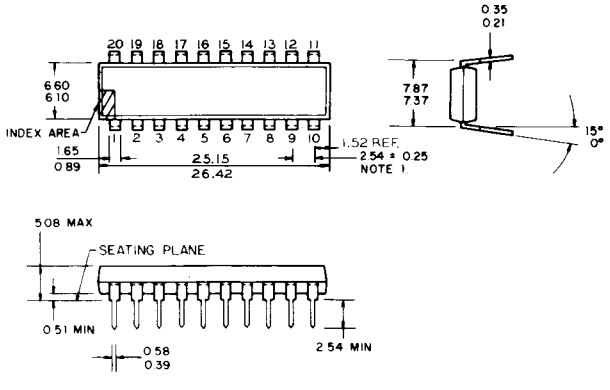
### DIMENSIONS IN INCHES




DWG. NO. A-10,430A - IN

### DIMENSIONS IN MILLIMETRES

Based on 1 in. = 25.4 mm

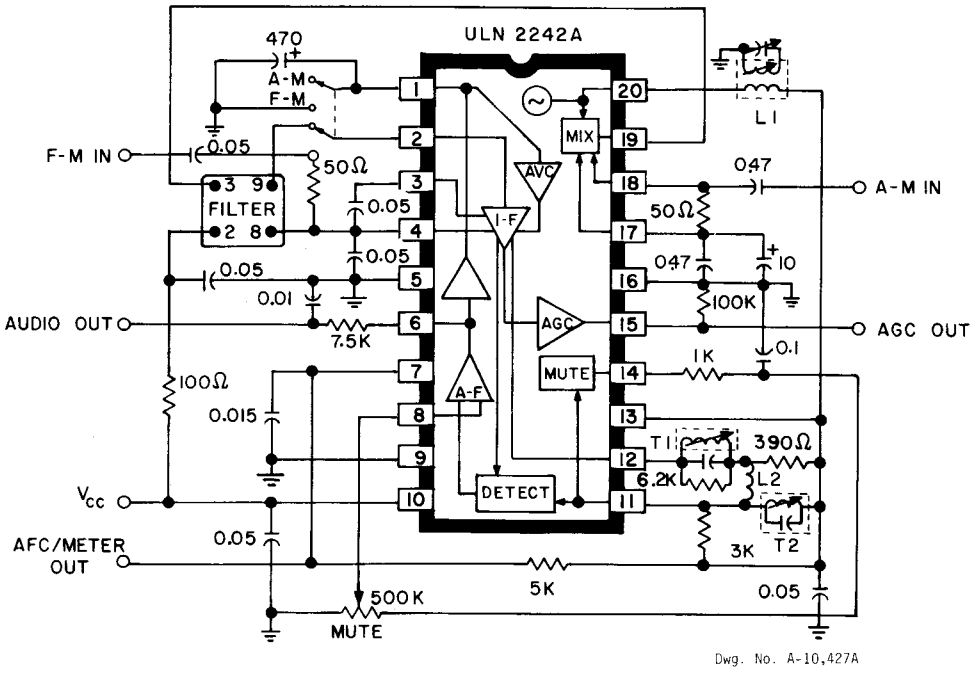



DWG. NO. A-10,430A - MM

NOTES:

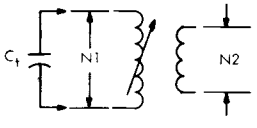
1. Lead spacing tolerance is non-cumulative.
2. Exact body and lead configuration at vendor's option within limits shown.
3. Leads missing from their designated positions shall also be counted when numbering leads.
4. Terminal lead standoffs may be omitted and replaced by body standoffs.
5. Lead gauge plane is 0.030'' (0.76 mm) max. below seating plane.

