MIC5890

DUPLEXER

Advance Information

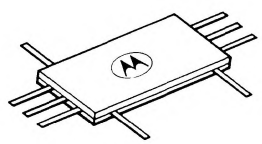
MICROWAVE SOLID–STATE DUPLEXER

This unique solid-state circuit is designed to operate at frequencies between 400 MHz and 500 MHz with 40 Watts maximum input.

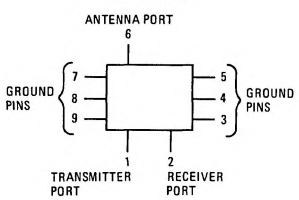
- High Input Power Capability – 40 Watts max
- Low Transmit-Mode Insertion Loss – 0.1 dB typ
- High Transmit-Mode Isolation – 25 dB typ
- Small, Lightweight Package

MICROWAVE SOLID–STATE DUPLEXER

INTEGRATED CIRCUIT



(Top View)



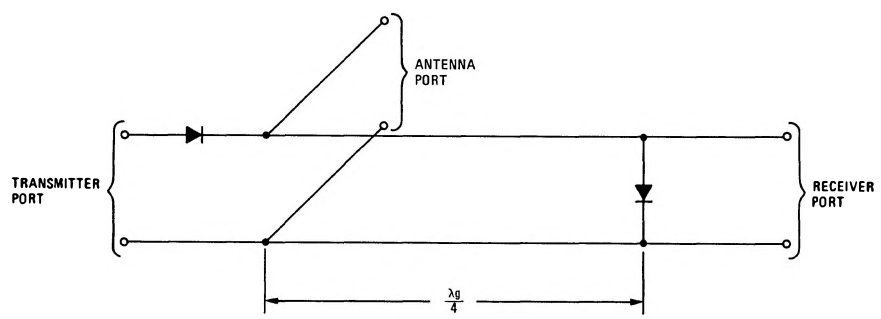
PLASTIC AND CERAMIC PACKAGE

CASE 631

MAXIMUM RATINGS (T_A = +25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Forward dc Current (Pin 1)	I_F	0.10	Ampere
RF Power Input (Pin 1)	P_{in}	40	Watts
Operating Temperature Range	T_A	0 to +120	°C
Storage Temperature Range	T_{stg}	–65 to +150	°C

PARALLEL WIRE REPRESENTATION



THE CHARACTERISTIC IMPEDANCE OF EACH ARM IS 50 OHMS.
λ_g IS THE WAVELENGTH.

See Packaging Information Section for outline dimensions.

ELECTRICAL CHARACTERISTICS (All ports terminated in a 50-ohm load, T_A = 25°C unless otherwise noted)

Characteristic	Min	Typ	Max	Unit
Isolation Between Transmitter Port and Receiver Port (P_{in} = 10 Watts, I_b* = 10 to 20 mA) f = 400 MHz, 460 MHz or 500 MHz (See Figure 1)	20	25	–	dB
Insertion Loss from Transmitter Port to Antenna (P_{in} = 10 Watts, I_b = 10 to 20 mA)				dB
f = 400 MHz	–	0.2	0.3	
f = 460 MHz	–	0.1	0.2	
f = 500 MHz	–	0.2	0.3	
(See Figure 1)				
Insertion Loss from Antenna Port to Receiver Port (P_{in} = −10 dBm, I_b = 0) f = 400 MHz, 460 MHz or 500 MHz (See Figure 2)	–	0.4	0.6	dB
Spurious Signal Level at Antenna Port (dB down from Transmitter Signal) (P_{in} = 10 Watts, I_b = 10 to 20 mA)				dB
f = 400 MHz, 2nd Harmonic	35	40	–	
f = 400 MHz, 3rd Harmonic	30	40	–	
f = 460 MHz, 2nd Harmonic	38	43	–	
f = 460 MHz, 3rd Harmonic	50	55	–	
f = 500 MHz, 2nd Harmonic	33	38	–	
f = 500 MHz, 3rd Harmonic	50	60	–	
(See Figure 1)				

*I_b = dc bias current applied to Pin 1 thru a 1.0 k ohm resistor.

FIGURE 1 – TRANSMIT–MODE TEST CIRCUIT

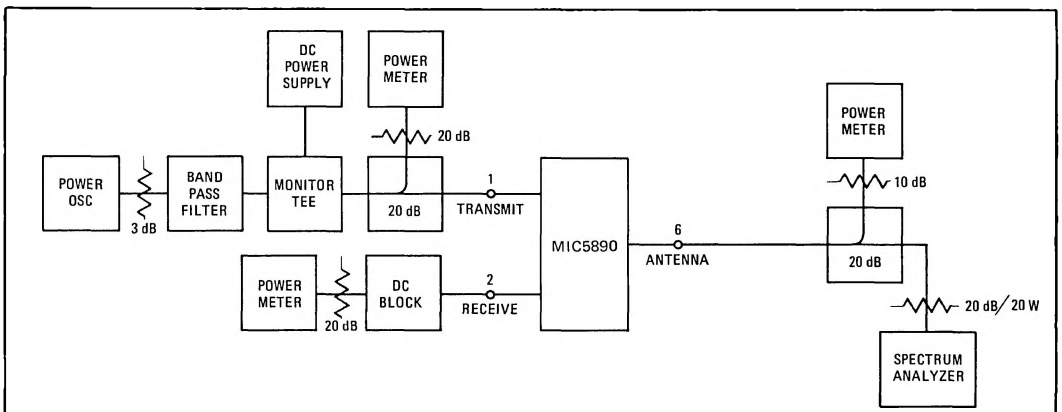
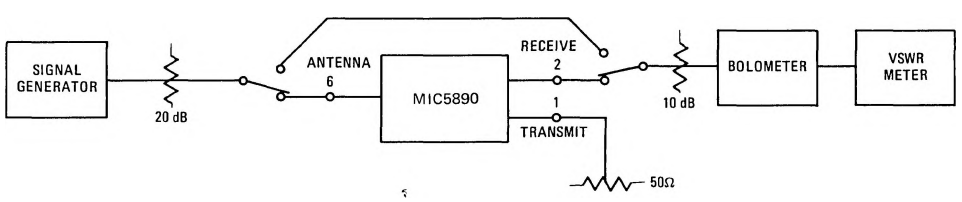


