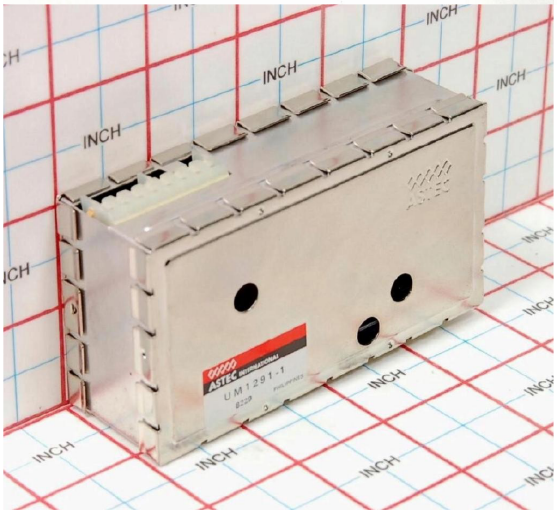
ASTEC UM1291-1 RF Modulator
Compilation of Information, October 31, 2017

The ASTEC UM1291-1 RF modulator is a direct replacement for the RF modulator that's inside the Bally Arcade/Astrocade. It looks like this:



One source where it can be purchased is from Electronics Surplus, here:

`http://www.electronicsurplus.com/astec-um1291-1-rf-modulator`

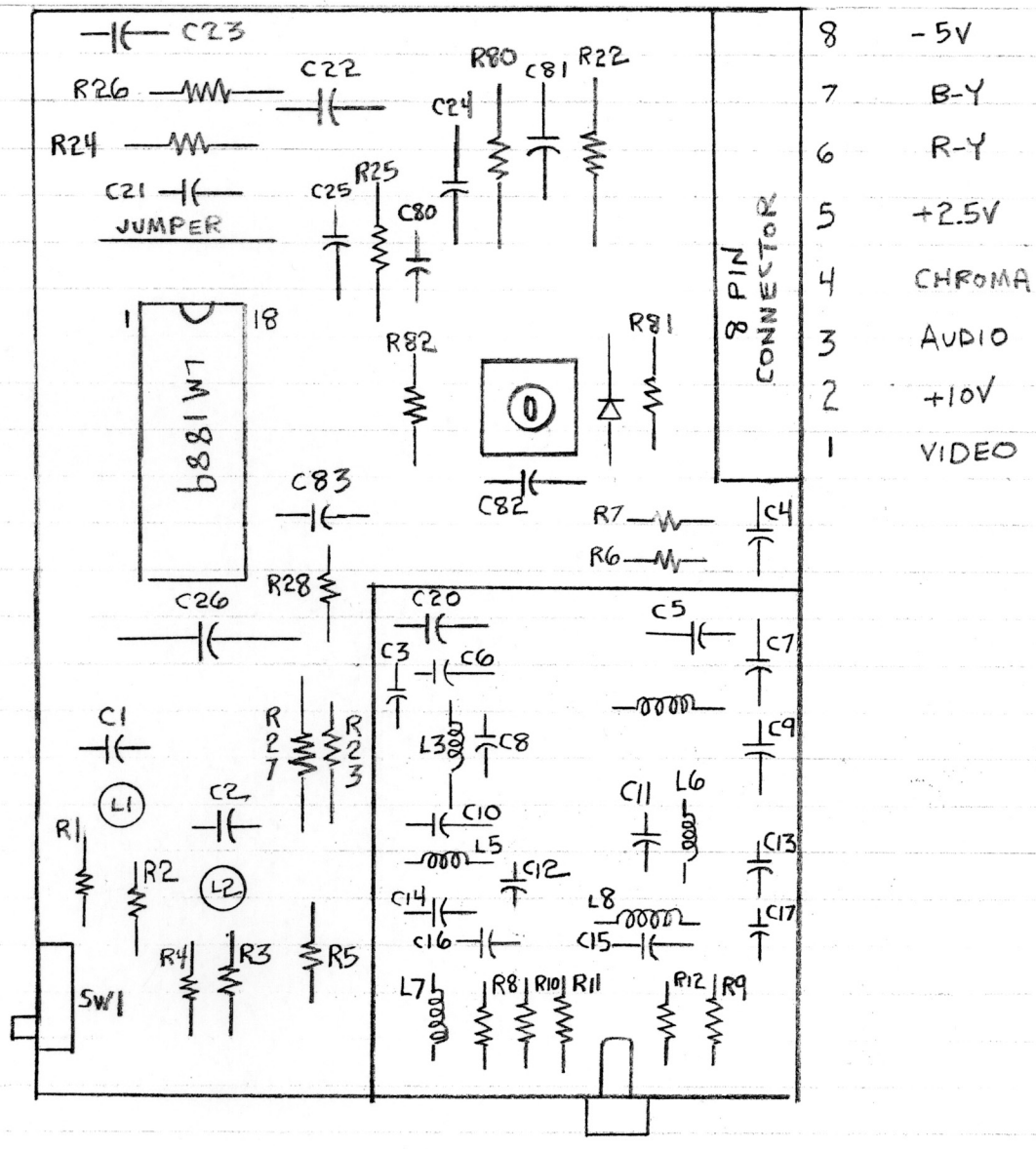
This document contains:

1) **ASTEC UM1291-1 TV Video Modulator (Board Layout)** - Drawn by Michael Matte

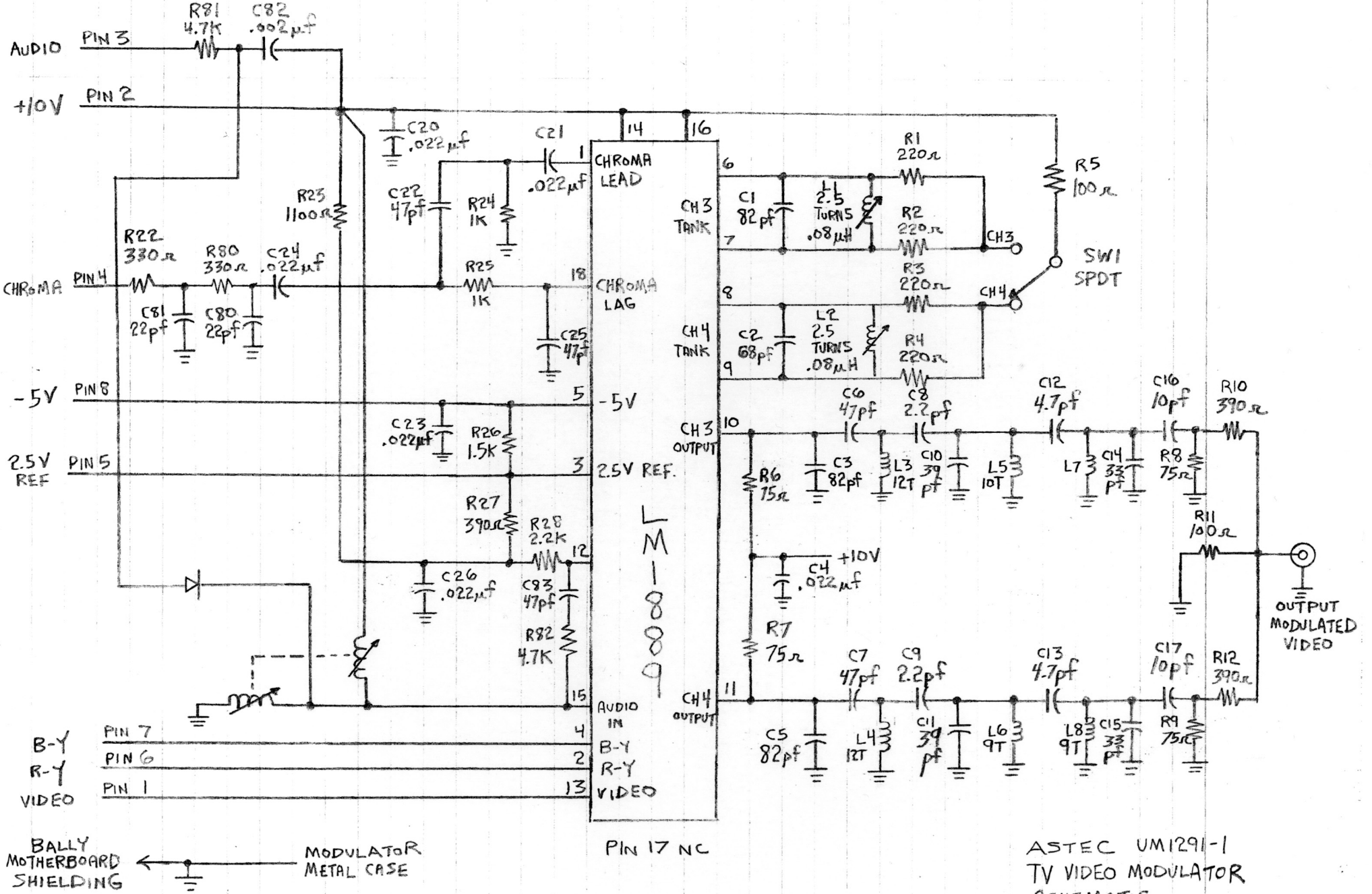
2) **ASTEC UM1291-1 TV Video Modulator (Schematic)** - Drawn by Michael Matte

3) **LM1889 TV Video Modulator** - 4-Page except from National Semiconductor datasheet for the 18-pin chip used in the UM1291-1.