## TEST CIRCUIT




Dwg. No. A-10,427A

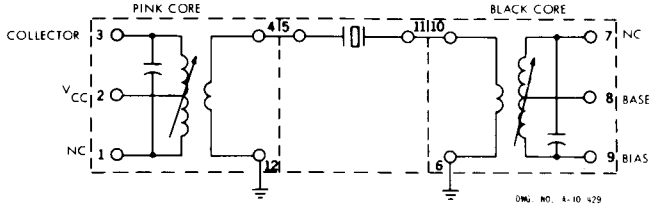
## COIL WINDING INFORMATION




DWG. NO. A-10,428

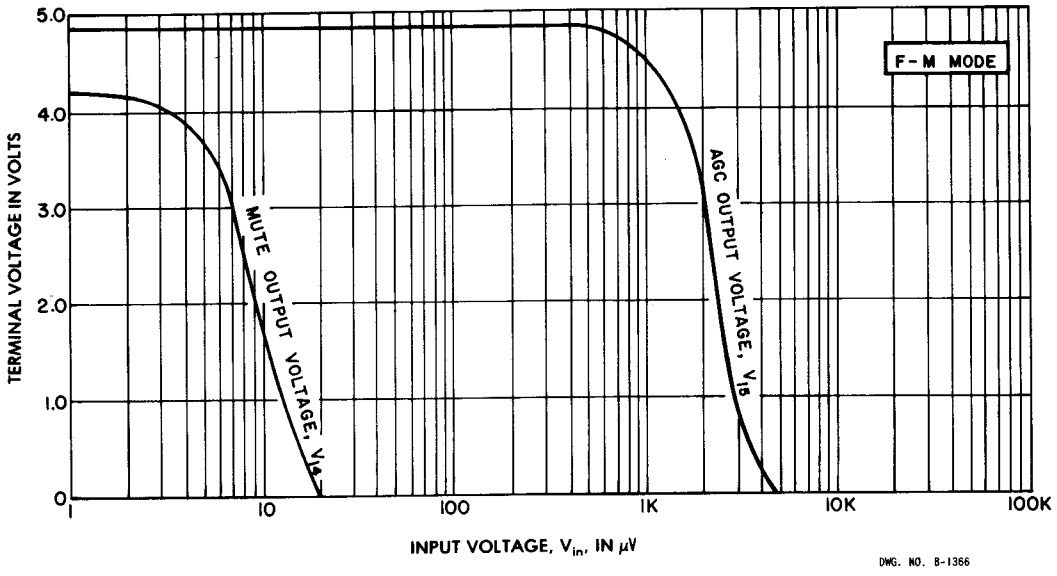
| | | | |
|---|---|---|---|
| T1 A-M I-F<br>455 kHz | Qu = 45<br>Ct = 1000 pF | General Instrument<br>Part No. EX 27765 | Toko Part No.<br>RXN-6A6909HM |
| T2 F-M Detector<br>10.7 MHz | Qu = 60<br>Ct = 82 pF | General Instrument<br>Part No. EX 27975 | Toko Part No.<br>TKAC-17044Z |
| L1 A-M Oscillator<br>1455 kHz | Qu = 50<br>N1:N2 = 11:1<br>Ct = 39 pF | General Instrument<br>Part No. EX 27641 | Toko Part No.<br>RWO-6A7640BM |
| L2 F-M Detector<br>10.7 MHz | L = 18 $\mu$H<br>Qu = 55 | | Coilcraft<br>Type V |

