# M51365SP

## PLL-SPLIT VIF/SIF

### DESCRIPTION

The M51365SP is a semiconductor integrated circuit consisting of an IF signal processor suitable for color TV sets and VTRs with AV.

Circuits include VIF amplifiers, video detector, VCO, APC detector, AFT, video equalizer, plus IF/RF AGC and SIF detector functions.

### FEATURES

- Employment of a full synchronous detector circuit using PLL as video detector provides excellent DG, DP, 920kHz beat and cross color characteristics.
- Usage of PLL-SPLIT method to obtain intercarrier by separating video IF and audio IF processing by VCO output provides good sound sensitivity and reduces buzz. In consumer sets, intercarrier is also available from the video detector output.
- Built-in video equalizer suitable for VTRs and color TV sets equipped with video output terminals.
- Employment of quadrature detector circuit for FM detection of audio IF requires no adjustment.

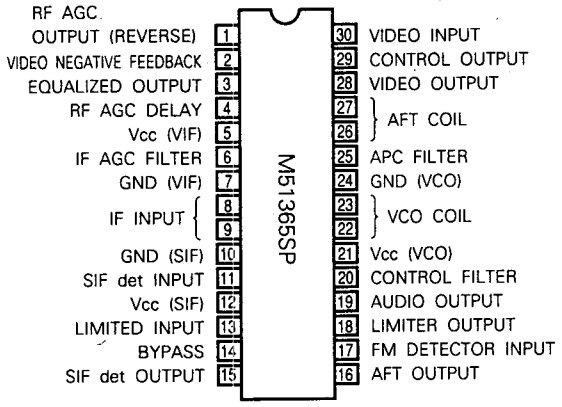
### APPLICATIONS

TV sets, VTR tuners

### RECOMMENDED OPERATING CONDITIONS

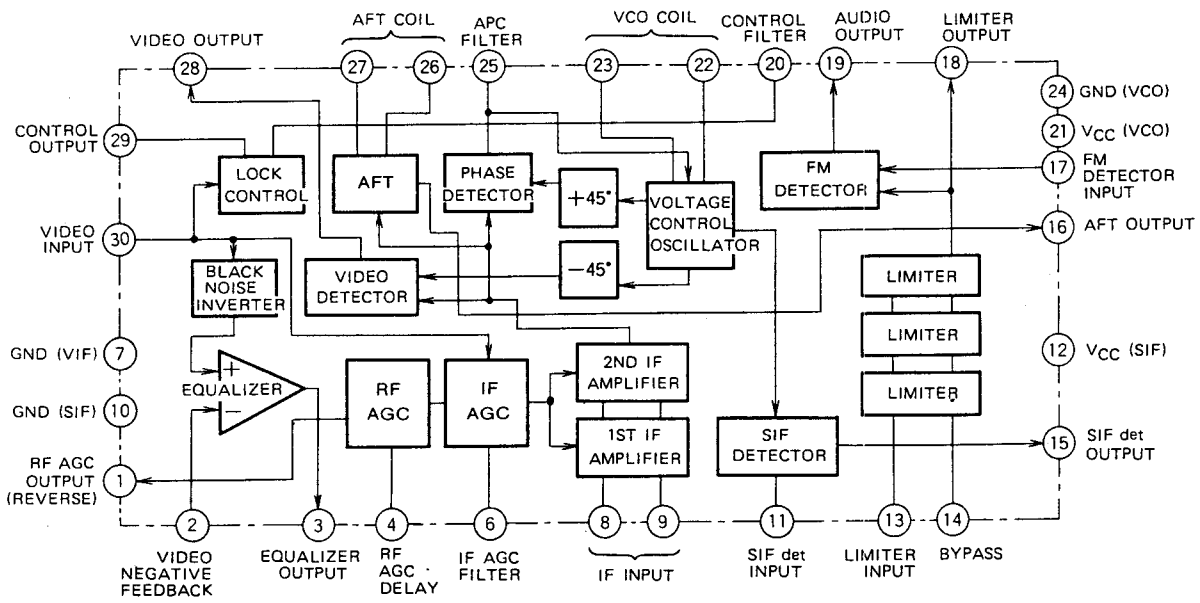
Supply voltage range ..... 8~10V
Rated supply voltage ..... 9V

