

BUILD A

HIGH-PERFORMANCE CD-4 DEMODULATOR

Low-cost add-on unit for playing discrete 4-channel discs.

BY LOUIS BORREN

THE Compatible Discrete 4-channel sound system, called CD-4, permits four fully separate channels of sound to be reproduced, starting with discrete channel information incorporated right into the record groove. This contrasts with SQ¹ or QS matrix 4-channel sound, where channel information is encoded.

Some four-channel receivers today are akin to multiple-speed record players that play 33-1/3 or 45 rpm discs. The receivers can quite often handle information from either discrete or matrix discs. There are many 4-channel receivers, however, that only have a CD-4 input jack for adding a demodulator that's needed to play CD-4 discs (which includes RCA's "Quadradsics," among other labels), while incorporating decoding circuits for SQ and/or QS matrix discs. If this is the case with your receiver, you will want to build the high-performance,

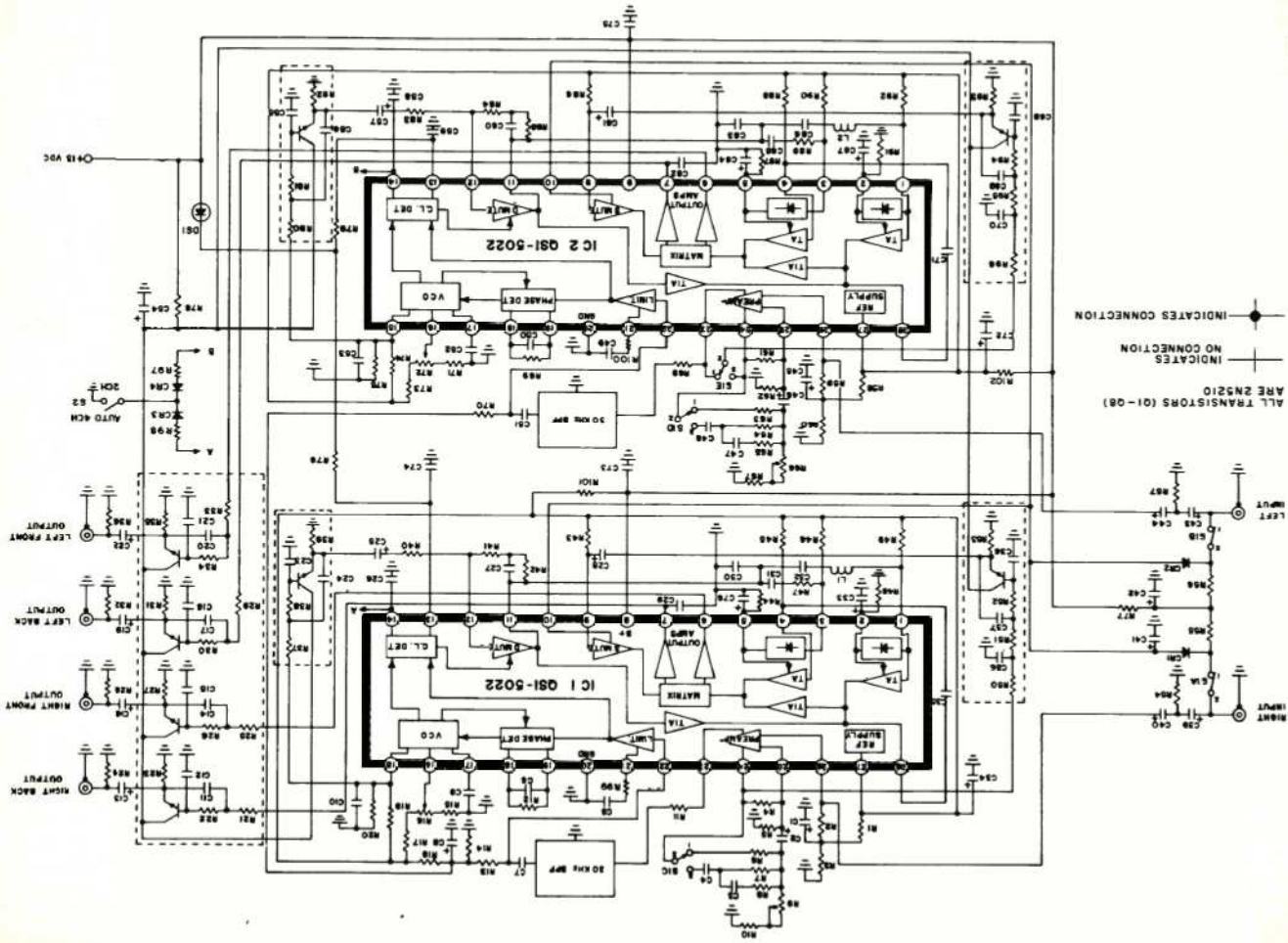
low-cost demodulator described here. With the demodulator plugged into your receiver and a CD-4 cartridge on your record player, you will be able to play all types of 4-channel discs including discrete.