4) **ASTEC UM1291-1 Internal Product Specification** - Four pages



ASTEC UM1291-1
TV VIDEO MODULATOR
BOARD LAYOUT



ASTEC UM1291-1
TV VIDEO MODULATOR
SCHEMATIC

LM1889 TV Video Modulator

General Description

The LM1889 is designed to interface audio, color difference, and luminance signals to the antenna terminals of a TV receiver. It consists of a sound subcarrier oscillator, chroma subcarrier oscillator, quadrature chroma modulators, and RF oscillators and modulators for two low-VHF channels.

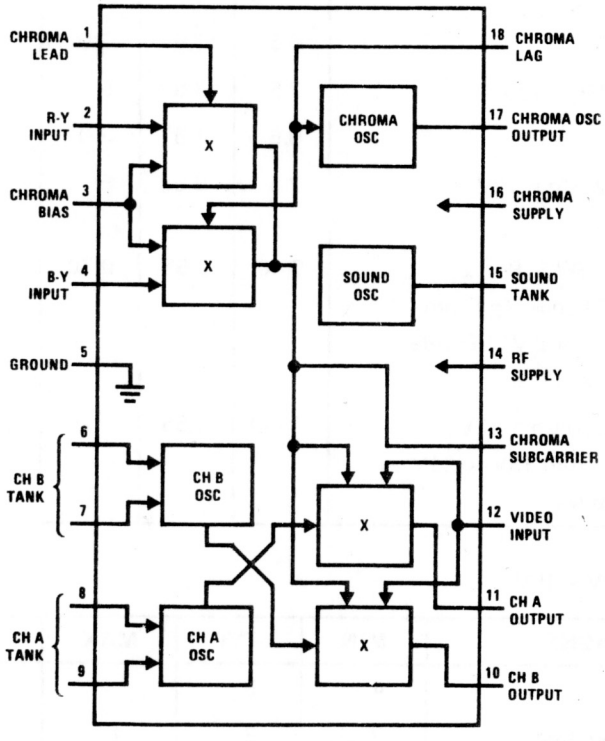
The LM1889 allows video information from VTR's, games, test equipment, or similar sources to be displayed on black and white or color TV receivers. When used with the MM57100 and MM53104, a complete TV game is formed.

Features

- dc channel switching
- 12V to 18V supply operation
- Excellent oscillator stability
- Low intermodulation products
- 5 Vp-p chroma reference signal
- May be used to encode composite video

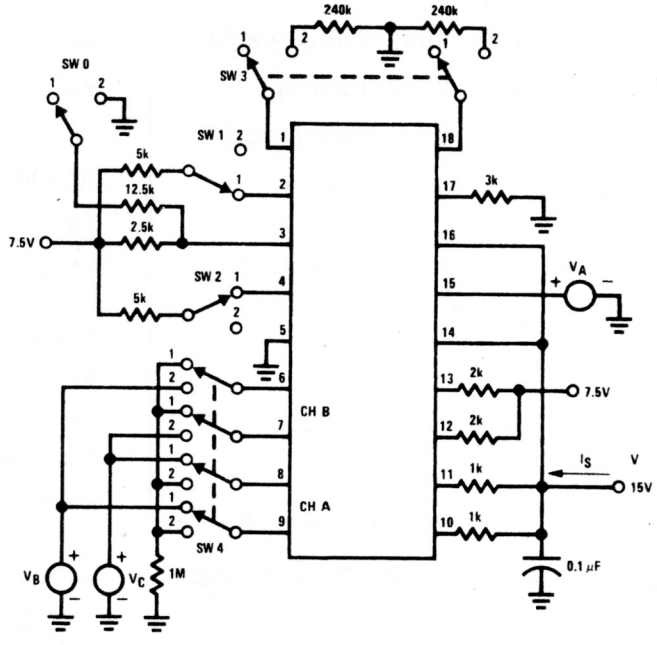
Block Diagram

Dual-In-Line Package



Order Number LM1889N
See NS Package N18A

DC Test Circuit



Absolute Maximum Ratings

Supply Voltage V14, V16 max	19 V_{dc}
Power Dissipation Package (Note 1)	1390 mW
Operating Temperature Range	0°C to +70°C
Storage Temperature Range	−55°C to +150°C
Chroma Osc Current I_{17} max	10 mA_{dc}
(V16−V15) max	±5 V_{dc}
(V14−V10) max	7V
(V14−V11) max	7V
Lead Temperature (Soldering, 10 seconds)	300°C