**Filter Assembly:**
**Toko Part No. CFU455C-82BR**

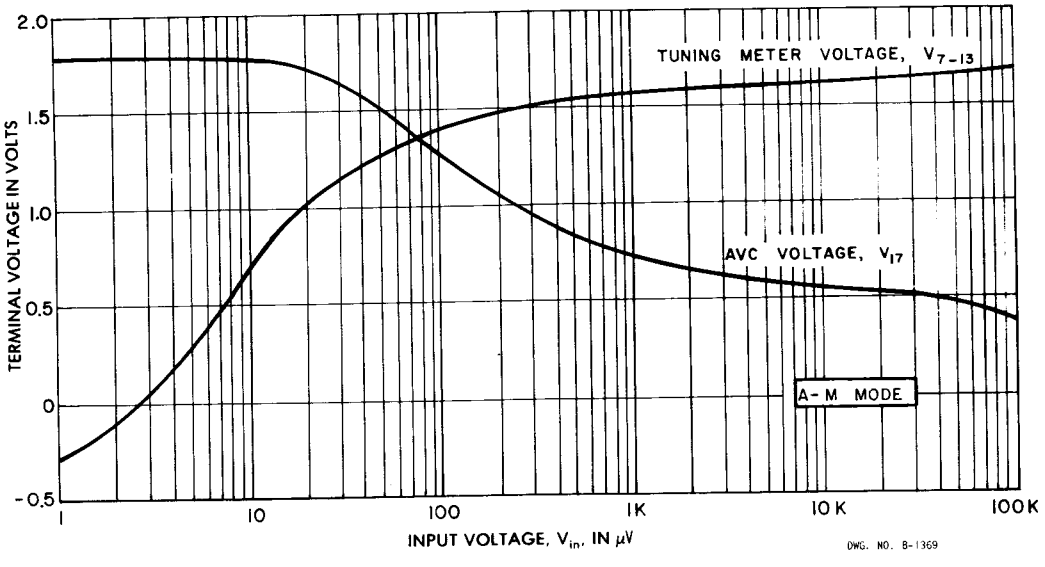



DWG. NO. A-10,429

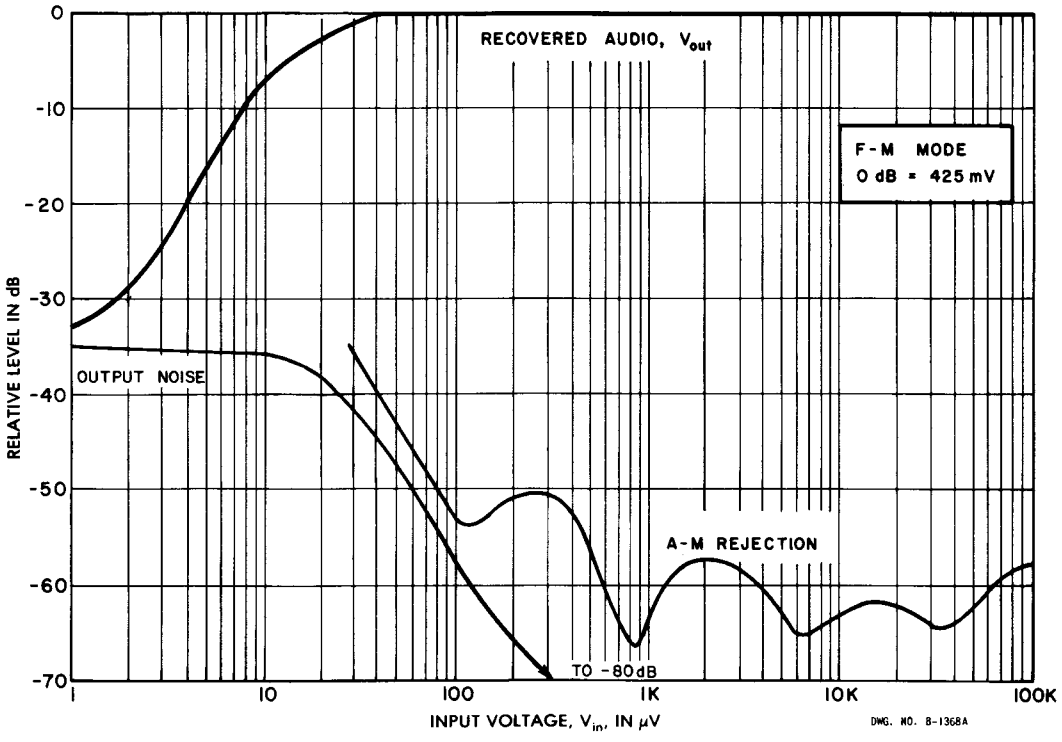
## F-M CONTROL VOLTAGES AS FUNCTIONS OF INPUT VOLTAGE



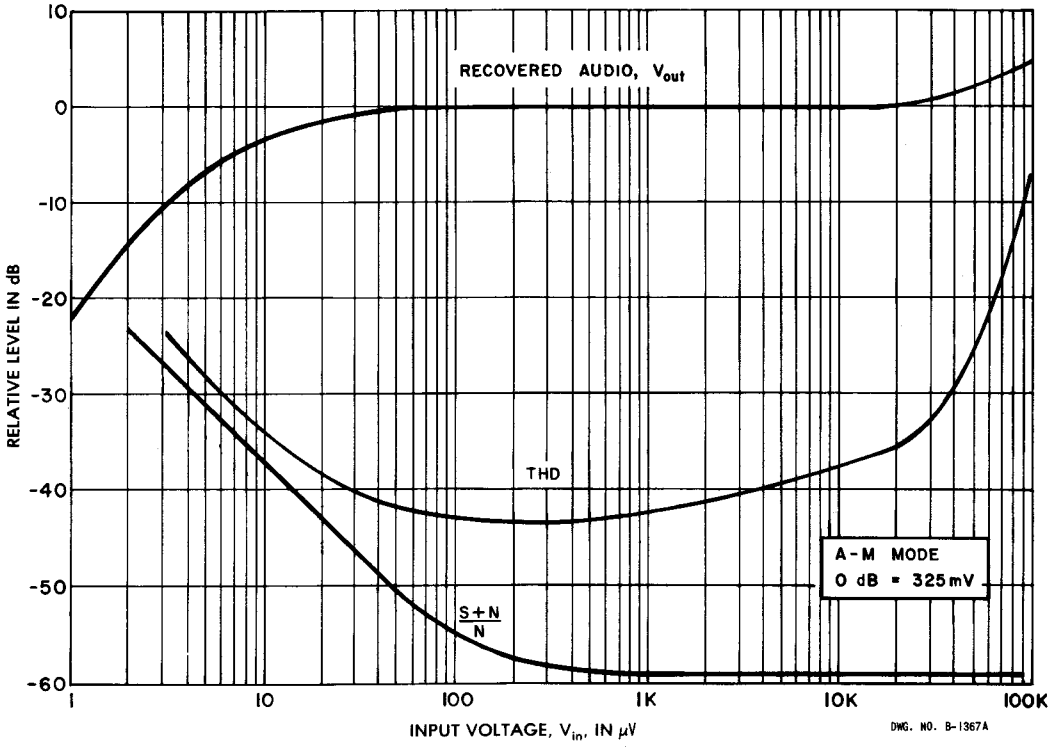