CD-4 Operation. The CD-4 system was designed to utilize the standard V-shaped record groove to assure compatibility of quadrasonic disc recordings with conventional stereo and mono playing equipment. So, all of the information contained in the four signal channels had to be combined to physically fit on the two walls of the record groove. In the process, the left-front and left-back signals are combined and impressed on one wall, while the right-front and right-back signals are combined and impressed on the other wall of the record groove.

To facilitate separation (demodulation) of the front and back channels

from the combined right and left signals, separate 30-kHz subcarriers are used. One carrier contains the difference of left-front and left-back signals and the other contains the difference of the right-front and right-back signals. By mixing the signals in an appropriate resistive network, each of the originally recorded channels can be extracted, resulting in the four discrete different channels originally recorded.

While the CD-4 system is basically very simple, special techniques developed to minimize signal degradation require a complex demodulator circuit design. Pre-emphasizing the carrier is one such technique. Unlike the case in standard FM broadcasting, the pre-emphasized signal is frequency modulated from 0 to 630 Hz and from 6000 to 15,000 Hz, and audio information between these two ranges is phase modulated (PM) to provide a



better signal-to-noise (S/N) ratio as well as other advantages from the standpoint of higher level-capacity to the overall system.

Audio level compression is also applied in the modulation technique. It reduces the harmonic distortion of second-, third-, and fourth-order components. In some cases, it even reduces noise.

How It Works. Each specialized IC used in this project contains all of the subsystems required for demodulating one pair of channels. These include a phono preamplifier to increase signal levels from the phono cartridge; a high-gain limiter FM detector; a phase-locked-loop (PLL) FM detector; and a high-speed carrier dropout cancellation circuit. Also present on-chip are an FM/PM/FM amplifier, mid- and high-band audio expanders, resistive combining output networks (true matrix) output buffer amplifiers, a drive circuit for a quadruplex indicator LED, a complete power-supply regulator, and automatic transient muting circuits. By combining two IC's, with appropriate filters and other related components, in a single system (see Fig. 1), we can obtain a CD-4 demodulator of advanced design.

The input signal from a magnetic phono cartridge is applied to pins 26 of IC1 and IC2. Equalization networks between pins 24 and 25 of each integrated circuit shape the frequency responses of the amplifiers to produce the RIAA curve characteristic. In the case of a semiconductor phono cartridge input, the equalization is flat for the preamplifier. The preamplifier has both inverting and non-inverting outputs. The inverting network is used in one IC and the noninverting network is used in the other IC because the semiconductor outputs are out-of-phase with each other and only one must be inverted before the signal is passed to the rest of the demodulating system.

The outputs of the preamps (pins 23) go through 30-kHz bandpass filters that isolate the subcarriers and eliminate unwanted signals from the main, or audio, channels. The filter outputs go to the circuit limiters (pins 22). Then, pins 21 serve as the bypasses for the limiter stages. The outputs from the limiters (inside the IC's) feed the phase detectors of the PLL's.

