

DECvoice DTC04 System Technical Manual

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**digital equipment corporation
maynard, massachusetts**

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About This Manual

This manual describes the DECvoice DTC04 system hardware, including installation, system microcode, and maintenance. The system hardware includes the DECvoice DTC04 Q-bus module, telephone line interface assembly, and cables. Please read this document before you install the system.

Intended Audience

This manual is for Digital Field Service personnel and technically sophisticated users of the DECvoice system.

Organization

This manual is divided into five chapters and three appendixes. Chapter 1, "Installation," describes how to install and set up the DECvoice system hardware.

Chapter 2, "System Overview," provides a general description of DECvoice components and features, and lists the technical specifications of the system hardware.

Chapter 3, "Software Interface," describes the DECvoice microcode and how it sends and receives data over the Q-bus.

Chapter 4, "Telephone Interfaces," describes the telephone line interface microcode and how it communicates with the telephone network.

Chapter 5, "Troubleshooting and Diagnostic Procedures," describes basic troubleshooting and how to run diagnostic tests to isolate problems with the DECvoice system.

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Appendix A, "Connector Pinouts," shows pin diagrams and signal names for the Q-bus and telephone line interface connectors.

Appendix B, "Telephonics," lists and details the telephonic characteristics of the DECvoice system.

Appendix C, "FCC Requirements," details the FCC requirements and service requirements for the DECvoice system.

Conventions

The following conventions are used in this document:

Caution	Provides information to prevent damage to equipment.
Note	Provides general information about the current topic.
Ctrl Z	For sequences that use the Ctrl key, hold down Ctrl and press the second key.
Bold text	Bold print identifies user input. This is particularly used in examples and system displays.
Generic printer queue LN03	Examples of commands or other text you enter on the keyboard are shown in monospace type.

Associated Documents

Document	Order Number
DECvoice DTC04 Software Reference Manual	AA-LE86A-7E
MicroVAX Systems Maintenance Guide	EK-O01AA-MG
MDM User's Guide	AA-FM7AB-DN

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1 Installation

This chapter describes how to unpack, install, and test the DECvoice system hardware.

1.1 Unpacking

The DECvoice system hardware includes the DTC04 Q-bus module, telephone line interface (TLI) assembly, and two 20-pin ribbon cables. Unpack each box and check the equipment against the shipping list. Carefully examine the module and TLI assembly for loose components, breaks in the etch, or other signs of damage. Immediately report missing or damaged items to the shipper and your Digital representative.

CAUTION

The DTC04 module comes in a protective sleeve. Do not remove the sleeve until you are ready to install the module. Also, make sure you protect the module from static during installation.

2 Installation

Table 1–1 lists the components included in the DECvoice system.

Table 1–1 DECvoice Components

Part Name	Description	Order Number
DECvoice M7132 module	1 module	DTC04-AA
TLI assembly	1 TLI, 2 cables for BA23 system	CK-DTC04-AB
TLI assembly	1 TLI, 2 cables for BA123 system	CK-DTC04-AA
TLI assembly	1 TLI, 2 cables for H9642 DECvoice response system	CK-DTC04-AF
Bulkhead	Bulkhead panel for use with complete system	H3490-E
Complete system	Dedicated DECvoice response system	DTCAA-AA

NOTE

Each TLI assembly can support two DTC04 modules.

1.2 Installation

NOTE

Please read Appendix C, FCC Requirements, before you connect DECvoice modules to a telephone line.

Install the DECvoice hardware into the Q-bus backplane as follows:

1. Set the addresses for the control status register (CSR) and the device interrupt vector as follows:
 - a. Set the switches on switchpacks E68, E67, and E59 (Figure 1-1) so that the module responds to its assigned address.

If the switches are labeled ON and OFF (or ON with an arrow), set the switch to:
 - OFF if the bit is a 1
 - ON if the bit is a 0
If the switches are labeled OPEN, set the switch to:
 - OPEN if the bit is a 1
 - CLOSED if the bit is a 0
 - b. Set the switches on switchpacks E68 and E67 to set the CSR address.
 - c. Set the switches on switchpack E59 to set the interrupt vector address.
2. See Section 1.3 for details on how to set the device address assignments. See Section 1.4 for details on how to set the interrupt vector address assignments. Section 1.3.2 shows how to use VMS SYSGEN (on VAX/VMS version 5.0 or higher) to configure the system and determine the CSR and vector settings.

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Figure 1-1 shows the locations of the switchpacks on the module.

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Figure 1-1 Switchpack Locations on the Module

Figure 1-2 shows how to set the switches for the CSR address.

MA-0546-88

Figure 1-2 Setting the CSR Address Switches

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Table 1-2 shows common CSR settings for DECvoice modules.

Table 1-2 Common CSR settings for DECvoice

E67						E68						CSR SETTING
S6	S5	S4	S3	S2	S1	S6	S5	S4	S3	S2	S1	
0	0	0	1	0	0	1	1	0	0	0	1	761142
0	0	0	1	0	0	1	1	0	0	1	0	761144
0	0	0	1	0	0	1	1	0	0	1	1	761146
0	0	0	1	0	0	1	1	0	1	0	0	761150
0	0	0	1	0	1	0	1	0	0	0	1	761242
0	0	0	1	0	1	0	1	0	0	1	0	761244
0	0	0	1	0	1	0	1	0	0	1	1	761246
0	0	0	1	0	1	0	1	0	1	0	0	761250

Figure 1-3 shows how to set the switches for the interrupt vector.

MA-0547-88

Figure 1-3 Setting the Interrupt Vector Address Switches

Install the DTC04 module board into the Q-bus backplane. The module is a quad-slot board that plugs into an AB/AB or AB/CD slot.

NOTE

When using an AB/CD slot, make sure there are no modules other than DECvoice modules using the CD slot plugged in above or below a DECvoice module. Figure 1-4 is a block diagram of a Q-bus backplane that shows all the valid locations for a DECvoice module.

MA-0548-88

Figure 1-4 Valid Locations for DECvoice in Q-bus Backplane (with optional third BA23)

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Verify The CSR and vector settings as follows:

If using the MicroVAX Diagnostic Monitor (MDM):

- a. Refer to the "MDM Release Note" and the other documentation that you received with your MDM kit for instructions on how to boot MDM. You must use release 125 of MDM or greater to test DECvoice modules. (For more troubleshooting and diagnosis information, see Chapter 5 in this manual.)
- b. If you set the DECvoice modules to the proper CSR setting, they appear in the configuration display. The first DECvoice module is named DTC04A, the second DTC04B, and so on. If any DECvoice modules do not appear in the configuration, refer to the troubleshooting section in Chapter 5.
- c. After MDM locates all the DECvoice modules, run the verification tests. Initially, you should run the verification tests for one module at a time. If the test reports a failure - "cannot generate Host alert" then the vector settings may be incorrect for that module. (Refer to Chapter 5.)
- d. Verification is complete. You can now run the exercisor testing.

If using VMS:

- a. Boot VMS by following the instructions given in the VAX/VMS system documentation. You must be using VAX/VMS version 5.0 or greater and you must have the VOX Run-Time Library installed.
- b. After you boot VAX/VMS, log in to the system account and type:
\$ SHOW DEVICE VX
- c. The DECvoice modules appear as VXA0;, VXB0;, ... , up to VXP0: (for a 16 line system). If any of your DECvoice modules are missing, refer to the troubleshooting information in Chapter 5.
- d. Run the DECvoice tests on each module following the instructions on the VOX Run-Time Library software release notes. If any of your DECvoice modules return with a DEVICE TIMEOUT error, refer to the troubleshooting information in Chapter 5. The tests should (initially) be run one module at a time.
- e. Verification is complete. You can now run further testing.

Install the TLI assembly. You can install the TLI assembly in the holes on a bulkhead panel. Usually, you install the TLI assembly in a pair of B-size holes on the panel. These holes are normally labeled A and B. Figure 1-5 shows where to install the TLI assembly for each system. The following list describes where to install the TLI assembly for each system:

- For systems with BA23 bulkhead panels (pedestal or single-box rackmount), the TLI installs in an A + B pair of holes. This leaves holes available for the console and other options. In this configuration, you can install a maximum of one TLI assembly (CK-DTC04-AB) and two modules (DTC04).
- For systems with double BA23 panels (DECvoice DTCAA systems), you can install the TLI in an E + I, F + J, or G + K pair of holes. In this configuration, you can install a maximum of three TLI assemblies (CK-DTC04-AF) and six modules (DTC04).
- For systems with triple BA23 panels (DECvoice H9642 cabinets), you can install the TLI assembly in an A + B, C + D, E + F, G + H, I + J, K + L, M + N, or O + P pair of holes. In this configuration, you can install a maximum of eight TLI assemblies (CK-DTC04-AF) and 16 modules (DTC04).
- For BA123 systems, you can install the TLI in a C + D or E + F pair of holes. In this configuration, you can install a maximum of two TLI assemblies (CK-DTC04-AA) and four modules (DTC04).