### PIN CONFIGURATION (TOP VIEW)




Outline 30P4B

### BLOCK DIAGRAM






MITSUBISHI ELECTRIC

## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Ratings | Unit |
|---|---|---|---|
| Vcc | Supply voltage | 14 | V |
| Pd | Power dissipation | 1250 | mW |
| Topr | Operating temperature | −20~75 | °C |
| Tstg | Storage temperature | −40~125 | °C |
| Surge 8 | Permissible surge (pin ⑧) | +200, −150 | V |
| Surge 9 | Permissible surge (pin ⑨) | +200, −150 | V |
| | Permissible surge (other pins) | ±200 | V |

## ELECTRICAL CHARACTERISTICS (Ta=25°C, Vcc=9V, unless otherwise noted)

### VIF SECTION

| Symbol | Parameter | Test circuit | Test point | Test conditions | | | | | | Limits | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Input signal | | External voltage(V) | | | * Switch is set at 1. | Min. | Typ. | Max. | |
| | | | | VIF | SIF1 | $V_1$ | $V_6$ | $V_{20}$ | | | | | |
| $I_{CC}$(VIF) | Circuit current (VIF) | 1 | A1 | — | — | 3 | — | — | SW1=2, SW2=3 | 33 | 45 | 57 | mA |
| $V_{28}$ | Video detector output DC voltage 1 | 1 | TP9 | — | — | 3 | 0 | — | SW2=3, SW3=2 | 3.4 | 3.75 | 4.1 | V |
| $V_3$ | Video detector output DC voltage 2 | 1 | TP2 | — | — | 3 | 0 | — | SW2=3, SW3=2 | 4.4 | 4.8 | 5.2 | V |
| $V_{o\ det\ 1}$ | Video detector output 1 | 1 | TP9 | SG1 | — | 3 | — | — | SW2=3 | 1.15 | 1.45 | 1.75 | $V_{P-P}$ |
| $V_{o\ det\ 2}$ | Video detector output 2 | 1 | TP2 | SG1 | — | 3 | — | — | SW2=3 | 1.6 | 1.95 | 2.3 | $V_{P-P}$ |
| P/N | Video S/N | 1 | TP10 | SG2 | — | 3 | — | — | SW2=3, SW6=2 Refer to note 1 | 50 | 58 | | dB |
| $B_W$ | Video frequency characteristics | 1 | TP9 | SG3 | — | 3 | — | — | SW2=3 Refer to note 2 | 5.5 | 7 | | MHz |
| $V_{in(min)}$ | Input sensitivity | 1 | TP9 | SG4 | — | 3 | — | — | SW2=3 Refer to note 3 | | 46 | 51 | dBμ |
| $V_{in(max)}$ | Maximum permissible input | 1 | TP9 | SG5 | — | 3 | — | — | SW2=3 Refer to note 4 | 107 | 110 | | dBμ |
| GR | AGC control range | 1 | — | — | — | — | — | — | Refer to note 5 | 58 | 64 | | dB |
| $V_{IH}$ | Maximum IF AGC voltage | 1 | TP3 | — | — | 3 | — | — | SW2=3 | 6.5 | 8.6 | | V |
| $V_{I(80dB\mu)}$ | IF AGC voltage (80dBμ) | 1 | TP3 | SG6 | — | 3 | — | — | SW2=3 | 4.3 | 4.9 | 5.5 | V |
| $V_{IL}$ | Minimum IF AGC voltage | 1 | TP3 | SG7 | — | 3 | — | — | SW2=3 | 3.4 | 3.9 | 4.4 | V |
| $V_{O\ SIF-1}$ | SIF det 4.5MHz output (100dBμ) | 1 | TP4 | SG2 | SG8 | 3 | — | — | SW2=3 | 104 | 109 | 114 | dBμ |
| $V_{O\ SIF-2}$ | SIF det 4.5MHz output (80dBμ) | 1 | TP4 | SG2 | SG9 | 3 | — | — | SW2=3 | 90 | 96 | 101 | dBμ |
| $V_{16}$ | AFT output voltage | 1 | TP5 | — | — | 3 | 0 | — | SW2=3 | 3.2 | 4.3 | 5.4 | V |
| μ | AFT detector sensitivity | 1 | TP5 | SG10 | — | 3 | — | — | SW2=3 Refer to note 6 | 48 | 70 | 92 | mV/kHz |
| $V_{16H}$ | Maximum AFT voltage | 1 | TP5 | SG10 | — | 3 | — | — | SW2=3 Refer to note 7 | 8 | 8.7 | | V |
| $V_{16L}$ | Minimum RF AGC voltage | 1 | TP5 | SG10 | — | 3 | — | — | SW2=3 Refer to note 8 | | 0.38 | 1.0 | V |
| $V_{1H}$ | Minimum RF AGC voltage | 1 | TP1 | SG2 | — | 2 | — | — | SW2=3 | 7 | 7.85 | | V |
| $V_{1L}$ | Maximum RF AGC voltage | 1 | TP1 | SG2 | — | 4 | — | — | SW2=3 | | 0 | 1.0 | V |
| CL-U1 | Capture range (U) 1 | 1 | TP9 | SG11 | — | 3 | — | — | SW2=3 Refer to note 9 | 0.5 | 1.0 | | MHz |
| CL-L1 | Capture range (L) 1 | 1 | TP9 | SG11 | — | 3 | — | — | SW2=3 Refer to note 10 | 1.2 | 1.7 | | MHz |
| CL-T | Capture range (T) | 1 | — | — | — | — | — | — | Refer to note 11 | 2.0 | 2.7 | | MHz |
| CL-U2 | Capture range (U) 2 | 1 | TP9 | SG11 | — | 3 | — | — | SW2=3, SW5=2 Refer to note 9 | 0.45 | 0.9 | 1.45 | MHz |
| CL-L2 | Capture range (L) 2 | 1 | TP9 | SG11 | — | 3 | — | — | SW2=3, SW5=2 Refer to note 10 | 0.7 | 1.0 | 1.35 | MHz |
| $V_{20TH}$ | Lock detection threshold voltage | 1 | TP8 | — | — | 3 | 5 | Variable | SW2=3, SW3, 4, 5=2 Refer to note 12 | 3.6 | 4.0 | 4.4 | V |
| $V_{29L}$ | Minimum pin 29 voltage | 1 | TP8 | — | — | 3 | 5 | Variable | SW2=3, SW3, 4, 5=2 Refer to note 13 | | 0.15 | 0.5 | V |