Because the fidelity of the 4-channel

DEMODULATOR PARTS LIST

- BPF1, BPF2—30-kHz bandpass filter (EUL-BPF006)
- C1, C8, C13, C16, C19, C22, C25, C28, C39, C40, C43, C44, C45, C57, C61—3.3- μ F, 2-volt electrolytic capacitor
- C2—40—250- μ F, 25-volt electrolytic capacitor
- C3, C47—0.0047- μ F capacitor
- C4, C48—0.002- μ F capacitor
- C5, C49, C64, C76—0.47- μ F capacitor
- C6, C50—0.033- μ F capacitor
- C7, C51, C59, C73, C74, C75—0.01- μ F capacitor
- C9, C52—0.0027- μ F capacitor
- C10, C36, C37, C38—0.0031- μ F capacitor
- C11, C14, C15, C18, C21, C26, C27—1- μ F capacitor
- C12, C17, C20, C23, C24, C26, C29, C30, C32, C33, C34, C35, C38, C39, C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C58, C59, C60, C61, C62, C63, C65, C66, C67, C68, C69, C70, C71, C72, C73, C74, C75, C76, C77, C78, C79, C80, C81, C82, C83, C84, C85, C86, C87, C88, C89, C90, C91, C92, C93, C94, C95, C96, C97, C98, C99, C100—100-pF capacitor
- C101, C102—33-pF capacitor
- C103, C104, C105, C106, C107, C108, C109, C110, C111, C112, C113, C114, C115, C116, C117, C118, C119, C120, C121, C122, C123, C124, C125, C126, C127, C128, C129, C130, C131, C132, C133, C134, C135, C136, C137, C138, C139, C140, C141, C142, C143, C144, C145, C146, C147, C148, C149, C150, C151, C152, C153, C154, C155, C156, C157, C158, C159, C160, C161, C162, C163, C164, C165, C166, C167, C168, C169, C170, C171, C172, C173, C174, C175, C176, C177, C178, C179, C180, C181, C182, C183, C184, C185, C186, C187, C188, C189, C190, C191, C192, C193, C194, C195, C196, C197, C198, C199, C200—100-pF capacitor
- C201, C202, C203, C204, C205, C206, C207, C208, C209, C210, C211, C212, C213, C214, C215, C216, C217, C218, C219, C220, C221, C222, C223, C224, C225, C226, C227, C228, C229, C230, C231, C232, C233, C234, C235, C236, C237, C238, C239, C240, C241, C242, C243, C244, C245, C246, C247, C248, C249, C250, C251, C252, C253, C254, C255, C256, C257, C258, C259, C260, C261, C262, C263, C264, C265, C266, C267, C268, C269, C270, C271, C272, C273, C274, C275, C276, C277, C278, C279, C280, C281, C282, C283, C284, C285, C286, C287, C288, C289, C290, C291, C292, C293, C294, C295, C296, C297, C298, C299, C300—100-pF capacitor
- C301, C302, C303, C304, C305, C306, C307, C308, C309, C310, C311, C312, C313, C314, C315, C316, C317, C318, C319, C320, C321, C322, C323, C324, C325, C326, C327, C328, C329, C330, C331, C332, C333, C334, C335, C336, C337, C338, C339, C340, C341, C342, C343, C344, C345, C346, C347, C348, C349, C350, C351, C352, C353, C354, C355, C356, C357, C358, C359, C360, C361, C362, C363, C364, C365, C366, C367, C368, C369, C370, C371, C372, C373, C374, C375, C376, C377, C378, C379, C380, C381, C382, C383, C384, C385, C386, C387, C388, C389, C390, C391, C392, C393, C394, C395, C396, C397, C398, C399, C400—100-pF capacitor