DC Electrical Characteristics (dc Test Circuit, All SW Normally Pos. 1, V_A = 15V, $V_B = V_C$ = 12V)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Current, I_S		20	35	45	mA
Sound Oscillator, Current Change, ΔI_{15}	Change V_A From 12.5V to 17.5V	0.3	0.6	0.9	mA
Chroma Oscillator Balance, V17		9.5	11.0	12.5	V
Chroma Modulator Balance, V13		7.0	7.4	7.8	V
R-Y Modulator Output Level, ΔV13	SW 3, Pos. 2, Change SW 1 From Pos. 1 to Pos. 2	0.6	0.9	1.2	V
B-Y Modulator Output Level, ΔV13	SW 3, Pos. 2, Change SW 2 From Pos. 1 to Pos. 2	0.6	0.9	1.2	V
Chroma Modulator Conversion Ratio, ΔV13/ΔV3	SW 3, Pos. 2, Change SW 0 From Pos 1 to Pos. 2. Divide ΔV13 by ΔV3	0.45	0.70	0.95	V/V
Ch. A Oscillator "OFF" Voltage, V8, V9	SW 4 Pos. 2	0.5	1.5	3.0	V
Ch. A Oscillator Current Level, I_9	V_B = 12V, V_C = 13V	2.5	3.5	5	mA
Ch. B Oscillator "OFF" Voltage, V6, V7		0.5	1.5	3.0	V
Ch. B Oscillator Current Level, I_6	SW 4, Pos. 2, V_B = 12V, V_C = 13V	2.5	3.5	5	mA
Ch. A Modulator Conversion Ratio, ΔV11/(V13−V12)	SW 1, SW 2, SW 3, Pos. 2, V_B = 12V, Change V_C From 13V to 11V For ΔV11 Divide By V13−V12	0.40	0.55	0.70	V/V
Ch. B Modulator Conversion Ratio, ΔV10/(V13−V12)	All SW, Pos. 2, V_B = 12V, Change V_C From 13V to 11V Divide as Above	0.40	0.55	0.70	V/V

AC Electrical Characteristics (ac Test Circuit, V = 15V)

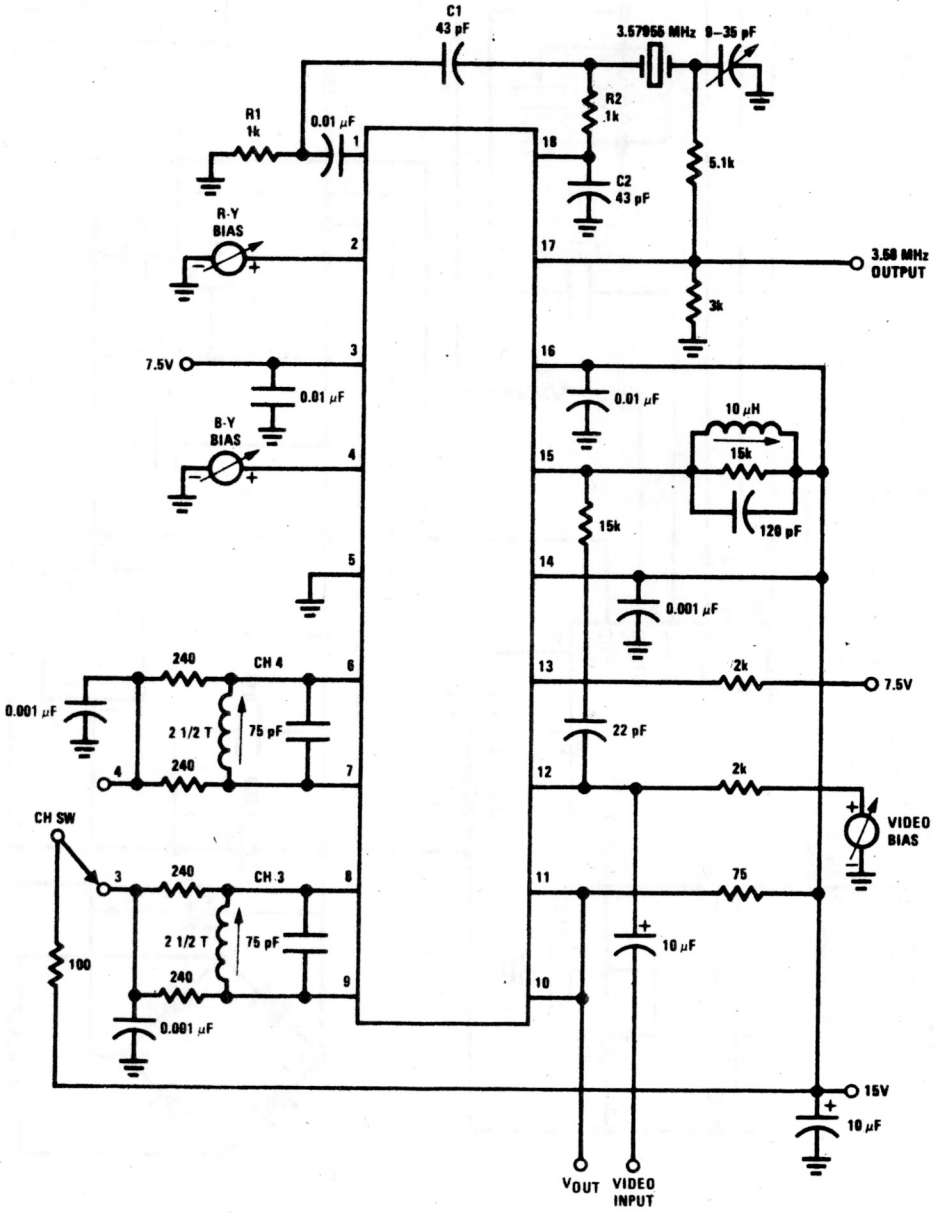
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Chroma Oscillator Output Level, V17	$C_{LOAD} \leq 20$ pF	4	5		Vp-p
Sound Carrier Oscillator Level, V15	Loaded by RC Coupling Network	2	3	4	Vp-p
Ch. 3 RF Oscillator Level, V8, V9	Ch. Sw. Pos. 3, f = 61.25 MHz, Use FET Probe	200	350		mVp-p
Ch. 4 RF Oscillator Level, V6, V7	Ch. Sw. Pos. 4, f = 67.25 MHz, Use FET Probe	200	350		mVp-p