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Figure 1-5 Valid Locations for TLI Assembly on a Bulkhead Panel

Connect the cables. Each TLI assembly can support two DTC04 modules. The 20-pin cable connectors on the module and TLI assembly are keyed.

Figure 1-6 shows how to plug the cable into the module.

MA-0550-88

Figure 1-6 Cable Connector to Module

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Figure 1-7 shows how to plug the cable into the TLI assembly. Make sure you plug the cable in with the ribbon away from the module surface.

MA-0551-88

Figure 1-7 Cable Connector to TLI Assembly

Figure 1-8 shows how the TLI assembly and module appear in a system.

MA-0552-88

Figure 1-8 TLI Assembly and Module in a System

1.3 Device Addresses Assignments

On Q-bus systems, a range of addresses in the top 4K words is reserved as floating address space for options. The range of addresses is from xxx60010₈ to xxx63776₈. The xxx means all top address bits = 1.

The first part of the list of devices that you can assign floating address space to is in Table 1-3. The rank represents the sequence of address assignment for the devices.

If you assign device addresses according to VAX/VMS rules, you can run configuration programs to check which devices are installed in the system. Devices of the same type should have sequential addresses.

In Table 1-3, the size column shows how many words of address space each device needs. The modulus column shows the modulus used for each starting address. For example, devices with an octal modulus of 10 must start at an address that is a multiple of 10₈. Use the same rule to select a gap address after a device, or an address for a nonexistent device.

Table 1-3 CSR Address Assignments

Rank	Device	Size (Decimal)	Modulus (Octal)	
1	DJ11	4	10	
2	DH11	8	20	
3	DQ11	4	10	
4	DU11, DUV11	4	10	
5	DUP11	4	10	
6	LK11A	4	10	
7	DMC11/DMR11	4	10	(DMC before DMR)
8	DZ11/DZV11, DZS11 ¹			(DFA before DZx)
	DZQ11, DFA01, DZ32	4	10	(DZ11 before DZ32)
9	KMC11	4	10	

¹DZ11-E and DZ11-F are treated as two DZ11s.

Table 1–3 (Cont.) CSR Address Assignments

Rank	Device	Size (Decimal)	Modulus (Octal)
10	LPP11	4	10
11	VMV21	4	10
12	VMV31	8	20
13	DWR70	4	10
14	RL11, RLV11 ²	4	10
15	LPA11-K ²	8	20
16	KW11-C	4	10
17	Reserved	4	10
18	RX11/RX211, ² RXV11/RXV21	4	10
			(RX11 before RX211)
19	DR11-W	4	10
20	DR11-B ³	4	10
21	DMP11	4	10
22	DPV11	4	10
23	ISB11	4	10
24	DMV11	8	20
25	DEUNA ²	4	10
26	UDA50 ²	2	4
27	DMF32	16	40
28	KMS11	6	20
29	VS100	8	20
30	MSCP (tape) ²	2	4
31	KMV11	8	20

²The first device of the type has a fixed address. Any extra devices have floating devices.

³The first two devices of this type have fixed addresses. Any extra devices have floating addresses.

Table 1–3 (Cont.) CSR Address Assignments

Rank	Device	Size (Decimal)	Modulus (Octal)
32	DHV11, DHU11	8	20
33	DMZ32, CPI (asynch)	16	40
34	CPI32 (asynch)	16	40
35	QVSS ²	32	100
36	VS31	4	10
37	QPSS	8	20
38	DTQNA	4	10
39	DSV11 ²	4	10
40	CSAM	4	10
41	ADV11-C	4	10
42	AAV11-C	4	10
43	AXV11-C	4	10
44	KWV11-C	2	4
45	ADV11-D	4	10
46	AAV11-D	4	10
47	DRQ3B	8	20
48	VSV24	4	10
49	VSV21	4	10
50	IBQ01	2	10
51	IDV11-A	4	10
52	IDV11-B	4	10
53	IDV11-C	4	10
54	IDV11-D	4	10
55	IAV11-A	4	10

²The first device of the type has a fixed address. Any extra devices have floating devices.

Table 1–3 (Cont.) CSR Address Assignments

Rank	Device	Size (Decimal)	Modulus (Octal)
56	IAV11-B	4	10
57	M7763	4	10
58	IEQ11	8	20
59	ADQ32	16	40
60	DTC04	1	2

1.3.1 Assignment Rules

The assignment rules for addresses and devices are as follows:

1. Assign addresses, starting at xxx60010, according to the sequence of Table 1–3.
2. Assign device and gap addresses according to the octal modulus as follows:
 - a. For devices with an octal modulus of 10, assign an address on a 10_8 boundary. (The three least significant address bits = 0.)
 - b. For devices with an octal modulus of 20, assign an address on a 20_8 boundary. (The four least significant address bits = 0.)
3. For each device connected to the bus, you must allow address space that is equal to the modulus of the device.
4. After the last device of each type, you must allow a one-word gap (assigned according to rule 2). This gap could be bigger when rule 2 is applied to the following rank.
5. If a device with a higher address is used, you must allow a one-word gap for each unused rank on the list (assigned according to rule 2). This gap could be bigger when rule 2 is applied to the following rank.

1.3.2 Address Assignment Examples

This section provides two examples of device address assignment for DECvoice. The first example shows how to use the VMS SYSGEN utility to configure new Q-bus devices into the system. SYSGEN is a utility available in the VMS operating system. Only VMS version V5.0 or later can recognize the DECvoice DTC04 Q-bus module. SYSGEN automatically assigns device and vector addresses. The second example shows the proper switch settings for a sample configuration.

1.3.2.1 Using SYSGEN to configure a system

To use SYSGEN, you must have system manager privileges. The assignment process is automated. You enter device names, and SYSGEN assigns the devices according to how the system is configured. Use SYSGEN as follows:

1. Log into the system manager account.
2. Enter MCR SYSGEN to access the SYSGEN utility as follows:
\$ MCR SYSGEN
3. At the SYSGEN> prompt, enter the CONFIGURE command. SYSGEN responds by issuing the DEVICE> prompt.

```
SYSGEN>CONFIGURE
DEVICE>
```

4. At the DEVICE> prompt, enter all the devices currently in the system and all the devices you want to add to the system. The following example shows how to enter the RQDX3, TK50, DEQNA, and DTC04 devices:

```
DEVICE> RQDX3\bold)
%SYSGEN-I-EQV_NOTICE, equivalent name - device RQDX3 will be output as UDA
DEVICE> TK50
%SYSGEN-I-EQV_NOTICE, equivalent name - device TK50 will be output as TU81
DEVICE> DEQNA
%SYSGEN-I-EQV_NOTICE, equivalent name - device DEQNA will be output as QNA
DEVICE> DTC04,4
```

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5. To check how SYSGEN has configured the system, type `CTRL Z` at the `DEVICE>` prompt. Then exit SYSGEN.

```
DEVICE> CTRL Z
Device: UDA Name: PUA CSR: 772150 Vector: 154 Support: yes
Device: TU81 Name: PTA CSR: 774500 Vector: 260 Support: yes
Device: QNA Name: XQA CSR: 774440 Vector: 120 Support: yes
Device: DTC04 Name: VXA CSR: 761142* Vector: 300* Support: no
Device: DTC04 Name: VXB CSR: 761144* Vector: 310* Support: no
Device: DTC04 Name: VXC CSR: 761146* Vector: 320* Support: no
Device: DTC04 Name: VXD CSR: 761150* Vector: 330* Support: no
```

1.3.2.2 Setting the switches for a system configuration

This example show how to configure a system with an RQDX3, TK50, DEQNA, two DHV11 modules, and two DTC04 modules.

```
$ MCR SYSGEN
SYSGEN> configure
DEVICE> rqdx3
%SYSGEN-I-EQV_NOTICE, equivalent name - device RQDX3 will be output as UDA
DEVICE> deqna
%SYSGEN-I-EQV_NOTICE, equivalent name - device DEQNA will be output as QNA
DEVICE> tk50
%SYSGEN-I-EQV_NOTICE, equivalent name - device TK50 will be output as TU81
DEVICE> dhv11,2
DEVICE> dtc04,2
DEVICE> CTRL Z
Device: UDA Name: PUA CSR: 772150 Vector: 154 Support: yes
Device: TU81 Name: PTA CSR: 774500 Vector: 260 Support: yes
Device: QNA Name: XQA CSR: 774440 Vector: 120 Support: yes
Device: DHV11 Name: TXA CSR: 760440* Vector: 300* Support: yes
Device: DHV11 Name: TXB CSR: 760460* Vector: 310* Support: yes
Device: DTC04 Name: VXA CSR: 761242* Vector: 320* Support: no
Device: DTC04 Name: VXB CSR: 761244* Vector: 330* Support: no
SYSGEN> CTRL Z
```

Example 1–1 Configuring a System with Two DECvoice Modules

NOTE

See the tables in section 1.2 to find the correct switchpack settings for CSRs and Vectors.