- C401, C402, C403, C404, C405, C406, C407, C408, C409, C410, C411, C412, C413, C414, C415, C416, C417, C418, C419, C420, C421, C422, C423, C424, C425, C426, C427, C428, C429, C430, C431, C432, C433, C434, C435, C436, C437, C438, C439, C440, C441, C442, C443, C444, C445, C446, C447, C448, C449, C450, C451, C452, C453, C454, C455, C456, C457, C458, C459, C460, C461, C462, C463, C464, C465, C466, C467, C468, C469, C470, C471, C472, C473, C474, C475, C476, C477, C478, C479, C480, C481, C482, C483, C484, C485, C486, C487, C488, C489, C490, C491, C492, C493, C494, C495, C496, C497, C498, C499, C500—100-pF capacitor
- C501, C502, C503, C504, C505, C506, C507, C508, C509, C510, C511, C512, C513, C514, C515, C516, C517, C518, C519, C520, C521, C522, C523, C524, C525, C526, C527, C528, C529, C530, C531, C532, C533, C534, C535, C536, C537, C538, C539, C540, C541, C542, C543, C544, C545, C546, C547, C548, C549, C550, C551, C552, C553, C554, C555, C556, C557, C558, C559, C560, C561, C562, C563, C564, C565, C566, C567, C568, C569, C570, C571, C572, C573, C574, C575, C576, C577, C578, C579, C580, C581, C582, C583, C584, C585, C586, C587, C588, C589, C590, C591, C592, C593, C594, C595, C596, C597, C598, C599, C600—100-pF capacitor
- C601, C602, C603, C604, C605, C606, C607, C608, C609, C610, C611, C612, C613, C614, C615, C616, C617, C618, C619, C620, C621, C622, C623, C624, C625, C626, C627, C628, C629, C630, C631, C632, C633, C634, C635, C636, C637, C638, C639, C640, C641, C642, C643, C644, C645, C646, C647, C648, C649, C650, C651, C652, C653, C654, C655, C656, C657, C658, C659, C660, C661, C662, C663, C664, C665, C666, C667, C668, C669, C670, C671, C672, C673, C674, C675, C676, C677, C678, C679, C680, C681, C682, C683, C684, C685, C686, C687, C688, C689, C690, C691, C692, C693, C694, C695, C696, C697, C698, C699, C700—100-pF capacitor
- C701, C702, C703, C704, C705, C706, C707, C708, C709, C710, C711, C712, C713, C714, C715, C716, C717, C718, C719, C720, C721, C722, C723, C724, C725, C726, C727, C728, C729, C730, C731, C732, C733, C734, C735, C736, C737, C738, C739, C740, C741, C742, C743, C744, C745, C746, C747, C748, C749, C750, C751, C752, C753, C754, C755, C756, C757, C758, C759, C760, C761, C762, C763, C764, C765, C766, C767, C768, C769, C770, C771, C772, C773, C774, C775, C776, C777, C778, C779, C780, C781, C782, C783, C784, C785, C786, C787, C788, C789, C790, C791, C792, C793, C794, C795, C796, C797, C798, C799, C800—100-pF capacitor