**VIF SECTION** (cont.)

| Symbol | Parameter | Test circuit | Test point | Test conditions | | | | | | Limits | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Input signal | | External voltage(V) | | | * Switch is set at 1. | Min. | Typ. | Max. | |
| | | | | VIF | SIF1 | $V_1$ | $V_6$ | $V_{20}$ | | | | | |
| FC1 | EQ frequency characteristics 1 | 1 | TP9 TP2 | SG12 | — | 3 | — | — | SW2=3 Refer to note 14 | 1.4 | 2.4 | 3.4 | dB |
| FC2 | EQ frequency characteristics 2 | 1 | TP9 TP2 | SG13 | — | 3 | — | — | SW2=3 Refer to note 14 | 4.2 | 5.7 | 7.2 | dB |
| FC3 | EQ frequency characteristics 3 | 1 | TP9 TP2 | SG14 | — | 3 | — | — | SW2=3 Refer to note 14 | 9.5 | 12.0 | 14.5 | dB |
| IM | Intermodulation | 1 | TP9 | SG15 | — | 3 | Vari-able | — | SW2=3, SW3=2 Refer to note 15 | 30 | 35 | | dB |
| DG | DG | 1 | TP9 | SG16 | — | 3 | — | — | SW2=3 Refer to note 16 | | 2 | 5 | % |
| DP | DP | 1 | TP9 | SG16 | — | 3 | — | — | SW2=3 Refer to note 16 | | 2 | 5 | deg |
| $V_{BTH}$ | Black spot inverter threshold level | 1 | TP2 | SG1 | — | 3 | Vari-able | — | SW2=3, SW3=2 Refer to note 17 | 1.3 | 1.7 | 2.1 | V |
| $V_{BCL}$ | Black spot inverter clamp level | 1 | TP2 | SG1 | — | 3 | Vari-able | — | SW2=3, SW3=2 Refer to note 17 | 3.7 | 4.2 | 4.7 | V |
| $V_{SYNC}$ | Pin ③ sync chip level | 1 | TP2 | SG2 | — | 3 | — | — | SW2=3 | 2.1 | 2.5 | 2.9 | V |
| Rin(V) | VIF input resistance | 2 | | 90dBμ | — | 3 | — | — | | | 0.95 | | kΩ |
| Cin(V) | VIF input capacitance | 2 | | 90dBμ | — | 3 | — | — | | | 5 | | pF |
| Rin(S1) | SIF1 input resistance | 2 | | — | 90dBμ | 3 | — | — | | | 2.1 | | kΩ |
| Cin(S1) | SIF1 input capacitance | 2 | | — | 90dBμ | 3 | — | — | | | 2.5 | | pF |