Note 1: For operation in ambient temperatures above 25°C, the device must be derated based on a 150°C maximum junction temperature and a thermal resistance of 90°C/W junction to ambient.

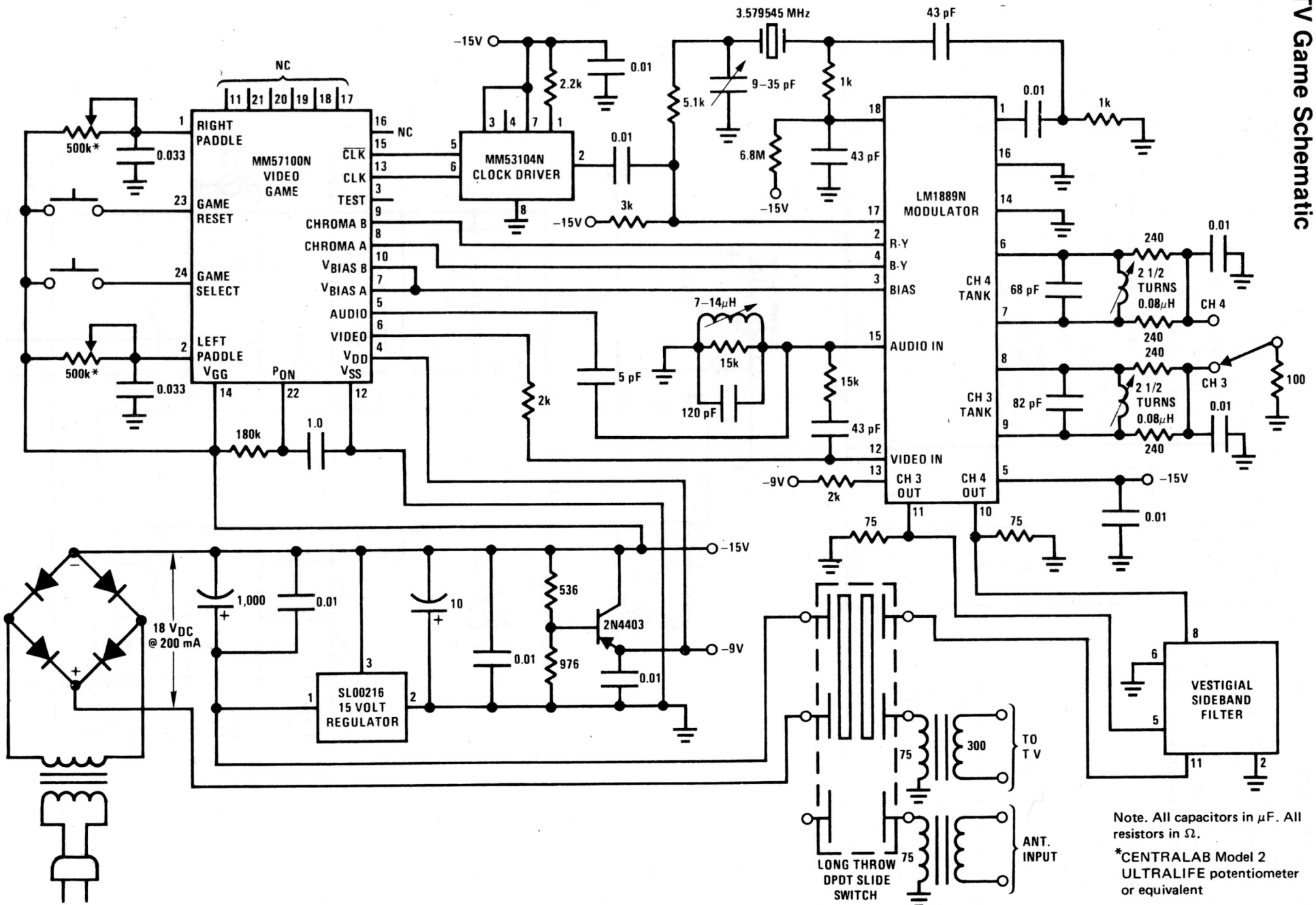
Design Characteristics (ac Test Circuit, V = 15V)