The SYSGEN display in Example 1–1 shows that for the first DECvoice the CSR is 761242, and the Vector is 320. The switchpack settings for the first DECvoice are as follows:

The settings for switchpack E67 (moving from S6 to S1)
are 0 0 0 1 0 1.
The settings for switchpack E68 (moving from S6 to S1)
are 0 1 0 0 0 1.
The settings for switchpack E59 (moving from S6 to S1)
are 0 1 1 0 1 0.

For the second DECvoice the CSR is 761244, and the Vector is 330. The switchpack settings for the second DECvoice are as follows:

The settings for switchpack E67 (moving from S6 to S1)
are 0 0 0 1 0 1.
The settings for switchpack E68 (moving from S6 to S1)
are 0 1 0 0 1 0.
The settings for switchpack E59 (moving from S6 to S1)
are 0 1 1 0 1 1.

1.4 Interrupt Vector Address Assignments

In a Q-bus system, the addresses between 300_8 and 774_8 are reserved for floating vector space. Assign these addresses in sequence as listed in Table 1–4.

Each device needs two 16-bit locations for each vector. For example, a device with one receive and one transmit vector needs four words of vector space.

1.4.1 Assignment Rules

The vector assignment rules are as follows:

1. Each device uses a vector address equal to n words, where n is the Size listed in Table 1–4. For example, DECvoice uses four words of vector space. If the device's vector was 300_8 , the next available vector would be at 310_8 .
2. There are no gaps between vectors, except those needed to align an octal modulus.

Table 1–4 Floating Vector Address Assignments

Rank	Device	Size (Decimal)	Modulus (Octal)
1	DC11	4	10
1	TU58	4	10
2	KL11 ¹	4	10
2	DL11-A ¹	4	10
2	DL11-B ¹	4	10
2	DLV11-J	16	10
2	DLV11, DLV11-F	4	10
3	DP11	4	10
4	DM11-A	4	10
5	DN11	2	4
6	DM11-BB/AA	2	4
7	DH11 modem control	2	4
8	DR11-A, DRV11-B	4	10
9	DR11-C, DRV11	4	10
10	PA611 (reader + punch)	8	10
11	LPD11	4	10
12	DI07	4	10
13	DX11	4	10
14	DL11-C to DLV11-F	4	10
15	DJ11	4	10
16	DH11	4	10
17	VT40	8	10
17	VSV11	8	10
18	LPS11	12	10
19	DQ11	4	10
20	KW11-W, KWV11	4	10

¹A KL11 or DL11 used as the console has a fixed vector.

Table 1–4 (Cont.) Floating Vector Address Assignments

Rank	Device	Size (Decimal)	Modulus (Octal)	
21	DU11, DUV11	4	10	
22	DUP11	4	10	
23	DV11 + modem control	6	10	
24	LK11-A	4	10	
25	DWUN	4	10	
26	DMC11/DMR11	4	10	(DMC before DMR)
27	DZ11/DZS11/DZV11, DZQ11, DFA01, DZ32	4	10	(DFA before DZx) (DZ11 before DZ32)
28	KMC11	4	10	
29	LPP11	4	10	
30	VMV21	4	10	
31	VMV31	4	10	
32	VTV01	4	10	
33	DWR70	4	10	
34	RL11/RLV11 ²	2	4	
35	TS11, TU80 ²	2	4	
36	LPA11-K	4	10	
37	IP11/IP300 ²	2	4	
38	KW11-C	4	10	
39	RX11/RX211 ² RXV11/RXV21	2	4	(RX11 before RX211)

²The first device of this type has a fixed vector. Any extra devices have floating vectors.

Table 1–4 (Cont.) Floating Vector Address Assignments

Rank	Device	Size (Decimal)	Modulus (Octal)	
40	DR11-W	2	4	
41	DR11-B ²	2	4	
42	DMP11	4	10	
43	DPV11	4	10	
44	ML11 ³	2	4	(MASSBUS device)
45	ISB11	4	10	
46	DMV11	4	10	
47	DEUNA/DEQNA/DELQA ²	2	4	
48	UDA50 ²	2	4	
49	DMF32	16	4	
50	KMS11	6	10	
51	PCL11-B	4	10	
52	VS100	2	4	
53	MSCP (tape) ²	2	4	
54	KMV11	4	10	
55	Reserved	4	10	
56	IEX	4	10	
57	DHV11, DHU11	4	10	
58	DMZ32, CPI32 (asynch)	12	4	
59	CPI32 (synch)	12	4	
60	QVSS ²	4	10	
61	VS31	2	4	
62	LNV11	2	4	
63	QPSS (LNV21)	2	4	
64	DTQNA	2	4	

²The first device of this type has a fixed vector. Any extra devices have floating vectors.

³ML11 is a MASSBUS device that can connect to a UNIBUS through a bus adapter.

Table 1–4 (Cont.) Floating Vector Address Assignments

Rank	Device	Size (Decimal)	Modulus (Octal)
65	DSV11	2	4
66	QSAM	4	10
67	ADV11-C	4	10
68	AAV11-C	0	0
69	AXV11-C ²	4	10
70	KWV11-C	4	10
71	ADV11-D	4	10
72	AAV11-D	4	10
73	QDSS	6	20
74	DRV11-J	32	4
75	DRQ3B	4	10
76	VSV24	2	4
77	VSV21	2	4
78	IBQ01	2	4
79	IDV11-A	2	10
80	IDV11-D	2	10
81	IAV11-A	4	10
82	M7763	4	10
83	IEQ11	4	10
84	ADQ32	4	10
85	DTC04	4	10

²The first device of this type has a fixed vector. Any extra devices have floating vectors.

For an example of how to set the vector address, see Section 1.3.2.

1.5 Verifying the Installation

Chapter 5 of this document describes the troubleshooting, testing and diagnostic procedures available for DECvoice. For information on verifying the installation, refer to Chapter 5.

2

System Overview

This chapter provides an overview of the the DECvoice DTC04 system. The DECvoice system is an integrated hardware and software product that provides a MicroVAX II computer with a voice application platform. The complete system includes hardware and software components. Figure 2-1 is a functional block diagram of the system.

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Figure 2-1 The Complete DECvoice System

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Figure 2-2 DECvoice DTC04 Module and TLI Assembly

The hardware components include the DECvoice DTC04 Q-bus module and telephone line interface (TLI) assembly with cables. Figure 2-2 shows the hardware components.

The software components include the DECvoice Run-Time Library (RTL), ancilliary control process (ACP), device driver, and system firmware.

This document deals mainly with the hardware. For a detailed description of the DECvoice software components, see the *DECvoice Software Reference Manual*.

2.1 Features

This section describes the DTC04 Q-bus module and the TLI assembly components.

2.1.1 DTC04 Q-bus Module

The DTC04 module is the heart of the DECvoice system. This module provides the following capabilities:

- Text-to-speech conversion capabilities of the DECTalk DTC03 system
- Speaker-independent voice recognition of the numbers 0 through 9, and the words "yes," "no," and "oh"
- Speaker-dependent voice recognition of up to 50 words

- Digitized speech recording and playback, including full bandwidth and low-bit-rate voice encoding
- Control of the TLI that includes DTMF tone signal detection, call progress detection, and outward pulse and DTMF dialing

2.1.2 TLI Assembly

The TLI assembly connects the DTC04 module to the telephone network. The TLI has the following capabilities:

- Standard tip and ring connection over analog telephone lines with USOC RJ11 service
- Incoming call (ring) detection
- Line current interruption (wink) detection
- Outward pulse dial and switchhook flash

The TLI meets the standards of FCC Part 68—U.S. Telephonics and Canadian DOC Telecommunications.

2.2 Physical Description

This section describes the DTC04 module and TLI assembly hardware.

2.2.1 DTC04 Module

The DTC04 voice module is a quad-height, 25.8 x 20.6 centimeter (10.5 x 8.4 inch) Q-bus module. It contains all the voice processing circuitry for the DECvoice system. The DTC04 module plugs into a Digital MicroVAX II Q-bus processor. The module connects to the TLI assembly through a 20-pin ribbon cable connector.