**SIF SECTION**

| Symbol | Parameter | Test circuit | Test point | Test conditions | | | | | | Limits | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Input signal | | External voltage(V) | | | * Switch is set at 1. | Min. | Typ. | Max. | |
| | | | | SIF2 | | $V_1$ | $V_6$ | $V_{20}$ | | | | | |
| $I_{CC}$(SIF) | Circuit current (SIF) | 1 | A2 | — | | 0 | — | — | SW1=3, SW2=2 | 5.0 | 7.2 | 9.4 | mA |
| $V_{19}$ | AF output DC voltage | 1 | TP6 | — | | 0 | — | — | SW1=3 | 4.0 | 4.6 | 5.2 | V |
| $V_{OAFMAX}$ | Maximum AF output | 1 | TP6 | SG17 | | 0 | — | — | SW1=3 | 530 | 680 | 830 | mVrms |
| $THD_{AF}$ | AF output distortion | 1 | TP6 | SG21 | | 0 | — | — | SW1=3 | | 0.2 | 1.0 | % |
| $V_{in(lim)}$ | Input limiting sensitivity | 1 | TP6 | SG18 | | 0 | — | — | SW1=3 Refer to note 18 | | 38 | 46 | dBμ |
| AMR | AMR | 1 | TP6 | SG19 | | 0 | — | — | SW1=3 Refer to note 19 | 50 | 60 | | dB |
| S/N | AF S/N | 1 | TP6 | SG20 | | 0 | — | — | SW1=3 Refer to note 20 | 60 | 75 | | dB |

## ELECTRICAL CHARACTERISTICS TEST METHOD

**Note 1. Video s/n "P/N"**

a. Input SG2 to VIF IN.

b. Passing Pin 28 noise through a low pass filter (5MHz, at –3dB), measure the ouput voltage at TP10 in r.m.s.

c. $P/N=20 \log \frac{\text{Vodet1(Vp-p)} \times 0.7}{\text{noise (Vrms)}}$

Voget 1 is video detector output 1.

**Note 2. Video frequency characteristics "Bw"**

a. SG3 is set as follows.

$f_1$=58.75MHz Vi=90dBμ
$f_2$=57.75MHz Vi=70dBμ
} mixed signal

b. Measure $V_1$, the component of 1MHz at TP9.

c. Decrease frequency $f_2$ level until the component ($f_1$–$f_2$) at TP9 becomes 3dB smaller than $V_1$, and read the value at that level.

d. Bw=58.75 – $f_2$ (MHz)

**Note3.Input sensitivity "Vin(min)"**

a. Input SG4 to VIF IN.

b. Decrease SG4 evel until pin 28 detector output is 3dB smaller thatn Vodet 1. This is the input sensitivity level.

**Note 4. Maximum permissible input "Vin(max)"**

a. Set SG5 at 90dBμ and input to VIF IN.
b. $V_2$ is detector output at pin 28.
c. Increase SG5 voltage until detector output becomes 3dB smaller than $V_2$. This is the maximum permissible voltage.

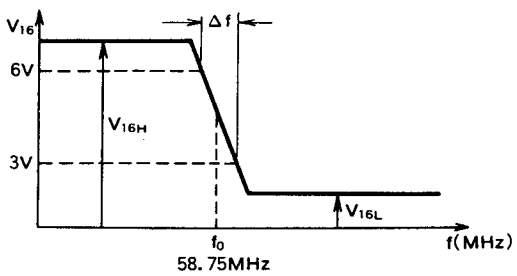
**Note 5. AGC control range "GR"**

a. AGC control range is defined as follows:
GR=maximum permissible input-input sensitivity

**Note 6. AFT detector sensitivity "μ"**

a. Input SG10 to VIF IN
b. Measure frequency difference Δf when DC voltage at TP5 transits from 3.0V to 6.0V.
c. AFT detector sensitivity is defined as follows:

$$\mu = \frac{3000mV}{\Delta f\ (kHz)}\ (mV/kHz)$$




**Note 7. Maximum AFT voltage "$V_{16H}$"**

a. Maximum AFT voltage is $V_{16H}$ in the above figure.