PARAMETER	TYP	UNITS	PARAMETER	TYP	UNITS
Oscillator Supply Dependence			RF Modulator		
Chroma, f_O = 3.579545 MHz	3	Hz/V	Conversion Gain, f = 61.25 MHz,		
Sound Carrier, RF	See Curves		$V_{OUT}/(V13-V12)$	10	mVrms/V
Oscillator Temperature Dependence (IC Only)			3.58 MHz Differential Gain	5	%
Chroma	0.05	ppm/°C	Differential Phase	3	degrees
Sound Carrier	−15	ppm/°C	2.5 Vp-p Video, 87.5% mod.		
RF	−50	ppm/°C	Output Harmonics Below Carrier		
Chroma Oscillator Output, Pin 17			2nd, 3rd	−12	dB
t_{RISE}, 10–90%	20	ns	4th and above	−20	dB
t_{FALL}, 90–10%	30	ns	Input Impedances		
Duty Cycle (+) Half Cycle	51	%	Chroma Modulator, Pins 2, 4	500k//2 pF	
(−) Half Cycle	49	%	RF Modulator, Pin 12	1M//2 pF	
RF Oscillator Maximum Operating Frequency	100	MHz	Pin 13	250k//3.5 pF	
(Temperature Stability Degraded)					
Chroma Modulator (f = 3.58 MHz)					
B-Y Conversion Gain V13/(V4−V3)	0.6	Vp-p/V			
R-Y Conversion Gain V13/(V2−V3)	0.6	Vp-p/V			
Gain Balance	±0.5	dB			
Bandwidth	See Curve				

AC Test Circuit



TV Game Schematic



Note. All capacitors in μF. All resistors in Ω.

*CENTRALAB Model 2 ULTRALIFE potentiometer or equivalent

AN OFFSET BETWEEN PIN 12 AND PIN 13 WILL PRODUCE AN RF CARRIER AT PIN 10 OR 11 DEPENDING ON THE CHANNEL SELECTED. RF MODULATION, IN THIS CASE, IS ACHIVED WITH PIN 12 SET AT A DC REFERENCE AND VIDEO SIGNAL APPLIED TO PIN 13.

FEEDING A CHROMA SUBCARRIER THROUGH A LEAD-LAG NETWORKS TO PIN 1 AND 18 DEFINES A QUADRATURE PHASE RELATIONSHIP BETWEEN THESE TWO PINS. THESE QUADRATURE PHASE AT PIN 1 AND 18 ARE DEFINED AS THE COLOR DIFFERENCE AXES R-Y AND B-Y. A SIGNAL AT PIN 2 (R-Y) WILL GIVE A CHROMINANCE SUBCARRIER OUTPUT FROM THE MODULATOR WITH A RELATIVE PHASE OF 90° COMPARED TO THE SUBCARRIER OUTPUT PRODUCED BY A SIGNAL AT PIN 4 (B-Y). THE MAGNITUDE OF THE CHROMINANCE SUBCARRIER OUTPUT IS DETERMINED BY THE DIFFERENCE IN DC LEVEL BETWEEN PIN 2 AND 3 (OR PIN 4 AND 3), WHERE PIN 3 IS DC BIASED AT A REFERENCE LEVEL. THE PHASE OF THE SUBCARRIER IS CHANGED BY 180° WHEN THE POLARITY OF THE SIGNAL AT PIN 2 (OR 4) IS CHANGED WITH RESPECT TO THAT AT PIN 3. WHEN SIMULTANEOUS SIGNALS EXIST AT PIN 2 AND 4, THE SUBCARRIER OUTPUT LEVEL AND PHASE WILL BE THE VECTOR SUM OF THE QUADRATURE COMPONENTS PRODUCED BY PIN 2 AND 4. THIS SUBCARRIER IS INTERNALLY CONNECTED TO PIN 13 FOR RF MODULATION.