2.2.2 TLI Assembly

The TLI assembly consists of a two-card stack and a metal plate. The circuitry in the assembly is logically divided in half so that each TLI can support two DECvoice DTC04 modules. One card contains all the TLI circuitry. The other card contains the circuitry to communicate with the DTC04 voice module. The assembly measures 13.3 cm x 8.6 cm x 3.18 cm (5.25 x 3.4 x 1.25 inches). The assembly can connect to two telephone lines through two separate AT&T RJ11 connectors. The assembly can connect to two DTC04 voice modules through two separate 20-pin ribbon cable connectors.

The assembly can install into any of the following components.

- BA23 pedestal or single-box rack
- BA123 world box
- H9642 cabinets

2.3 Functional Description

This section describes how the DTC04 module and the TLI assembly operate.

2.3.1 DTC04 Module

The DTC04 module consists of three functional blocks: the main processor, signal processor, and Q-bus interface. These blocks communicate through interrupts and 64 Kbyte windows into the main processor's 1 Mbyte memory space.

Main Processor

The main processor consists of an 8 MHz Intel 80186 microprocessor coupled to the 1 Mbyte shared memory. The main processor performs the following functions:

- Controls communication with the host system.
- Implements the text-to-vocal tract control portion of text-to-speech translation.
- Performs buffer management for speech recording and playback.
- Processes that part of speech recognition that is not handled by the signal processor.

Signal Processor

The signal processor consists of a Texas Instruments TMS320C25 or TMS320 family digital signal processor, 64 Kbytes of high-speed static random access memory, and a shared-memory interface. The shared-memory interface provides communication between the main processor and signal processor. The signal processor performs the following functions:

- Implements the vocal tract model that the text-to-speech system uses.
- Compresses and expands stored speech.

- Performs the analysis half of the speech recognition system.
- Performs the analysis half of call progress detection.
- Controls the telephone line interface.
- Generates tone dialing.

Q-bus Interface

The Q-bus interface consists of a slave section and a memory interface section. The slave section contains the control and status register and sends interrupts to the host. The memory interface section provides communication between the Q-bus and module.

2.3.2 TLI Assembly

The TLI assembly is functionally divided into two halves. One half controls communication with the telephone network. The other half controls communication with the DTC04 voice module. The heart of the TLI is the Intel 29C50 Subscriber Line Datalink chip. This chip uses the Intel SLD protocol to control communication between the DTC04 module and the telephone network.

Communication with the Telephone Network

The half of the TLI that controls communication with the telephone network is divided into five functional blocks.

- Protective circuitry that protects TLI from power surges over the phone line and conforms to the specifications of FCC Part 68
- Ring detection logic
- Wink detection logic (detection of line current when the phone is off the hook)
- Hook control logic
- Analog path

Communication with the DTC04 Module

The TLI communicates with the DTC04 module through the Intel SLD interconnect. The SLD interconnect is a serial bus that sends 32 bits in each direction every 125 microseconds. The 32 bits are divided into four 8-bit bytes: the primary voice and data byte, the secondary voice and data byte, the control byte, and the signalling byte. The voice and data bytes contain the actual voice data sent and received over the telephone line. DECvoice does not use both the primary and secondary bytes, only one or the other. The control byte programs how the SLD components operate. The signalling byte controls the reading and writing of network signalling.

2.4 Specifications

This sections lists the specifications for the DTC04 module.

DTC04 Voice Module Dimensions

Height	25.8 centimeters (10.5 inches)
Length	20.6 centimeters (8.4 inches)
Width	1.0 centimeters (0.4 inches)

TLI Assembly Dimensions

Height	12.9 centimeters (5.25 inches)
Length	8.3 centimeters (3.38 inches)
Width	3.1 centimeters (1.25 inches)

Electrical Power Requirements

Volts	Amperes
+5	3.80
+12	0.05

Bus Loading

AC	DC
3.2	0.5

Storage Conditions

Temperature	5° C (41° F) to 50° C (122° F)
Relative Humidity	10% to 95% with maximum wet bulb temperature 32° C (90° F) and minimum dew point 2° C (36° F)

Operating Conditions

Temperature	10° C (50° F) to 40° C (104° F)
Relative Humidity	10% to 90% with maximum wet bulb temperature 32° C (90° F) and minimum dew point 2° C (36° F)

3

Software Interface

This chapter describes the software interface that the DECvoice hardware uses with the host system. Specifically, this chapter describes:

- communication between DECvoice and the host
- data movement between DECvoice and the host
- initialization of the DECvoice DTC04 module
- DECvoice read-only memory commands

3.1 Q-bus Interface

The Q-bus interface controls communication between the DECvoice DTC04 module and the host system. The Q-bus interface consists of the control and status register (CSR) and a Q-bus memory window. The CSR lets the host control data movement to and from the DTC04 module, and checks the operation status of the module. The memory window provides communication space between the host and module. This section describes the CSR in detail.

3.1.1 Control and Status Register

The CSR is a read-write register with a width of one 16-bit word. The host uses the CSR to reset the module, to determine the module's status, and to manage the alert interrupts that flow between the module and the host.

You can set the address of the CSR to any location in I/O memory space by setting switches on the module. Chapter 1 describes this procedure in detail.

NOTE

DECvoice treats all write cycles to the CSR as complete word cycles. DECvoice does not support the writing of individual bytes to the CSR.

Figure 3-1 shows the CSR. Table 3-1 describes the bit assignments in the CSR.

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Figure 3–1 The Q-bus Control and Status Register

Table 3–1 CSR Bit Assignments

Bits	Name	Function
03:00	Module state (MS)	This field passes the complete module state from the main microprocessor microcode to the host. When the main reset bit is set, this field is set to 0. The microcode determines all other settings of this field. Table 3-2 lists the settings that the MS field can have.
04	Main reset (MR)	MR is a read-write bit. When MR is set, the main microprocessor and most other components on the module are held in the reset state. When MR is reset, the module restarts. The MR bit is cleared when the Q-bus is initialized (BINIT) or when the module is powered up.

NOTE

The MR bit must be asserted for at least 500 nanoseconds to ensure that the reset operation is complete.

Table 3–1 (Cont.) CSR Bit Assignments

Bits	Name	Function
05	Memory enable (ME)	<p>ME is a read-write bit. When ME is set, the Q-bus can access the module memory. When ME is reset, the Q-bus cannot access the module memory. The ME bit is cleared when the Q-bus is initialized (BINIT) or when the module is powered up.</p> <p>NOTE The ME bit prevents all the DECvoice modules in a system from responding to memory location 0 at power-up. This makes it possible to control several DECvoice modules using a single 64 Kbyte area in Q-bus address space.</p>
06	Alert interrupt enable (AI)	<p>AI is a read-write bit. An alert interrupt occurs in one of two cases:</p> <ul style="list-style-type: none"> • The host alert bit is set while the AI bit is set. • The AI bit is set while the host alert bit is set. <p>Generally, the host must acknowledge any alert interrupt by explicitly clearing the host alert bit. The AI bit is cleared when the Q-bus is initialized (BINIT) or when the module is powered up.</p>
07	Host alert (HA)	<p>HA is a read-write bit. The module sets HA to request a host alert interrupt. The host must clear HA to acknowledge the request. Writing a 1 to the HA bit clears it. Writing a 0 to the HA bit has no effect. The HA bit is cleared when the Q-bus is initialized (BINIT) or when the module is powered up.</p> <p>The module sets or clears this bit according to certain guidelines. Basically, the module sets the HA bit to alert the host that data movement has occurred in the module's shared memory. For details on the DECvoice interrupt scheme, see Section 3.3.2.1</p>

Table 3–1 (Cont.) CSR Bit Assignments

Bits	Name	Function
13:08	Memory bank (MB)	<p>MB is a read-write field. The MB field provides the bank selection bits (21 through 16) to the module memory address decoder. For example, suppose the memory bank field is set to 12_{16} and the memory enable bit is set. In this case, the module responds to Q-bus memory references for locations 120000_{16} through $12FFFF_{16}$.</p> <p>The addressing of the module memory is programmable. The MB field is cleared when the Q-bus is initialized (BINIT) or when the module is powered up.</p>
14	Timer interrupt enable (TI)	<p>TI is a read-write bit. TI is intended for real-time applications that run the module using a polling scheme.</p> <p>The interval timer is a free-running clock with a host-programmable rate. By default, the timer rate is set to 125 microseconds. Soft-loaded module firmware can change the rate.</p> <p>The timer generates an interrupt whenever the timer sends a clock signal while the TI bit is set. The module automatically clears the timer interrupt after it sends the interrupt to the host. The TI bit is cleared when the Q-bus is initialized (BINIT) or when the module is powered up.</p>
15	Module alert (MA)	<p>MA is a read-write bit. Writing a 1 to the MA bit sets it. Writing a 0 to MA has no effect. Setting MA requests a module alert interrupt. The module clears MA after it acknowledges the alert interrupt. The MA bit is cleared when the Q-bus is initialized (BINIT) or when the module is powered up.</p> <p>The host sets or clears the MA bit according to certain guidelines. Basically, the host must set the MA bit to alert the module that the host has moved data into the module's shared memory. For details on the DECvoice interrupt scheme, see Section 3.3.2.1</p>

Table 3–2 Module State Field Values

Value	Name	Meaning
0	RESET	The module is held in the reset state.
1	READY	The module is ready for operation.
2	BROKEN	The module has a hardware problem.
3	PARITY	There is a parity error in the module's RAM.
4	TRAP	The module hardware detected a microcode error.
5	BUG	The module microcode detected a microcode error.
6	RING	The module detected an error with the host software.
7	ROM	The module detected a ROM checksum error.
8	RAML	The module detected an error in low bank RAM.
9	RAMH	The module detected an error in high bank RAM.
10	RAMA	The module has a RAM addressing error.