**Note 8. Minimum AFT voltage "$V_{16L}$"**

a. Minimum AFT voltage is $V_{16L}$ in the above figure.

**Note 9. Capture range (U) "CL-U-1" "CL-U-2"**

a. Input SG11 to VIF IN and increase frequency until VCO lock is removed.
b. Decrease SG11 frequency until VCO lock is enabled again. This frequency is fv (MHz).
c. Capture range (U) is fv–58.75 (MHz).

**Note 10. Capture range (L) "CL-L-1" "CL-L-2"**

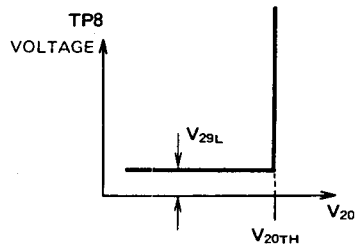
a. Input SG11 to VIF IN and decrease frequency until VCO lock is removed.
b. Increase SG11 frequency until VCO lock is enabled again. This frequency is $f_L$ (MHz).
c. Capture range (L) is between 58.75-$f_L$ (MHz).

**Note 11. Capture range (T) "CT-T".**

a. "CL–T" = "CL–U–1" + "CCL–L–1" (MHz)

**Note 12. Lock detection threshold voltage "$V_{20TH}$"**

a. Measure TP8 value with $V_{20}$ voltage at 3V.
b. Increase $V_{20}$ voltage until TP8 voltage shows drastic change. This voltage is $V_{20TH}$. (threshold 1V).




**Note 13. Minimum pin 29 voltage "$V_{29L}$"**

a. $V_{29L}$ is the minimum voltage mentioned in note 12.

**Note 14. EQ frequency characteristics "FC1" "FC2" "FC3"**

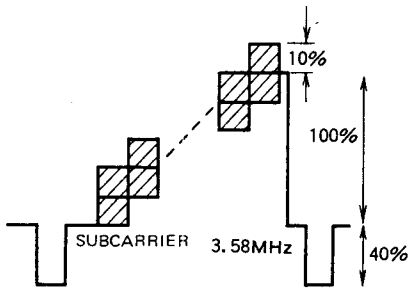
a. Input SG12, SG13 or SG14 to VIF IN.
b. Measure level of ($f_1$–$f_2$) component at TP9, this is $V_{EQ\ IN}$ (dBμ).
c. Measure level of ($f_1$–$f_2$) component at TP2, this is $V_{EQ\ OUT}$ (dBμ).
d. EQ frequency characteristics are defined as follows:
FC1~3=$V_{EQ\ OUT}$–$V_{EQ\ IN}$ (dB)

**Note 15. Intermodulation "IM"**

a. Input SG15 to VIF IN
b. Read values of TP9 on an oscilloscope and adjust $V_6$ voltage to set minimum level of detector output waveform at 2V.
c. Observe TP9 value on a spectrum analyzer. The relation 920kHz level to 3.58MHz level is the intermodulation.


**Note 16. DG,DP "DG,DP"**

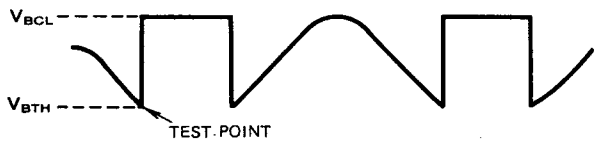
a. As shown below, the modulated waveform of SG16 is a 10-step wave with 87.5% video modulation.
b. Measure values of DG and DP at TP9 on a vectorscope.



**Note 17. Black spot inverter threshold, clamp level "$V_{B\ TH}$, $V_{B\ CL}$"**

a. Input SG1 to VIF IN.

b. Measure DC voltages from output waveform at TP2 as shown in the figure.




**Note 18. Input limiting sensitivity "Vin(lim)"**

a. Set SG18 value at 80dBμ and input to SIF2 IN.

b. Decrease SG18 output untill detector output at TP6 becomes 3dB smaller than $V_{OAF\ MAX.}$ That SG18 level is the input limiting sensitivity.