L9 AND C11 FORM THE TANK CIRCUIT OF THE AUDIO SUBCARRIER OSCILLATOR. FREQUENCY DEVIATION IS ACHIEVED BY SWITCHING A SMALL VALUE - CAPACITOR TO GROUND. THIS IS DONE BY VARYING THE DC VOLTAGE TO THE ANODE OF THE VARACTOR DIODE.

THE LC NETWORKS CONNECTED TO PIN 10 AND 11 FORMS THE VESTIGIAL SIDEBAND FILTER OF CHANNEL 3 AND 4 RESPECTIVELY.

3.2.2 ELECTRICAL CHARACTERISTICS

3.2.2.1 ABSOLUTE MAXIMUM RATINGS.

THE MAXIMUM VOLTAGE APPLIED BETWEEN ANY PIN AND CASE SHOULD BE WITHIN - 18V TO +15V.

3.2.2.2 CHARACTERISTICS

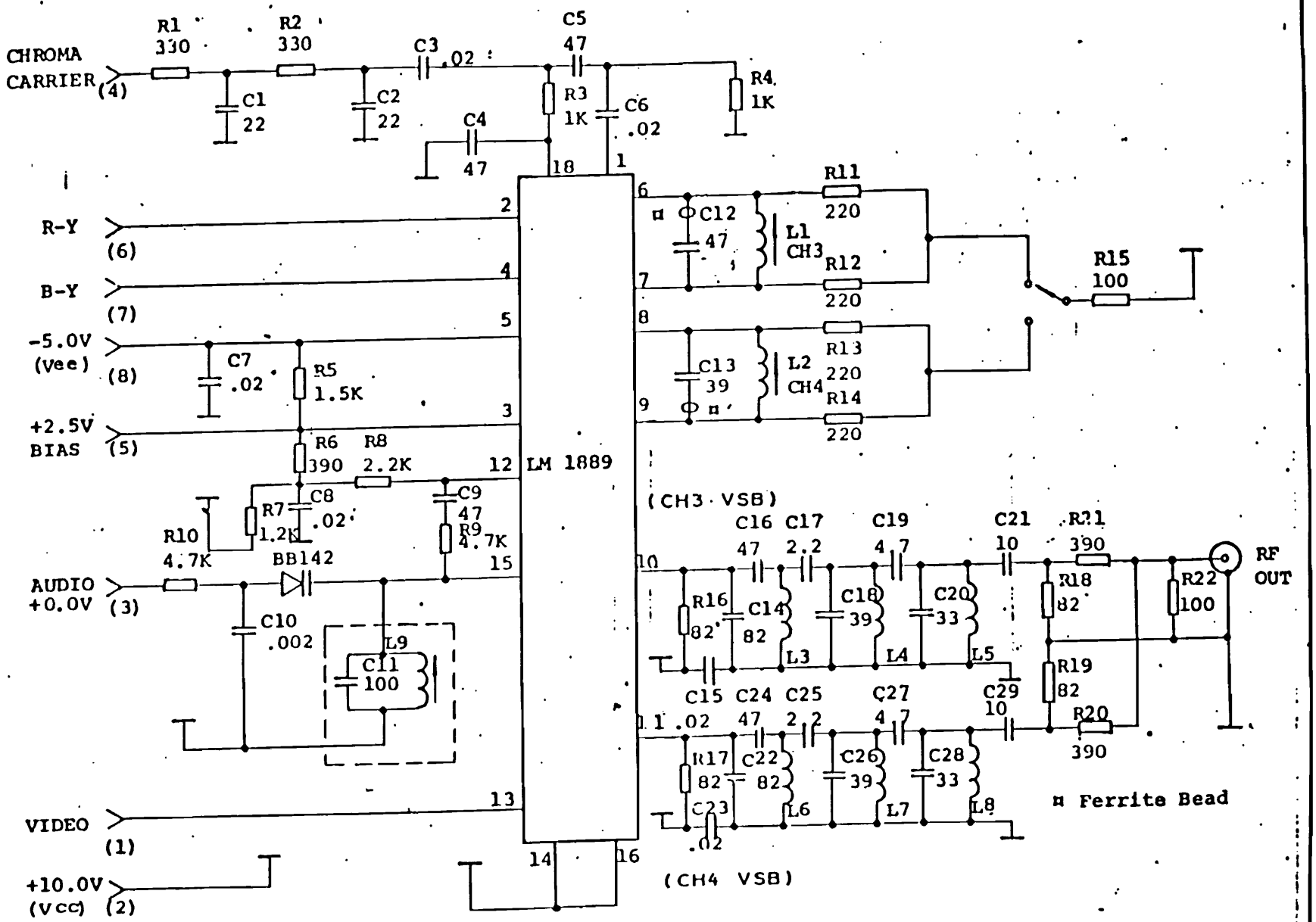


FIG.3 CIRCUIT DIAGRAM

ASTEC INTERNATIONAL LIMITED HONG KONG

TITLE

INTERNAL PRODUCT SPECIFICATION

UM1291-1

Sheet 13 of 21

A-4

3.2.2.4 ALIGNMENT CHART

STEP		COIL TO BE ADJUSTED	METHOD OF ADJUSTMENT	UNTIL THE FOLLOWING REQUIREMENT IS MET
CH3	1	L1	ADJUST BRASS SLUG	61.25MHZ.
CH4	2	L2	ADJUST BRASS SLUG	67.25MHZ.
CH3*	3	L9	ADJUST FERRITE CORE	4.5MHZ.
CH3	4A	L4	KNIFE THE COIL.	THE PASS BAND CENTRE IS MOVED TO 63.50MHZ.
	B	L5	KNIFE THE COIL	THE PASS BAND IS AS FLAT AS POSSIBLE.
	C	L3	KNIFE THE COIL	THE PASS BAND IS AS FLAT AS POSSIBLE.
	D	L4	KNIFE THE COIL	THE PASS BAND IS WITHIN SPEC.
	E	L5	KNIFE THE COIL	THE PASS BAND IS WITHIN SPEC.
CH4	5A	L7	KNIFE THE COIL	THE PASS BAND CENTRE IS MOVED TO 69.50MHZ.