3.2 Resetting the DECvoice Module

There are three ways to reset the module: power it up, initialize the Q-bus with a BINIT signal, or set the main reset bit in the CSR. Table 3-3 summarizes how each type of reset affects the module.

Table 3–3 Summary of Reset Operations

Type of Reset	What It Does
Power-up	Clears the CSR, resets the main processor, signal processor, and TLI.
BINIT	Clears the CSR, resets the main processor, signal processor, and TLI.
CSR main reset	Resets the main processor, signal processor, and TLI. Does not clear the CSR.

3.3 Data Transfer Scheme

This section describes the shared-memory scheme used to move data between the host system and the DTC04 module.

3.3.1 Rings

Data moves between the host and the module through two unidirectional rings. These rings use a total of 64 Kbytes of memory in the module. This memory is shared by the host and the module. Each ring uses 32 Kbytes of the shared memory.

NOTE

The last 256 bytes of each 32 Kbyte area are reserved. Host device handlers should consider each memory area to be 32K—256 bytes long.

The first ring in the shared memory is called the command ring. The command ring passes command data from the host to the module. The host is the sender for the command ring.

The second ring is called the message ring. The message ring passes status data from the module to the host. The module is the sender for the message ring.

Each ring is an array of buffers. Each segment of data uses one or more of the buffers. The host determines the size of each buffer when the host initializes the shared memory space. Usually, all the buffers are the same size.

Each ring has a load pointer that points to the next buffer to fill, and an unload pointer that points to the next buffer to empty. The host and module maintain these load pointers. The host keeps its pointers in data structures handled by the module's device driver. The module keeps its pointers in private memory. On initialization, the host sets its load pointer to the first buffer in the command ring, and its unload pointer to the first buffer in the message ring. The module microcode sets its load pointer to the first buffer in the message ring, and its unload pointer to the first buffer in the command ring.

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Figure 3-2 shows the structure of command and message rings in shared memory.

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Figure 3-2 Ring Structure

3.3.1.1 Buffer Structure

Figure 3-3 shows the structure of each buffer in the command and message rings.

Figure 3–3 Buffer Structure

Flag

The flag field in the buffer determines whether the sender or the receiver owns the buffer. When the host initializes the shared memory, all of the buffers are marked as owned by the sender. A sender passes data to a receiver as follows:

1. Waits until enough buffers are available to send the data, starting with the buffer at the load pointer.
2. Copies data into the data area of the buffers.
3. Sets the used field in the buffers.
4. Changes ownership of the buffers to the receiver by changing the owner bit in the flag field. The sender should change ownership of the buffers in last-to-first order. (The last buffer to change ownership should be the buffer at the load pointer.)

The receiver gets the data from the sender as follows:

1. Waits until the owner bit in the flag field at the unload pointer indicates receiver ownership.
2. Copies the data out of the data area of the buffers.
3. Returns ownership of the buffers to the sender by changing the owner bit in the flag field. The receiver should change ownership of the buffers in last-to-first order.

The flag field contains four flags (bits 0 through 3). The rest of the bits in the field must be 0 or the result is undefined. The sender can change any flag in the field, except the LIR flag. The receiver can only change the OWN flag. Table 3-4 describes each flag.

Table 3–4 Flag Field Flags

Flag Name	Bit	Function
OWN	0	This flag indicates the current owner of the buffer. If the flag is 0, the sender owns the buffer. If the flag is 1, the receiver owns the buffer. On initialization, the OWN flag in each buffer is set to 0.
FIB	1	This flag indicates that the buffer is the first in a block of data. The sender sets or clears this bit as required. This flag cannot be changed by the receiver.
LIB	2	This flag indicates that the buffer is the last in a block of data. The sender sets or clears this bit as required. This flag cannot be changed by the receiver.
LIR	3	This flag indicates that the buffer is the last in the ring. This flag must always be valid. Senders and receivers should be sure not to invalidate this flag while changing the other flags.

Size

The size field indicates the exact size (in bytes) of the data section of the buffer. The address of the next flag word in the next buffer is equal to the value in the size field plus the address of the first data word in the current buffer. However, if the current buffer is flagged by LIR as the last in the ring, then a wraparound operation is needed. After module initialization, the size field becomes a read-only field.

Used

The used field indicates the size of the used portion of the data buffer. The sender sets this field before ownership of the buffer is given to the receiver.

Data[]

The data field contains the actual data being sent or received.

Figure 3-4 summarizes how the host enters command data into the command ring. (The module enters message data into the message ring the same way.)

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Figure 3-4 Placing Commands into the Command Ring

3.3.2 Interrupts

There are two ways to manage data flow between the host and the DTC04 module. One way is to use the fixed fields at the beginning of each data buffer in the command and message rings. This method is described in Section 3.3.1. Using these fixed fields, the host can perform all ring management by polling each ring to find out when buffers are full or empty.

The other way to manage data flow is to use interrupts. The DTC04 module implements interrupts. This lets the host manage the rings by using interrupts instead of by polling. This is the recommended way to manage data flow.

3.3.2.1 Interrupt Scheme

The interrupt scheme works as follows. The module sets the HA (host alert interrupt) bit in the CSR to alert the host that data movement has occurred in the rings. The host should check the flag fields of the buffers at its load and unload pointers to determine the appropriate action. Because the module microcode is interrupt driven, the host must set the MA (module alert interrupt) bit in the CSR to alert the module that the host made changes to the rings.

The interrupt handler on the interrupted device must acknowledge (reset) the appropriate alert interrupt before checking the rings. The interrupting device must request (set) the appropriate alert interrupt after changing the rings.

Interrupt handlers must be able to handle extra interrupts. It is possible for the interrupting device to request an interrupt after the interrupted device has acknowledged the interrupt, but before the interrupted device checks the rings. In this case, the first interrupt handles any changes to the rings and the second interrupt is extra.

The module requests a host alert any time it changes the module status (MS) field in the control and status register. This informs the host of a change in module status and lets the host initialize the module in an interrupt-driven manner. The module interrupts the host using BIRQ4, which is VAX IPL 20.

3.3.3 Commands and Messages

This section describes the formats of commands and messages. The host uses the command ring in shared memory to send commands to the module. The module uses the message ring in shared memory to send messages to the host. A message is a reply to a previous command. Typically, a command can cause DECvoice to return many messages. The module processes the commands in the order they enter the ring. Also, the module sends messages to the host in the order that the messages occur.

All command and message entries in the rings are prefixed with a message tag. The message tag is a 32-bit longword at the top of each command and message entry. The software driving DECvoice uses the message tag to track messages and commands. Many commands cause DECvoice to return a corresponding message to the host. The message tag informs the driving software which message belongs with which command. DECvoice does not interpret the message tag. The message tag is only significant to the driving software.

3.3.3.1 Command Format

A command consists of a fixed-size command header, followed by a block of command-specific data. Figure 3-5 shows the command format.

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Figure 3–5 Command Format

MSGTAG

The message tag informs the driving software which messages belong with which commands. DECvoice does not interpret the message tag. The message tag is only significant to the driving software.

Slot

The DECvoice module provides an environment for the execution of subsystems. A subsystem is a group of processes that performs a function. For example, all the processes that translate text to speech are contained in a subsystem. Each subsystem loaded into the module is associated with a slot. The slot is used to locate and to identify a particular subsystem for a particular task.

Each command has a slot field that informs the command processor which subsystem should process the command. The DECvoice module has a total of eight slots, 0 through 7. Slot 0 is reserved for the module ROM and the module system code. Application software can establish which subsystems are in slots 1 through 7, because the module does not require any specific assignments for these slots.