- C801, C802, C803, C804, C805, C806, C807, C808, C809, C810, C811, C812, C813, C814, C815, C816, C817, C818, C819, C820, C821, C822, C823, C824, C825, C826, C827, C828, C829, C830, C831, C832, C833, C834, C835, C836, C837, C838, C839, C840, C841, C842, C843, C844, C845, C846, C847, C848, C849, C850, C851, C852, C853, C854, C855, C856, C857, C858, C859, C860, C861, C862, C863, C864, C865, C866, C867, C868, C869, C870, C871, C872, C873, C874, C875, C876, C877, C878, C879, C880, C881, C882, C883, C884, C885, C886, C887, C888, C889, C890, C891, C892, C893, C894, C895, C896, C897, C898, C899, C900—100-pF capacitor
- C901, C902, C903, C904, C905, C906, C907, C908, C909, C910, C911, C912, C913, C914, C915, C916, C917, C918, C919, C920, C921, C922, C923, C924, C925, C926, C927, C928, C929, C930, C931, C932, C933, C934, C935, C936, C937, C938, C939, C940, C941, C942, C943, C944, C945, C946, C947, C948, C949, C950, C951, C952, C953, C954, C955, C956, C957, C958, C959, C960, C961, C962, C963, C964, C965, C966, C967, C968, C969, C970, C971, C972, C973, C974, C975, C976, C977, C978, C979, C980, C981, C982, C983, C984, C985, C986, C987, C988, C989, C990, C991, C992, C993, C994, C995, C996, C997, C998, C999, C1000—100-pF capacitor
- C1001, C1002, C1003, C1004, C1005, C1006, C1007, C1008, C1009, C1010, C1011, C1012, C1013, C1014, C1015, C1016, C1017, C1018, C1019, C1020, C1021, C1022, C1023, C1024, C1025, C1026, C1027, C1028, C1029, C1030, C1031, C1032, C1033, C1034, C1035, C1036, C1037, C1038, C1039, C1040, C1041, C1042, C1043, C1044, C1045, C1046, C1047, C1048, C1049, C1050, C1051, C1052, C1053, C1054, C1055, C1056, C1057, C1058, C1059, C1060, C1061, C1062, C1063, C1064, C1065, C1066, C1067, C1068, C1069, C1070, C1071, C1072, C1073, C1074, C1075, C1076, C1077, C1078, C1079, C1080, C1081, C1082, C1083, C1084, C1085, C1086, C1087, C1088, C1089, C1090, C1091, C1092, C1093, C1094, C1095, C1096, C1097, C1098, C1099, C1100—100-pF capacitor
- C1101, C1102, C1103, C1104, C1105, C1106, C1107, C1108, C1109, C1110, C1111, C1112, C1113, C1114, C1115, C1116, C1117, C1118, C1119, C1120, C1121, C1122, C1123, C1124, C1125, C1126, C1127, C1128, C1129, C1130, C1131, C1132, C1133, C1134, C1135, C1136, C1137, C1138, C1139, C1140, C1141, C1142, C1143, C1144, C1145, C1146, C1147, C1148, C1149, C1150, C1151, C1152, C1153, C1154, C1155, C1156, C1157, C1158, C1159, C1160, C1161, C1162, C1163, C1164, C1165, C1166, C1167, C1168, C1169, C1170, C1171, C1172, C1173, C1174, C1175, C1176, C1177, C1178, C1179, C1180, C1181, C1182, C1183, C1184, C1185, C1186, C1187, C1188, C1189, C1190, C1191, C1192, C1193, C1194, C1195, C1196, C1197, C1198, C1199, C1200—100-pF capacitor
- C1201, C1202, C1203, C1204, C1205, C1206, C1207, C1208, C1209, C1210, C1211, C1212, C1213, C1214, C1215, C1216, C1217, C1218, C1219, C1220, C1221, C1222, C1223, C1224, C1225, C1226, C1227, C1228, C1229, C1230, C1231, C1232, C1233, C1234, C1235, C1236, C1237, C1238, C1239, C1240, C1241, C1242, C1243, C1244, C1245, C1246, C1247, C1248, C1249, C1250, C1251, C1252, C1253, C1254, C1255, C1256, C1257, C1258, C1259, C1260, C1261, C1262, C1263, C1264, C1265, C1266, C1267, C1268, C1269, C1270, C1271, C1272, C1273, C1274, C1275, C1276, C1277, C1278, C1279, C1280, C1281, C1282, C1283, C1284, C1285, C1286, C1287, C1288, C1289, C1290, C1291, C1292, C1293, C1294, C1295, C1296, C1297, C1298, C1299, C1300—100-pF capacitor