**Note 19. AMR "AMR"**

a. Input SG19 to SIF2 IN.

b. Measure $V_{AM}$, which is output voltage at TP6.

c. AMR is defined as follows:

$$MR=20\ \log\ \frac{V_{OAF\ MAX}\ (mVrms)}{V_{AM}\ (mVrms)}\ (dB)$$

**Note 20. AF S/N "S/N"**

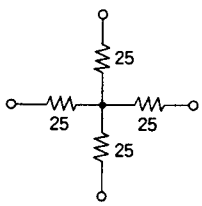
a. Input SG20 to SIF2 IN.

b. The output voltage measured at TP6 is VN.

c. AF S/N is defined as follows :

$$S/N=20\ \log\ \frac{V_{OAF\ MAX}\ (mVrms)}{V_{N}\ (mVrms)}\ (dB)$$

- The oscillation levels of all AM modulated waves are those at the peak level.
- The following circuit is used for the mixer.

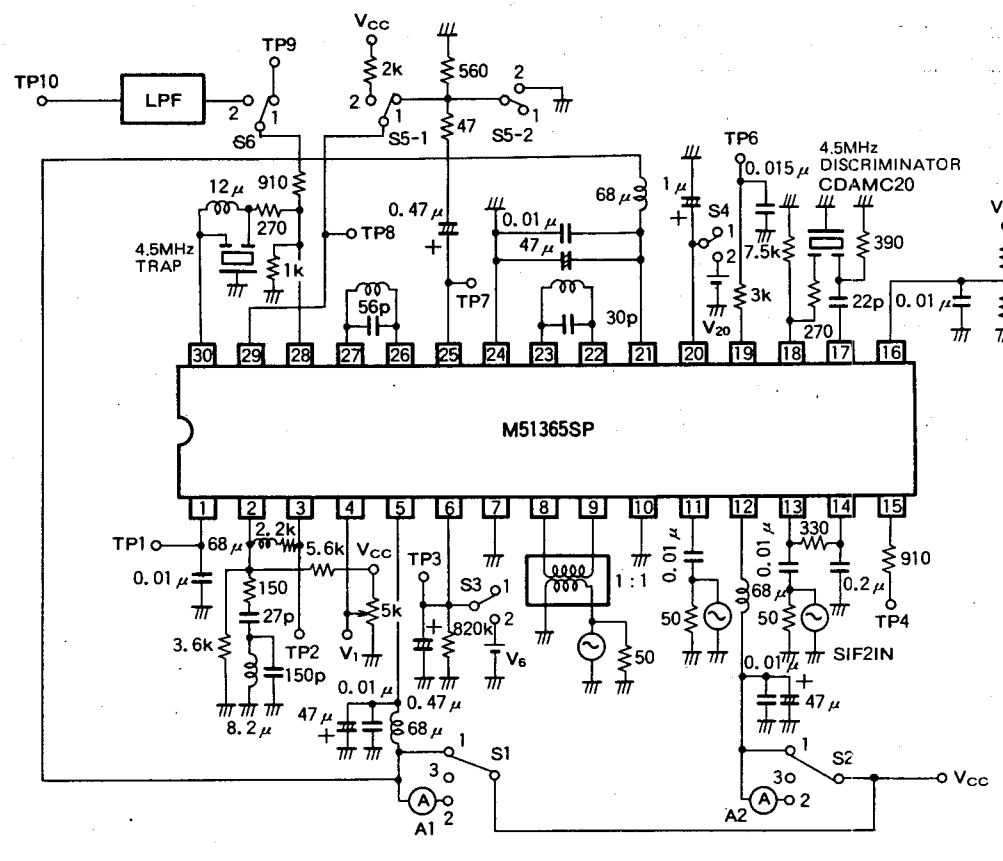



- Set IF AGC voltage of $V_{CO}$ coil at 0V and adjust free run frequency at 58.75MHz in quiescent state.