	B	L8	KNIFE THE COIL	THE PASS BAND IS AS FLAT AS POSSIBLE.
	C	L6	KNIFE THE COIL	THE PASS BAND IS AS FLAT AS POSSIBLE.
	D	L7	KNIFE THE COIL	THE PASS BAND IS WITHIN SPEC.
	E	L8	KNIFE THE COIL	THE PASS BAND IS WITHIN SPEC.

* THE SOUND INPUT IS OFFSET TO +0.0V W.R.T. GROUND

SEE SHEET 18

THE MODULE IS DESIGNED TO WORK AT 2 SUPPLIES WHERE ONE IS +10V (VCC) WHILE THE OTHER IS - 5V (VEE). THE IC GROUND IS TIED TO - 5V WHILE THE IC SUPPLY IS +10V. THE MODULATION TRANSFER CHARACTERISTIC WILL BE NEGATIVE, I.E. A POSITIVE GOING SIGNAL INPUT WILL CAUSE A DECREASE IN RF OUTPUT LEVEL. THE PEAK RF OUTPUT IS DEFINED WITH INPUT GROUNDED (0V). FIG 4 DEFINES A TYPICAL TRANSFER CHARACTERISTIC. TABLE 1 DEFINES OTHER VARIOUS PARAMETERS THAT THE MODULATOR SHALL MEET.

3.2.2.3 ALIGNMENT PROCEDURE

A. CHANNEL FREQUENCY.
USING ZERO BEAT METHOD, L1 AND L2 IS ADJUSTED TO GIVE 61.25MHZ (CH3) AND 67.25MHZ (CH4) RESPECTIVELY.

B. SOUND SUBCARRIER.
USING ZERO BEAT METHOD, L9 IS ADJUSTED FOR 4.5MHZ SOUND SUBCARRIER FREQUENCY.

C. VSB FILTER.
FOR CH3, L3, L4, L5 ARE ADJUSTED REPEATEDLY TO HAVE THE PASS BAND CENTRE AT ABOUT 63.50MHZ. AND THE BAND EDGES AT 60MHZ AND 66MHZ.
FOR CH4, L6, L7, L8 ARE ADJUSTED REPEATEDLY TO HAVE THE PASS BAND CENTRE AT ABOUT 69.50MHZ AND THE BAND EDGES AT 66MHZ AND 72MHZ.