- C1301, C1302, C1303, C1304, C1305, C1306, C1307, C1308, C1309, C1310, C1311, C1312, C1313, C1314, C1315, C1316, C1317, C1318, C1319, C1320, C1321, C1322, C1323, C1324, C1325, C1326, C1327, C1328, C1329, C1330, C1331, C1332, C1333, C1334, C1335, C1336, C1337, C1338, C1339, C1340, C1341, C1342, C1343, C1344, C1345, C1346, C1347, C1348, C1349, C1350, C1351, C1352, C1353, C1354, C1355, C1356, C1357, C1358, C1359, C1360, C1361, C1362, C1363, C1364, C1365, C1366, C1367, C1368, C1369, C1370, C1371, C1372, C1373, C1374, C1375, C1376, C1377, C1378, C1379, C1380, C1381, C1382, C1383, C1384, C1385, C1386, C1387, C1388, C1389, C1390, C1391, C1392, C1393, C1394, C1395, C1396, C1397, C1398, C1399, C1400—100-pF capacitor
- C1401, C1402, C1403, C1404, C1405, C1406, C1407, C1408, C1409, C1410, C1411, C1412, C1413, C1414, C1415, C1416, C1417, C1418, C1419, C1420, C1421, C1422, C1423, C1424, C1425, C1426, C1427, C1428, C1429, C1430, C1431, C1432, C1433, C1434, C1435, C1436, C1437, C1438, C1439, C1440, C1441, C1442, C1443, C1444, C1445, C1446, C1447, C1448, C1449, C1450, C1451, C1452, C1453, C1454, C1455, C1456, C1457, C1458, C1459, C1460, C1461, C1462, C1463, C1464, C1465, C1466, C1467, C1468, C1469, C1470, C1471, C1472, C1473, C1474, C1475, C1476, C1477, C1478, C1479, C1480, C1481, C1482, C1483, C1484, C1485, C1486, C1487, C1488, C1489, C1490, C1491, C1492, C1493, C1494, C1495, C1496, C1497, C1498, C1499, C1500—100-pF capacitor
- C1501, C1502, C1503, C1504, C1505, C1506, C1507, C1508, C1509, C1510, C1511, C1512, C1513, C1514, C1515, C1516, C1517, C1518, C1519, C1520, C1521, C1522, C1523, C1524, C1525, C1526, C1527, C1528, C1529, C1530, C1531, C1532, C1533, C1534, C1535, C1536, C1537, C1538, C1539, C1540, C1541, C1542, C1543, C1544, C1545, C1546, C1547, C1548, C1549, C1550, C1551, C1552, C1553, C1554, C1555, C1556, C1557, C1558, C1559, C1560, C1561, C1562, C1563, C1564, C1565, C1566, C1567, C1568, C1569, C1570, C1571, C1572, C1573, C1574, C1575, C1576, C1577, C1578, C1579, C1580, C1581, C1582, C1583, C1584, C1585, C1586, C1587, C1588, C1589, C1590, C1591, C1592, C1593, C1594, C1595, C1596, C1597, C1598, C1599, C1600—100-pF capacitor