**INPUT SIGNAL**

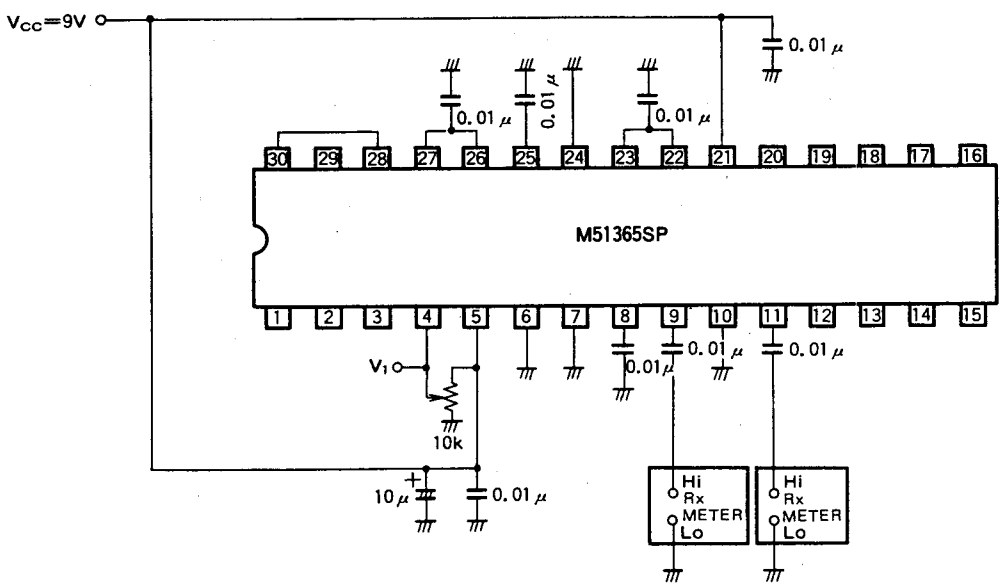
| SG | Input signal (Value at pin terminal, 50Ω) |
|---|---|
| 1 | $f_0$=58.75MHz $V_i$=90dBμ 77.78%AM (Equivalent to 87.5% video modulation fm=20kHz) |
| 2 | $f_0$=58.75MHz $V_i$=90dBμ |
| 3 | $f_1$=58.75MHz $V_i$=90dBμ, $f_2$=53±5MHz $V_i$=70dBμ } mixed signal |
| 4 | $f_0$=58.75MHz $V_i$=Vaviable $f_m$=20kHz 77.78%AM |
| 5 | $f_0$=58.75MHz $V_i$=Vaviable $f_m$=20kHz 16%AM |
| 6 | $f_0$=58.75MHz $V_i$=80dBμ |
| 7 | $f_0$=58.75MHz $V_i$=110dBμ |
| 8 | $f_0$=54.25MHz $V_i$=100dBμ |
| 9 | $f_0$=54.25MHz $V_i$=80dBμ |
| 10 | $f_0$=58.75MHz±5MHz $V_i$=90dBμ |
| 11 | $f_0$=58.75MHz±5MHz $V_i$=90dBμ $f_m$=20kHz 77.78%AM |
| 12 | $f_1$=58.75MHz $V_i$=90dBμ, $f_2$=58.25MHz $V_i$=60dBμ } mixed signal |
| 13 | $f_1$=58.75MHz $V_i$=90dBμ, $f_2$=55.75MHz $V_i$=60dBμ } mixed signal |
| 14 | $f_1$=58.75MHz $V_i$=90dBμ, $f_2$=54.75MHz $V_i$=60dBμ } mixed signal |
| 15 | $f_1$=58.75MHz $V_i$=90dBμ, $f_2$=55.17MHz $V_i$=80dBμ, $f_3$=54.25MHz $V_i$=80dBμ } mixed signal |
| 16 | $f_0$=58.75MHz, standard 10-step modulation m=87.5% video modulation sync chip level 90dBμ |
| 17 | $f_0$=4.5MHz±25kHz dev $V_i$=100dBμ $f_m$=400Hz |
| 18 | $f_0$=4.5MHz±25kHz dev $V_i$=Vaviabel $f_m$=400Hz |
| 19 | $f_0$=4.5MHz $V_i$=100dBμ 30%AM $f_m$=400Hz |
| 20 | $f_0$=4.5MHz $V_i$=100dBμ |
| 21 | $f_0$=4.5MHz $V_i$=100dBμ $f_m$=400Hz±7.5kHz dev |