If the host sends a command to a slot that is not associated with a subsystem, the module returns the command with an error indicator in the command status field. If the host sends a command that has faulty data, the module returns the command with an error indicator in the status field. In this case, it is unpredictable what will happen to the command data.

OP

The OP field contains the subsystem firmware command code. The command code represents specific firmware commands. Each command code is specific to a particular subsystem.

For example, sending a code of 0 in the basic subsystem loads a block of data into the command ring. Zero is the command code for the BASIC_LOAD command. Sending a code of 0 in the text-to-speech subsystem causes DECvoice to speak text. Zero is the command code for the SPEAK_TEXT command.

Status

The status field informs the host whether or not the command was completed successfully. The module sets this field. For example, if the command was completed successfully, the module would return a status code of 0. Any code other than 0 indicates an error.

Data[]

This field represents any data that the command operates on. Some commands do not have a data field.

3.3.3.2 Message Format

A message consists of a fixed-size header, followed by a variable length block of data. Figure 3-6 shows the format of messages.

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Figure 3–6 Message Format

MSGTAG

The MSGTAG field holds a copy of the MSGTAG field in the command that prompted DECvoice to return a message. The message tag informs the driving software which messages belong with which commands. DECvoice does not interpret the message tag. The message tag is only significant to the driving software.

Slot

The slot field identifies the subsystem that produced the message. This field in a message has the same value as the corresponding slot field in the command that prompted the message.

Type

This field indicates the purpose of the message and defines the format of the data portion of the message.

Status

This field provides further information about the message.

Data[]

There may be data fields in a message that contain special information specific to that message.

3.4 Initialization

The host must initialize the module before using it. Initialization occurs in three stages.

1. The host initializes the module's data transport system.
2. The host loads the module microcode into the module's private memory, then starts executing the microcode.
3. The microcode synchronizes with the telephone line interface hardware, then reads back that hardware's identification code.

3.4.1 Stage 1

Initialization of the module's data transport system executes as follows:

1. The module is reset. The reset can occur either from the host initiating a Q-bus or a CSR reset, or from a module power-up.
2. After the reset, the module automatically begins to execute initialization microcode. First, the module performs a series of self-tests to verify that all its major circuits are in working order.

If the module fails these tests, it informs the host by entering an appropriate error message in the module state field of the CSR (Table 3-2). If the module state field contains an error message, the first longword in shared memory contains further information about the message.
3. If the module passes the self-tests, it enters a ready message in the module state field of the CSR. Also, the green LED on the back of the module goes on and the module sets the host alert bit in the CSR. The module waits for the host to acknowledge the host alert.
4. The host acknowledges the host alert by clearing the host alert bit in the CSR. Then the host checks the module state field in the CSR to make sure the module passed the self-tests.

If the module is ready, the host enables the module shared memory by setting the memory enable bit and entering a bank selection value into the memory bank field in the CSR. The host also initializes the rings in shared memory.

5. The host requests a module alert by setting the module alert bit in the CSR.

6. The module acknowledges the alert by clearing the module alert bit in the CSR. Then the module begins to process commands received from the host.

3.4.2 Stage 2

The host loads the microcode into the module's private memory, then executes the microcode as follows:

1. The host sends a STATUS command to the module to get the base address and size of the block of shared memory that is available for allocation.
2. The host allocates module memory based on the message the module returns after receiving the STATUS command. The host copies the module microcode into memory using the LOAD command, then transfers control to the entry point of the resident microcode using a JUMP command.

NOTE

The host maintains the module memory map and determines which areas of memory to assign to each module subsystem.

3.4.3 Stage 3

The module microcode synchronizes with the TLI as follows:

1. The module tries to synchronize with the TLI hardware, and determine its identity code. The host can request the outcome of this attempt by sending a STATUS command to the module. If the module cannot synchronize with the TLI hardware, the module disables the TLI processor. If the module cannot synchronize with the TLI, the TLI probably has a hardware problem that must be fixed. To enable the TLI, the host must begin the initialization process over again.

The module can continue to operate with a broken TLI. However, the module will not be able to communicate with the telephone network.

2. If the module synchronizes with the TLI hardware, the module writes the telephone line identity code into a status message. Then the module enables the TLI.

3.5 Basic ROM Commands

This section describes commands that the host can use to move data into the module's shared memory and check the module's current status. This section covers three basic commands: LOAD, JUMP, and STATUS.

3.5.1 LOAD

The LOAD command copies a block of data into the module's main memory. During initialization, the host uses this command to copy the base microcode image into main memory. After the module is up and running, the host uses the LOAD command to copy images of module subsystems into main memory.

Figure 3-7 shows the structure of the LOAD command.

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Figure 3-7 LOAD Command Format

MSGTAG

The message tag informs the driving software which messages belong with which commands. DECvoice does not interpret the message tag. The message tag is only significant to the driving software.

Slot

This field contains the slot code that identifies the module subsystem to process the command. The slot code for the LOAD command is 0.

OP

This field contains the operation code that identifies the command as the LOAD command. The OP code for the LOAD command is 0.

Status

This field contains status information about the execution of the command. The module writes values into this field that indicate whether or not the command executed successfully.

Offset

This field contains the offset half of the 80186 address where the command data block is placed.

NOTE

The 80186 processor is a segmented device with the physical address of a memory area equal to $(16 \times \text{base}) + \text{offset}$.

The complete address for the command data is segmented into two halves, offset and base. Only the offset half of the address is incremented during a load operation. If the size of the data block is too large for the allocated space at the address, the result of the LOAD command is undefined. If a LOAD command writes data over memory that is part of the resident subsystem, the result is also undefined.

Base

This field contains the base half of the 80186 address where the command data block is placed.

Data[]

This field contains the data to be loaded. The LOAD command copies all the data bytes into module memory starting at the location specified by the base and offset values. The used field in the buffer header determines the length of the data string.

3.5.2 JUMP

This command transfers control of execution from the resident ROM on the module to the loaded microcode. Figure 3-8 shows the structure of the JUMP command.

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Figure 3-8 JUMP Command Format

MSGTAG

The message tag informs the driving software which messages belong with which commands. DECvoice does not interpret the message tag. The message tag is only significant to the driving software.

Slot

This field contains the slot code that identifies the module subsystem to process the command. The slot code for the JUMP command is 0.

OP

This field contains the operation code that identifies the command as the JUMP command. The OP code for the JUMP command is 1.

Status

This field contains status information about the execution of the command. The module writes values into this field that indicate whether or not the command executed successfully.

Offset

This field contains the offset half of the 80186 address where execution begins. This value is copied into the module's IP register.

The complete address for the command data is segmented into two halves, offset and base. Only the offset half of the address is incremented during a jump operation.

Base

This field contains the base half of the 80186 address where execution begins. This value is copied into the module's CS register.

3.5.3 STATUS

This command requests the module's current status. The STATUS command prompts a message reply from the module.

3.5.3.1 STATUS Command

Figure 3-9 shows the format of the STATUS command.

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Figure 3-9 STATUS Command Format**MSGTAG**

The message tag informs the driving software which messages belong with which commands. DECvoice does not interpret the message tag. The message tag is only significant to the driving software.

Slot

This field contains the slot code that identifies the module subsystem to process the command. The slot code for the STATUS command is 0.

OP

This field contains the operation code that identifies the command as the STATUS command. The code for the STATUS command is 4.

Status

This field contains status information about the execution of the command. The module writes values into this field that indicate whether or not the command executed successfully.

3.5.3.2 Status Message

Figure 3-10 shows the format of the STATUS message.

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Figure 3-10 Status Message Format

MSGTAG

The message tag informs the driving software which messages belong with which commands. DECvoice does not interpret the message tag. The message tag is only significant to the driving software.

Slot

This field contains the slot code that identifies the module subsystem that generates the message. The slot code for the status message is 0.

Type

This field contains the type code that identifies the message as a reply to the STATUS command. The code for the message type is 4.

Status

This field contains status information about the generation of the message. The module writes values into this field that indicate whether or not the module successfully generated the message.

ROMID

This field contains the version number of the firmware in slot 0. If the STATUS command is sent to the bootstrap and diagnostic ROM, this field contains the version number of that ROM. If the STATUS command is sent to the base microcode, this field contains the version number of the microcode. The upper byte (bits 8 to 15) of the ROMID field contains the major version number, the lower byte (bits 0 to 7) contains the minor version number.

TLIID

This field contains the identity code and status of the TLI hardware. The upper byte of the TLIID field (bits 8 to 15) contains the TLI status: 0 means normal, 1 means TLI not installed, 2 means TLI broken. The lower byte (bits 0 to 7) contains the TLI identity code.