- C1601, C1602, C1603, C1604, C1605, C1606, C1607, C1608, C1609, C1610, C1611, C1612, C1613, C1614, C1615, C1616, C1617, C1618, C1619, C1620, C1621, C1622, C1623, C1624, C1625, C1626, C1627, C1628, C1629, C1630, C1631, C1632, C1633, C1634, C1635, C1636, C1637, C1638, C1639, C1640, C1641, C1642, C1643, C1644, C1645, C1646, C1647, C1648, C1649, C1650, C1651, C1652, C1653, C1654, C1655, C1656, C1657, C1658, C1659, C1660, C1661, C1662, C1663, C1664, C1665, C1666, C1667, C1668, C1669, C1670, C1671, C1672, C1673, C1674, C1675, C1676, C1677, C1678, C1679, C1680, C1681, C1682, C1683, C1684, C1685, C1686, C1687, C1688, C1689, C1690, C1691, C1692, C1693, C1694, C1695, C1696, C1697, C1698, C1699, C1700—100-pF capacitor
- C1701, C1702, C1703, C1704, C1705, C1706, C1707, C1708, C1709, C1710, C1711, C1712, C1713, C1714, C1715, C1716, C1717, C1718, C1719, C1720, C1721, C1722, C1723, C1724, C1725, C1726, C1727, C1728, C1729, C1730, C1731, C1732, C1733, C1734, C1735, C1736, C1737, C1738, C1739, C1740, C1741, C1742, C1743, C1744, C1745, C1746, C1747, C1748, C1749, C1750, C1751, C1752, C1753, C1754, C1755, C1756, C1757, C1758, C1759, C1760, C1761, C1762, C1763, C1764, C1765, C1766, C1767, C1768, C1769, C1770, C1771, C1772, C1773, C1774, C1775, C1776, C1777, C1778, C1779, C1780, C1781, C1782, C1783, C1784, C1785, C1786, C1787, C1788, C1789, C1790, C1791, C1792, C1793, C1794, C1795, C1796, C1797, C1798, C1799, C1800—100-pF capacitor
- C1801, C1802, C1803, C1804, C1805, C1806, C1807, C1808, C1809, C1810, C1811, C1812, C1813, C1814, C1815, C1816, C1817, C1818, C1819, C1820, C1821, C1822, C1823, C1824, C1825, C1826, C1827, C1828, C1829, C1830, C1831, C1832, C1833, C1834, C1835, C1836, C1837, C1838, C1839, C1840, C1841, C1842, C1843, C1844, C1845, C1846, C1847, C1848, C1849, C1850, C1851, C1852, C1853, C1854, C1855, C1856, C1857, C1858, C1859, C1860, C1861, C1862, C1863, C1864, C1865, C1866, C1867, C1868, C1869, C1870, C1871, C1872, C1873, C1874, C1875, C1876, C1877, C1878, C1879, C1880, C1881, C1882, C1883, C1884, C1885, C1886, C1887, C1888, C1889, C1890, C1891, C1892, C1893, C1894, C1895, C1896, C1897, C1898, C1899, C1900—100-pF capacitor
- C1901, C1902, C1903, C1904, C1905, C1906, C1907, C1908, C1909, C1910, C1911, C1912, C1913, C1914, C1915, C1916, C1917, C1918, C1919, C1920, C1921, C1922, C1923, C1924, C1925, C1926, C1927, C1928, C1929, C1930, C1931, C1932, C1933, C1934, C1935, C1936, C1937, C1938, C1939, C1940, C1941, C1942, C1943, C1944, C1945, C1946, C1947, C1948, C1949, C1950, C1951, C1952, C1953, C1954, C1955, C1956, C1957, C1958, C1959, C1960, C1961, C1962, C1963, C1964, C1965, C1966, C1967, C1968, C1969, C1970, C1971, C1972, C1973, C1974, C1975, C1976, C1977, C1978, C1979, C1980, C1981, C1982, C1983, C1984, C1985, C1986, C1987, C1988, C1989, C1990, C1991, C1992, C1993, C1994, C1995, C1996, C1997, C1998, C1999, C2000—100-pF capacitor
- C2001, C2002, C2003, C2004, C2005, C2006, C2007, C2008, C2009, C2010, C2011, C2012, C2013, C2014, C2015, C2016, C2017, C2018, C2019, C2020, C2021, C2022, C2023, C2024, C2025, C2026, C2027, C2028, C