## TEST CIRCUIT 1




Units
Resistance: Ω
Capacitance: F

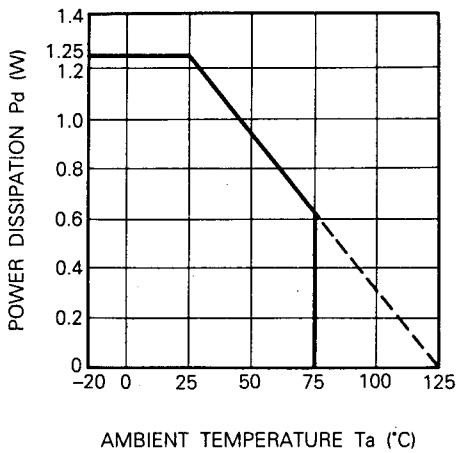
## TEST CIRCUIT 2



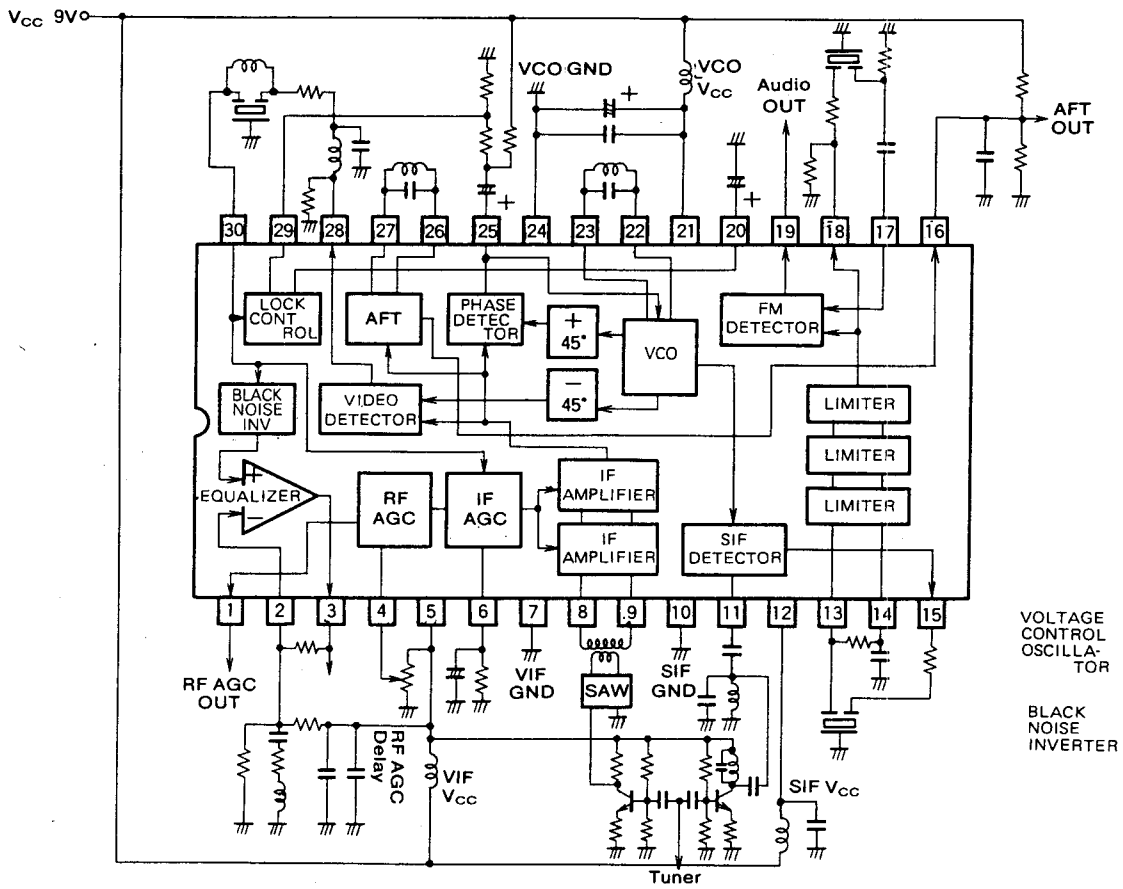

Units
Resistance: Ω
Capacitance: F

## TYPICAL CHARACTERISTICS

### THERMAL DERATING (MAXIMUM RATING)




## APPLICATION EXAMPLE






MITSUBISHI ELECTRIC