INDEX

If the STATUS command is sent to the bootstrap and diagnostic ROM, this field is always 0. If the STATUS command is sent to the base microcode, this field contains the last index value set by the text-to-speech or the stored voice subsystem. If no index values have been set since the base microcode was loaded, this field is 0.

RAMBASE

If the STATUS command is sent to the bootstrap and diagnostic ROM, this field contains the paragraph number of the base memory available for the host to allocate. This feature lets the host initialize its memory allocation map without knowing the location or size of the memory the ROM is using. If the STATUS command is sent to the base microcode, this field is always 0.

RAMSIZE

If the STATUS command is sent to the bootstrap and diagnostic ROM, this field contains the number of paragraphs of memory available for the host to allocate. This feature lets the host initialize its memory allocation map without knowing the location or size of the memory the ROM is using. If the STATUS command is sent to the base microcode, this field is always 0.

4

Telephone Interface

This chapter describes the telephone line interface (TLI) that DECvoice uses to connect to the telephone network. The chapter is divided into two main sections: subscriber line datalink (SLD) interface and North American TLI interface.

4.1 SLD Interface

DECvoice uses a modified version of the Intel SLD protocol to control communication with the telephone network. The Intel SLD is a three-wire interface for synchronous data transfer between a master and a slave device. The master device is the controlling device. The master controls the rate and direction of data movement by sending clock and directional signals to the slave device. The SLD protocol supports four full-duplex, time-multiplexed, 64 Kbits/s channels. Each channel transfers a byte of data every 125 microseconds.

The three lines of the SLD interface are

- SCL (data clock signal),
- SDIR (data direction signal),
- SLD (data lead).

The data clock and direction signals can be common to all slave devices connected to the master device.

SCL

The SCL clock signal controls the rate of data transfer over the SLD line. The clock supports a rate of 512 Kbits/s.

SDIR

The SDIR signal controls the direction of transmission over the SLD line. When the SDIR line is asserted, the SLD line transfers data to the slave device. When the SDIR line is not asserted, the SLD line transfers data to the master device.

SLD

The SLD line is the data line for the system. The SLD line supports a 512 Kbits/s rate, as defined by the SCL clock signal. The data on the SLD line is formatted as 32 bits of receive data (towards slave) followed by 32 bits of send data (from slave). This pattern repeats at an 8 kHz rate. The transmit and receive data is further divided into eight bytes, four for each direction with the most significant bit first. The devices connected to the SLD line determine the exact use of it.

For analog subscriber lines, the four bytes of data per direction are the following:

- **Primary voice**—This byte contains the actual voice data transferred between DECvoice and the telephone network. This byte is the primary voice path.
- **Secondary voice**—This byte can have various uses, depending on the system. This byte is often used as an extra voice channel for three-way calling. This byte also lets one SLD line serve two telephone lines. DECvoice can use either the primary voice byte or secondary voice byte for data exchange, but not both.
- **Control**—This byte is used to program the Intel SLD components, specifically the Intel 29C50 chip.
- **Signaling**— This byte controls network relays and reads the ring and line current detection signals.

For digital subscriber lines, there are two voice (or data) bytes, a control byte, and a signaling byte. The voice bytes can be used as one voice stream and one data stream, two voice streams, or two data streams. DECvoice only supports the use of one data byte as a channel to exchange data.

4.1.1 SLD System

In an Intel SLD master-slave system, the master controls the rate and direction of data flow by generating clock and directional signals. The slave reads the clock and direction signals.

In the DECvoice system, the TLI assembly serves as the master and the DTC04 module as the slave. The TLI controls the rate and direction of data transfer between the telephone network and the module.

NOTE

Although the module is the slave device in a timing sense, it is the master device in a logical sense. The module provides the programming information to any interface device connected to it. The module also provides the intelligence to run telephone transactions.

4.1.2 DECvoice Modifications to the Intel SLD Interface

The SLD protocol is designed for systems where the master and slave devices (chips) are on the same printed circuit board. In the DECvoice system, the master and slave devices are on separate boards. The SLD protocol has been modified in three ways to accommodate this separation.

- The SLD data lead wire has been split into two unidirectional wires.
- The telephone line interface sends an additional byte of identification data to the DTC04 module.
- A reset line has been added so the module can send a reset signal to the TLI assembly.

4.1.2.1 SLD Data Lead

The SLD protocol was designed for use on a single board. When the SLD master and slave devices are on one board, time delays are short for data travel. On a single board, the SLD data lead can handle bidirectional data travel with a minimal amount of time delay between the master and slave devices.

In the DECvoice system, the master and slave devices are on separate boards. Data must travel over a cable from the DTC04 module (slave) to the TLI (master). The SLD data can be separated into two unidirectional signals.

This separation makes it possible to have TLI assemblies that are not mounted in the Q-bus IO connector panel. If there is any length of cable between the TLI assembly and the module, it is necessary to have separate send and receive data wires. The two wires are called TX DATA H and RX DATA H (Table 4-1). The module sends data to the TLI over the TX DATA H line. The TLI sends its identification code and other data to the module over RX DATA H.

If the TLI assembly is mounted in the Q-bus IO connection panel, only one wire is needed for moving data between the module and TLI. In this case, the standard bidirectional SLD data is sent over the single TX DATA H line. The module uses the ONE WIRE L signal to determine whether one or two data wires are needed (Table 4-1).

4.1.2.2 Identification Data Byte

On a single board, the SLD chips that represent the master and the slave devices are always the same. In this case, it is not necessary for the master to identify itself to the slave.

In the DECvoice system, the master and slave devices are on separate boards. It is possible that the master and slave devices could have different programming requirements. Therefore, the TLI must send a byte of identification data to inform the DTC04 module what is at the other end of the cable. The identification byte informs the module of the following:

- What type of SLD chip the TLI is using (a 29C49, 29C50, 29C52, or some other chip)
- The exact meanings of the bytes in the data frames over the SLD slave and SLD master lines
- Any legal restrictions the microcode driving the interface must follow

The TLI sends the identification byte to the module when the module sends its first byte of data to the TLI.

4.1.2.3 Reset Line

When all components are on the same board, the power-up voltages all sequence at the same time. It is not necessary to synchronize a reset operation between components on the board, since all components receive power at the same time.

In the DECvoice system, the SLD master and slave devices are on separate boards. In this case, it is necessary to synchronize reset operations between the module and the TLI. A reset line has been added between the module and TLI assembly called TLI RESET. When the module resets, it asserts TLI RESET so that the TLI also resets.

4.1.3 Connection Between the Module and TLI

This section describes the actual connection between the DTC04 module and the TLI assembly. The module and TLI are connected over a 20-pin cable. Figure 4-1 is a diagram of the connector. Table 4-1 describes each pin assignment.

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Figure 4-1 20-Pin Connector

Table 4-1 Pin Assignments

Pin	Name	Function
1	+12 V	Supplies +12 V to TLI assembly.
2	+5 V	Supplies +5 V to TLI assembly.
3	TLI INSTALLED L	Indicates to the DTC04 module that the Q-bus IO connector bulkhead is plugged in. The module can use this signal to help isolate faults. The bulkhead must ground this signal.
4	GND	Ground.
5	ONE WIRE L	Indicates to the DTC04 module whether the TLI is using a one-wire SLD data lead (on the TX DATA H line) or a two-wire SLD data lead. In either case, the TLI sends its identification code over the RX DATA H line. The TLI ONE WIRE line should be grounded for a one-wire operation, and floated for a two-wire operation. The TLI assembly can use one-wire or two-wire operation. The North American TLI uses a one-wire operation.
6	GND	Ground.

Table 4–1 (Cont.) Pin Assignments

Pin	Name	Function
7	SCL H	This line is for the clock signal. The TLI drives this line, controlling the rate of data movement over the TX DATA H and RX DATA H lines.
8	GND	Ground.
9	SDIR H	This line is for the direction signal. The TLI drives this line, controlling the direction of data movement over the TX DATA H and RX DATA H lines.
10	GND	Ground.
11	TX DATA H (SLD H)	The module uses this line to send data to the TLI assembly. Valid data only moves over this line when the TLI asserts the SDIR H signal.
12	GND	Ground.
13	RX DATA H (ID H)	The TLI assembly uses this line to send data to the module. The TLI must turn off SDIR H to send data over this line. Typically, the TLI uses this line to send its identification code to the module.
14	GND	Ground.
15	GO H	The module uses this line to reset the TLI. This line carries the TLI RESET signal described in Section 4.2.2.3. When GO H is asserted, the TLI can make calls. When GO H is not asserted, the TLI resets and cannot make any calls until the module asserts GO H again.
16	GND	Ground.
17	MODULE INSTALLED L	This line informs the TLI that a DTC04 module is connected to it.
18	GND	Ground.
19	+5 V	Supplies +5 V to the TLI assembly.
20	+12 V	Supplies +12 V to the TLI assembly.

