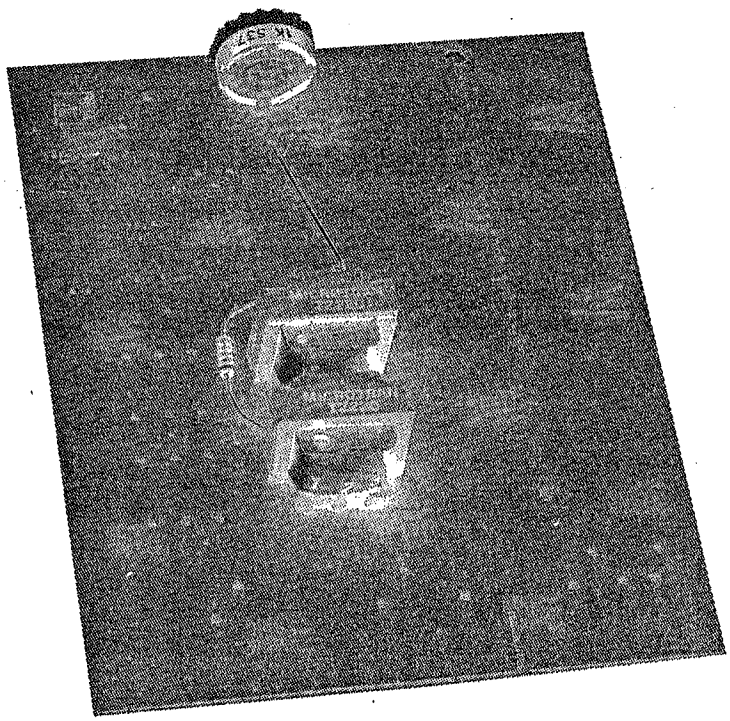
Vega® a MARK IV company
Signaling Products

Instruction Manual

098-0332

Model 353 Hybrid Module



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Introduction

The Model 353 hybrid module is designed for two-wire to four-wire systems. Typical applications include applying audio to a leased telephone line while receiving other audio from that same line, and maintaining isolation between the sending and receiving audio modules.

Connections

In a typical installation, the telephone line would connect to pins 13 and 15 of the card edge connector. The audio sending source (such as a tone encoder or a base-station receiver audio output) would connect through a balanced line to pins 11 and 12. (This signal will appear as the output into the telephone line on pins 13 and 15.) The audio receiving module (such as a tone decoder or a base-station transmitter modulator input) would connect through a balanced line to pins 9 and 10. (The signal from the telephone line on pins 13 and 15 would be coupled through pins 9 and 10 to the audio receiving module, which is isolated from the audio sending source on pins 11 and 12.)

Line-Termination Adjustments

The 353 module contains one pair of hybrid transformers for separating receive and transmit audio. These hybrid transformers must be terminated by an impedance that matches the connected line. All untreated (unequalized or nonconditioned) telephone lines carrying speech-plus-tone signals have attenuation and an impedance which varies with frequency. The longer the line, the greater its distributed capacitance. This distributed capacitance between the conductors lowers the impedance and increases the attenuation as the frequency increases.

Line characteristics cannot be predicted in advance. Therefore, special systems with 353 hybrid line termination modules are typically supplied with no hybrid terminations installed other than potentiometer R1. The proper termination network must be determined and appropriate connections made to the module during installation. (Refer to the Theory of Operation section for a detailed description of the hybrid-transformer operation and selection of terminating components.) Hybrid

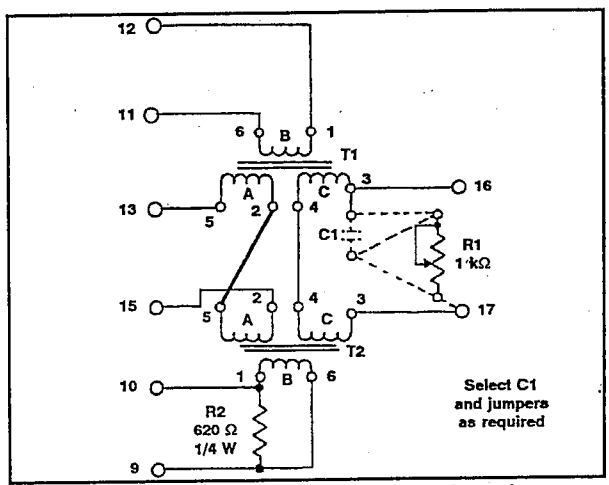


Figure 1. Model 353 hybrid transformer board.

modules are capable of providing greater than 45 dB separation throughout the frequency range of 300 to 3000 Hz if adequate care is used in selecting terminating impedances. Proper termination of the network can only be obtained with the entire system connected for operation. Preliminary adjustment with input/output lines replaced by artificial loads is generally not worthwhile.

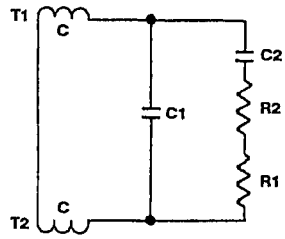
The 353 module uses a single hybrid transformer arrangement which must be terminated by a network adjusted according to the following procedure.