Fig. 4. Etching and drilling guide (above) and component layout for power supply (right)

also passed to the carrier-level (C.L.) detectors, which consist of quadrature phase detectors. These are fed from the limiters, vco's, and carrier dropout cancellation circuits. When the signal is locked, the quadrature detectors sense the 90° quadrature differences between the vco and input signals, turning on 4-channel LED DS1 and allowing the audio from the subchannel detectors to pass to the expanders.

Pins 14 of each IC can be used to select between 4-channel and 4-channel/auto operation as they are grounded or left floating, respectively. Pin S2. The output circuits that drive DS1, accessed through pins 13 on the IC's, provide a current sink of no more than 20 mA. So, it is important that you use a low-current LED for DS1.

Pins 12 are the signal inputs to the audio shaping networks in the subcarrier system. They are fed from the 15-kHz low-pass filter and delay networks. Audio-frequency shaping networks for FM/PM/FM equalization are connected to the IC's via pins 11 and 12. Pins 11 also drive the expander controls and audio inputs. Pins 2 and 5 are used for the expander time-constant controls, while pins 1, 3, 4, and 28 serve as audio and control inputs for the expanders.

The outputs from the expanders feed the resistive combining networks (true matrices), which are also fed by the subsystem amplifier and automatic changer mulling circuits. Pins 10 are the control inputs for the automatic changer mulling detectors, while pins 9 are the audio inputs and bias terminals for the amplifiers. Pins 8 are the

positive-voltage inputs for the IC's, while pins 6 and 7 are the audio outputs. These outputs are fed to the final 15-kHz emitter-follower low-pass filters.

The power supply for the demodulator is shown schematically in Fig. 2. It is quite conventional in design, employing bridge (D1) through D4) rectification, zener-diode (Z1) regulation, and a series-pass transistor (Q1).

Construction. Owing to the complexity of the circuit that makes up the demodulator, printed circuit board assembly is highly recommended. An actual-size etching and drilling guide for the pc board is shown in Fig. 3, along with the component placement diagram shown from foil side.

Start assembly by installing and soldering into place on the board the resistors, capacitors, and inductors (coils). Follow with the diodes, transistors, and bandpass filters. Pay careful attention to the polarities of the electrolytic capacitors and diodes and the basing of the transistors.

Last to be installed on the pc board should be the two IC's. You can directly mount the IC's and solder their pins to the pads on the board, or you can install sockets or Molex Soldercons® into which the IC's can be plugged.

Next, wire the power supply board. (The etching and drilling and component placement guides for this subassembly are shown in Fig. 4.) Again, pay careful attention to diode and electrolytic capacitor polarities and the transistor's basing.

The prototype of the CD-4 demodulator was mounted in a 9"D x 7"W x 2"H (23 x 18 x 5.1-cm) U-shaped metal chassis. The six input and output jacks, S1, S2, and a grounding lug mount on the rear panel. A hole drilled through this panel through which the line cord exits must be rubber grommet lined.

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cartridge to the demodulator via the audio input jacks. Make certain that switch S7 is set to SEMICONDUCTOR or MAGNETIC, according to the type of cartridge you are using. Use the setup tone provided on a CD-4 test record for an audio signal at all four outputs from the demodulator. (A CD-4 test record can be obtained for \$5.00 from the source given in the Parts List.) The absolute levels of the individual channel outputs are not critical at this point, but the left-front level should be the same as the left-back level and the right-front level should be the same as the right-back level.

When the system is properly detecting, DS1 will glow brightly. If it glows dimly or does not glow at all, one or both of the phase-locked loops may be too far out of adjustment. In this case, any of the following procedures can be used to set the PLL's on the correct 30-kHz frequency:

1. With the cartridge stylus tracking the setup band of the test record, adjust the vco's via R16 and R72. Adjust first one vco until the LED glows, then adjust the other until the LED glows at maximum brightness. Because of the high-level subcarrier modulation, you should now hear severe signal distortion. Now, adjust R16 and R72 for minimum audible distortion.
2. Using an accurate 30-kHz sine-wave source, feed this signal to pin 22 of IC1 through a 1000-pF capacitor. Adjust the vco's center frequency via R16 until the LED glows. Then couple the test signal to pin 22 of IC2 and adjust the other vco via R72 for maximum brightness.
3. Connect a high-impedance frequency counter to pin 16 of IC1 and ground and adjust the vco to 30 kHz (R16) without an input signal. Repeat the procedure for IC2 (R72).

Any of the above procedures will work successfully, but be sure that you adjust the center frequency of both IC's.

Once the vco's have been properly adjusted, use the test record to check out the entire demodulator. Carefully listen to the rear channels and adjust separation controls for minimum volume level of these channels. Once these adjustments have been made, they do not have to be touched again unless you decide to replace the phono cartridge.

The CD-4 demodulator is now ready to use. Fasten the case cover to the chassis, and connect the demodulator into your 4-channel hi-fi system. ♦



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