## A-M CONTROL VOLTAGES AS FUNCTIONS OF INPUT VOLTAGE



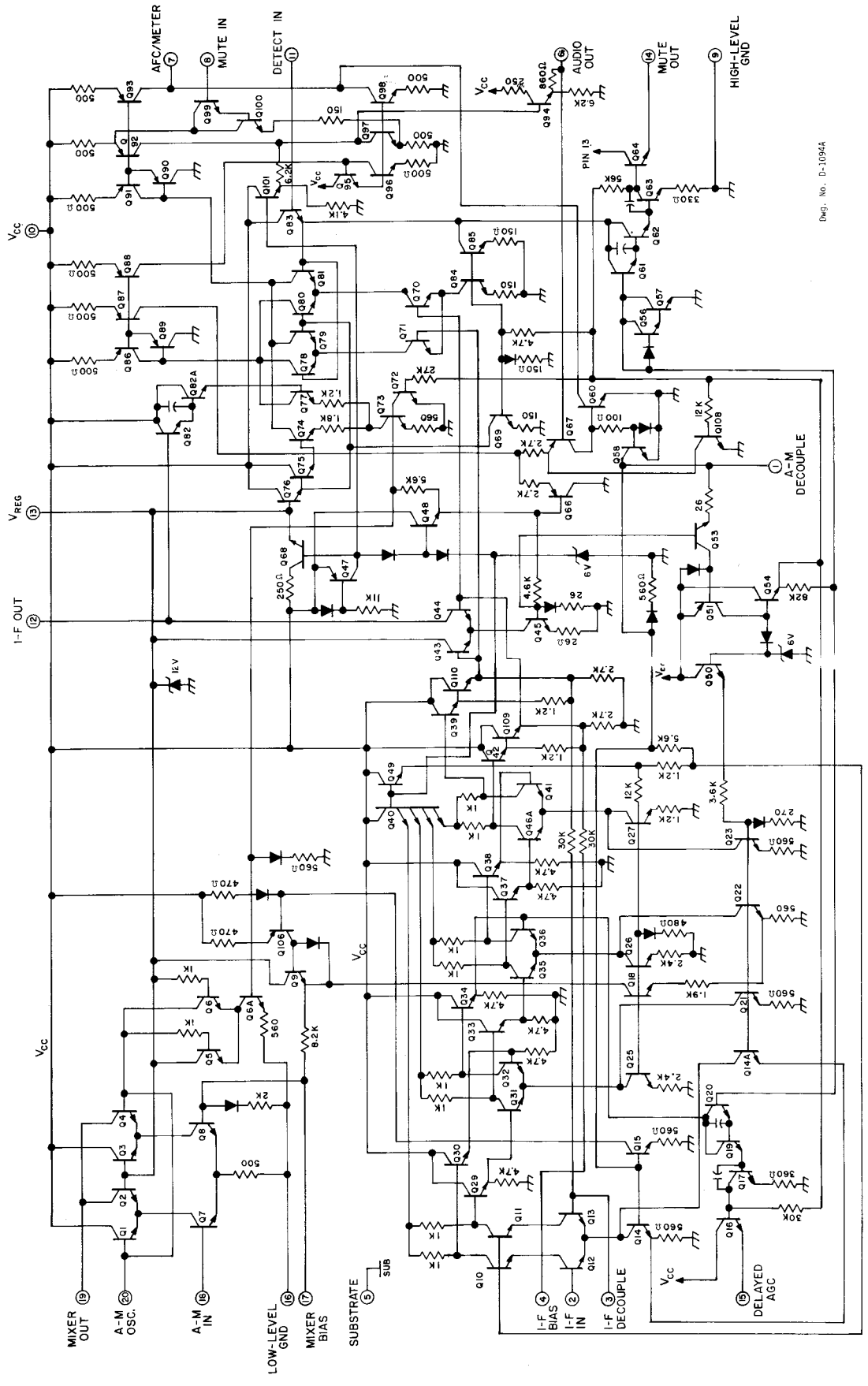
## F-M CHARACTERISTICS AS FUNCTIONS OF INPUT VOLTAGE




## A-M CHARACTERISTICS AS FUNCTIONS OF INPUT VOLTAGE



## SCHEMATIC




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.

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