If the 353 module is installed in a card cage, unplug it from the edge connector and make certain that a jumper exists (probably factory-installed) between the open end of potentiometer R1 and terminal 3 of of transformer T1. Reinsert the 353 module into the edge connector. Attach the signal line (in/out telephone line) to pins 13 and 15 of the card edge connector. Disconnect the local audio source (tone encoder or receiver audio output, for example) and apply an audio oscillator or other signal source (with an output impedance of 600 ohms) to pins 11 and 12. Adjust the signal level to about –5 dBm (0.44 V_{rms}) and the frequency to a convenient midband value (typically 2175 Hz for PTT frequency). Monitor the signal on pins 9 and 10 with a meter or oscilloscope. Adjust R1 for minimum signal (best null) on the monitor indicator. Often an adequate balance can be obtained with just the 1-k-ohm variable resistor supplied, because good balance is needed only at the push-to-talk frequency. If adequate balance in not achievable, remove the card temporarily from its edge connector and connect a suitable shunt capacitor between T1 pin 3 and T2 pin 3. (Using a switchable decade capacitor substitution box will facilitate selection. Set the capacitor box for zero capacitance to improve null depth.) Typical values of shunt capacitance range from 0.01 μF to 0.5 μF. For example, ten miles of uncompensated open wire line will require about 0.1 μF. Reinsert the card in the edge connector and alternately readjust R1 and the shunt capacitor for minimum signal, as above. If more than one tone frequency is used, check balance at each.

Multiconductor exchange cables have much higher shunt capacitance; however, this is usually compensated for by the telephone company at each repeater amplifier. Occasionally inadequate balance is obtained. This can generally be corrected by connecting a capacitor in series with R1. Each trial value of series capacitance will require readjustment of both the shunt capacitance and R1. Typical values of series capacitance range from 1 μF to 10 μF.

Theory of Operation

The operation of the hybrid arrangement can be understood by referring to the schematic for the 353 module in Figure 1. Consider a signal on the receiver output terminals which connect to winding B of transformer T1. Windings A, B, and C all have an equal number of turns. The signal of winding B of T1 causes a current to flow in winding A, out through the connected line and load, then back into transformer T2, winding A. At the same time, this signal causes a current to flow in winding C of T1, through the terminating network, and into



Hybrid Terminating Network

	C1	C2	R1	R2
Low Impedance Lines (Open Wire)	0 to 0.1 μF	1 to 8 μF	400 to 700 Ω	0
High Impedance Lines (Exchange Cable)	0 to 0.5 μF	40 to 20 μF (or shorted)	500 to 1000 Ω*	470 to 1500 Ω*
				*Total 400 to 2000 Ω

Table 1. Typical terminating networks.

winding C of T2. Because the two transformers have their windings, A, connected in phase opposition, the currents from A and C will cancel in R2 if the impedance of the balance network exactly matches that of the line and load. Under this condition, none of the input signal (B of T1) appears at winding B of T2. The signal at B of T1 divides equally between windings A and C; therefore, there is a 3-dB loss from winding B to the line in/out port (card pins 11 and 13) (neglecting transformer loss), but a high loss from B of T1 to B of T2.

A signal on the line in/out port similarly divides equally between the two windings of B of T1 and T2. However, since the A windings are in phase opposition, no additional power is lost in the terminating network. Thus, there is a 3-dB loss through the hybrid from the line in/out terminals to the audio receiving module (such as a tone decoder or transmitter modulator input). Note, however, that the above conditions are met only if the terminating network exactly matches the impedance of the line in/out port at the frequency of operation. Any difference in these two impedances will result in lack of complete cancellation at the cross-hybrid port. Telephone lines generally present a complex

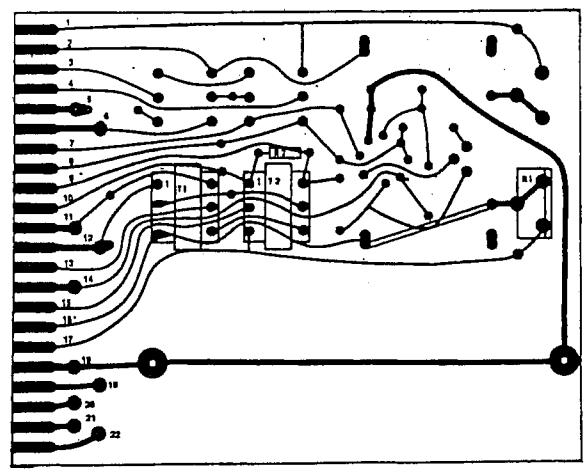


Figure 2. Model 353 parts layout.

Model 353 Specifications

Input/Output Impedances: All 600 Ω, balanced line types, with loading or balancing resistors required to match commonly used subsystems

Size: 1.0 in (2.54 cm) H x 3.6 in (9.1 cm) W x 4.5 in (11.4 cm) D

Card Connector: 22-pin (0.156 centers), standard, with two edge guides

impedance, which is a function of frequency, and are often difficult to match exactly across the audio range of 300 to 3000 Hz.

Typical terminating networks are shown in Table 1, with representative values shown for low-impedance (open-wire) lines and high-impedance lines (multiconductor exchange cables).

Warranty

Vega signaling products are guaranteed to be free from defects in material and workmanship for a period of three years from the date of shipment. Warranty is for factory repair or replacement only.

Technical Assistance

Vega products are engineered to meet your requirements of performance, reliability, and compatibility. Technical assistance is offered by correspondence or telephone, should it be required, to assure your satisfaction.

Model C-353 Parts List

Part No.	Description	Ckt Sym
001-0528	353 HYBRID ASSEMBLY	
001-1764	CONNECTOR KIT JK-22	
065-0081	PC BOARD 350/353 HYBRID	
130-0444	RES VAR 1000 LIN 1/4W	R1
136-0090	RES COMP 620 5% 1/4W	R2
318-0215	XFORMER HYBRID PCB	T1
		T2

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