FIGURE 2 – RECEIVE–MODE TEST CIRCUIT



APPLICATIONS INFORMATION

The MIC5890 duplexer is a three port network (see Figure 3) that can be thought of as a single-pole double-throw switch connecting an antenna to a transmitter or receiver.

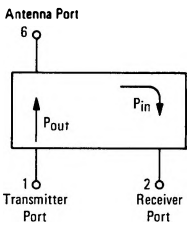


FIGURE 3 – THREE-PORT REPRESENTATION OF DUPLEXER

The MIC5890 is designed to operate from 400 MHz to 500 MHz, at an RF input power level of 40 Watts or less. The unit consists of two-step recovery diodes and a quarter-wave transmission line mounted on a 25-mil thick alumina substrate that is ½-inch wide and 1-inch long. A parallel-wire representation of the MIC5890 is shown in Figure 4, and a description of its operation follows.

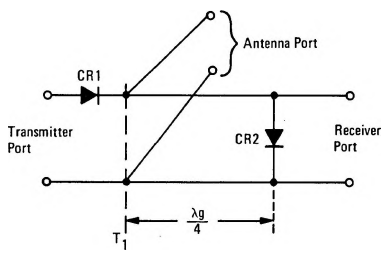
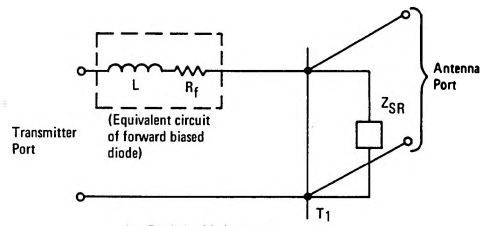


FIGURE 4 – PARALLEL WIRE REPRESENTATION OF THE MCH5890 DUPLEXER

The MIC5890 Duplexer has two modes of operation:

1. Transmit Mode – The antenna is connected to the transmitter and the receiver is disconnected.
2. Receiver Mode – The antenna is connected to the receiver and the transmitter is disconnected.

In the transmit mode the diodes are forward biased (by an external bias source of 10 mA to 20 mA) and are therefore low impedances. In this state of operation the transmitter is connected to the antenna via the low impedance of diode CR1. The receiver arm is effectively disconnected since diode CR2 (which is shunted across the receiver arm) appears as a high impedance when transformed a quarter-wavelength to the junction of all three arms (position T1 in Figure 4). Hence, the transmitted power is transferred to the antenna. An equivalent circuit of the duplexer in this mode of operation is shown in Figure 5.



L = Diode lead inductance

R_f = Diode forward bias resistance

Z_{SR} = Impedance looking into receiver arm at position T_1

$$Z_{SR} = \frac{Z_0^2}{Z_{rcvr} Z_{diode}/(Z_{rcvr} + Z_{diode})}$$

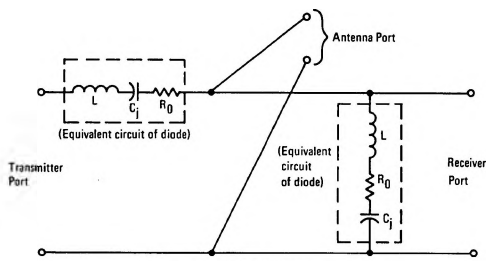
Z_0 = Characteristic impedance of transmission line

Z_{diode} = Impedance of CR2 in forward-bias state.

Z_{rcvr} = Impedance of the receiver measured at the receiver port of the duplexer

FIGURE 5 – TRANSMIT MODE

Consider next the MIC5890 when operated in the receive mode. In this mode the bias is zero and the diodes appear as high capacitive reactances in series with resistors. Thus the effect is to disconnect the transmitter arm since diode CR1 appears as a large capacitive reactance. Diode CR2 does not appreciably load the receiver arm since it also appears as a large capacitive reactance. The equivalent circuit of the duplexer in this mode of operation is shown in Figure 6.



L = diode lead inductance

C_j = junction capacitance

R_0 = zero bias resistance

FIGURE 6 – PARALLEL-WIRE PRESENTATION OF DUPLEXER IN RECEIVE MODE OF OPERATION

The primary application of the duplexer is to connect the antenna either to the system receiver or transmitter. Another possible use for the MIC5890 is as a monitor network in a transmitter circuit. Using the duplexer in the transmit mode, the port usually designated as the "receiver" port can be used to monitor the frequency or output power level (if the port is previously calibrated) of the transmitter. An extension of this last application would be to use the MIC5890 duplexer as the sampling unit in an AFC or an AGC circuit. The energy from the "receiver" port can be fed back to appropriate comparatory circuits to establish an error signal for use in a feedback network. In a pulsed system, the pulse waveform could also be observed. Other applications will become apparent as the user becomes more familiar with the MIC5890.