4.2 North American Telephone Line Interface

This section briefly describes the DECvoice TLI designed for use in North America.

4.2.1 TLI to Telephone Line Connection

The circuit that connects the TLI to the telephone network must meet certain North American telephone regulations, provide access to the network, and protect the TLI circuitry. The TLI connects to the telephone line through modular telephone jacks for RJ11 service.

The circuitry that connects the TLI to the telephone network provides the following features.

- Ring detection
- Line current interruption (wink) detection
- Hook control
- A protected analogue path
- Protection against surges in telephone line current

4.2.2 TLI to DTC04 Module Connection

The TLI connects to the module through a modification of the Intel Subscriber Line Datalink protocol. This protocol is described in more detail in Section 4.1. Make sure you read this section before you continue.

Briefly, the Intel SLD protocol is a master-slave system for connecting a computer to the telephone network. The master half of the system controls the rate and direction of data flow over the telephone network. The master controls the flow of data by sending a clock signal (SCL) and a directional signal (SDIR) to the slave. In the DECvoice system, the TLI is the SLD master, the DTC04 module is the slave.

4.2.2.1 Data Flow Control

The TLI contains a circuit that provides the clock signals for all the telephone lines in a DECvoice system. This circuit generates the 512 kHz clock signal and SDIR signals for the DTC04 module and the 29C50 chips.

4.2.2.2 Identification

The TLI sends an identification code to the DTC04 module. If two modules are connected to a TLI, the TLI sends the same identification code to each module. This identification is factory set to identify the TLI as a North American analog loop start interface.

4.2.2.3 Reset

When the module asserts the TLI RESET signal to the TLI, the TLI cannot accept any calls. This prevents the TLI from connecting to the telephone network while the module is resetting.

4.2.3 Intel SLD Feature Control Chip

The heart of the telephone line interface is the Intel 29C50 control chip. This chip is a user-programmable, fully integrated PCM codec with transmit and receive filters, parallel input, and parallel output. The chip communicates with the telephone line and DTC04 module through the SLD protocol. The SLD data lead channel sends four separate bytes of information between the module and TLI: voice, data, control, and signaling.

4.2.3.1 Voice Byte

The voice byte is the main data path into the 29C50 chip. The TLI converts data it receives from this byte into audio signals. The module receives audio signals from the telephone line through this byte. Voice data from the telephone line that is sent to the chip can use either of two encoding schemes: μ -law or A-law. The data stream to or from the 29C50 chip moves at a rate of 8 kHz in 8-bit compressed samples.

4.2.3.2 Data Byte

The DECvoice system does not use this byte.

4.2.3.3 Control Byte

The control byte programs the 29C50 chip. The SLD protocol uses a sequence of six feature control bytes to program the chip. The most significant bit of a control byte is used for framing. The first byte in the 6-byte sequence must have a framing bit value of 0. The rest of the bytes should have a framing bit value of 1. The second most significant bit in a control byte is a write-enable bit. When this bit is 0, writing is enabled. The remaining bits in the control byte contain programming information.

For details on the use of the control byte, refer to the Intel *Microcommunications Handbook*.

4.2.3.4 Signaling Byte

This section describes how DECvoice uses the signaling byte during a module write operation (from module to TLI) and a module read operation (from TLI to module).

Module Write Operation

The DTC04 module sends the signaling byte to the TLI to control the output of the signaling pins on the 29C50 chip. Figure 4-2 shows how the bits in the signaling byte correspond to the pins on the 29C50 chip.

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Figure 4-2 Signaling Byte From the Module

The R1 signaling pin serves as a hook switch. When R1 is 0, the telephone is off the hook. When R1 is 1, the telephone is on the hook. R1 is used for answering the telephone and pulse dialing. DECvoice does not use signaling pins R2, A, B, C, and D.

Module Read Operation

The TLI sends the signaling byte to the module to inform it of the state of signaling pin X1 and which of pins A, B, C, and D are programmed to transmit. Figure 4-3 shows how the bits in the signaling byte correspond to the pins on the 29C50 chip.

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Figure 4-3 Signaling Byte to the Module

Signaling pin A is used for ring detection. Signaling pin X1 is used for line current detection. DECvoice does not use pins B, C, and D. Signaling pins labeled with a Z are undefined.

5

Troubleshooting and Diagnostic Procedures

This chapter contains two sections:

- Section 5.1, Troubleshooting, contains a troubleshooting table to help you find and solve hardware problems.
- Section 5.2, Diagnostic Procedures, describes the diagnostic programs available to check the operating status of the DECvoice module and telephone line interface (TLI). There are two subsets of diagnostic programs: DECvoice test programs and the MicroVAX diagnostic monitor (MDM) program.

5.1 Troubleshooting

This section contains a troubleshooting table to help you find and solve hardware problems.

Table 5-1 Troubleshooting Table

Problem	Possible Cause	Corrective Action
The DECvoice device (VXA0:, VXB0:, and so on) is not visible when you issue the DCL "SHOW DEVICE VX" command.	DECvoice software is not installed.	Review Chapter 1 of the <i>DECvoice DTC04 Software Reference Manual</i> , and verify the software installation procedure. Check to make sure the file SYS\$LOADABLE_IMAGES:VXDRIVER.EXE is present.

Table 5-1 (Cont.) Troubleshooting Table

Problem	Possible Cause	Corrective Action
	On VAX/VMS V5.0 or V5.0-1, the WINDOW_SYSTEM is zero.	Change the WINDOW_SYSTEM sysgen parameter to 1, and reboot the system. Refer to the VAX/VMS SYSGEN manual for information on how to change this parameter. Run AUTOGEN to reset the SYSGEN parameters, and reboot the system by typing the following: \$ @SYS\$UPDATE:AUTOGEN GETDATA REBOOT FEEDBACK
	SYSGEN parameter STARTUP_P1 is set to "MIN"	Set STARTUP_P1 to " " to allow the DECvoice device to configure, and reboot the system.
	The DECvoice CSR is set incorrectly.	Run VMS SYSGEN, and type: SYSGEN> SHOW/UNIBUS The show unibus command displays the addresses and values of CSRs that are seen on the Q-bus. Remove the first module that is not seen and verify the CSR switch settings. For information on setting the CSRs, see Chapter 1, Section 1.2. Check the module for wrong switch settings and incomplete switch closure. Toggle the switches back and forth once to ensure complete switch closure.

Table 5-1 (Cont.) Troubleshooting Table

Problem	Possible Cause	Corrective Action
DECvoice device (VXA0:, VXB0:, and so on) is visible when you issue a "SHOW DEVICE VX" command, but on VAX/VMS, modules fail with device timeout errors, and on MDM, modules fail with "COULD NOT GENERATE HOST INTERRUPT" errors.	The DECvoice device VECTOR is set incorrectly.	Shutdown and power off the system, remove the module(s) and check the vector settings. Reset and incorrect vector settings. For information on setting the vectors, see Chapter 1, Section 1.2. Toggle the switches back and forth once to ensure complete switch closure.
When you run VMS or MDM diagnostics on all installed modules simultaneously, the tests pass, but when you test a module separately, it fails with a device timeout or host interrupt error.	Vector settings have been swapped on two modules.	Run the diagnostics separately for each module, and correct the vector settings on the modules that receive the timeout errors.

Table 5-1 (Cont.) Troubleshooting Table

Problem	Possible Cause	Corrective Action
<p>The DECvoice device (VXA0:, VXB0:, and so on) is visible when you issue DCL "SHOW DEVICE VX" command but is marked as off-line</p>	<p>Lack of system page table entries (SPTE) for the driver buffers.</p>	<p>Do not attempt to access an offline DECvoice. Each DECvoice requires 128 SPTEs to function. To raise the number of SPTEs available in a VMS system, perform the following:</p> <p>Place the line "ADD_SPTREQ=128" in the file SYS\$SYSTEM:MODPARAMS.DAT. You must add 128 to the SPTREQ SYSGEN parameter for each DECvoice module. Run AUTOGEN to reset the SYSGEN parameters, and reboot the system by typing the following:</p> <pre>\$ @SYS\$UPDATE:AUTOGEN GETDATA REBOOT FEEDBACK</pre> <p>The DECvoice module(s) should now appear as on-line.</p>
<p>On VAX/VMS one or more DECvoice modules are not mounted.</p>	<p>The VOX software startup procedure is not being run.</p>	<p>Verify that the following line has been added to the system startup procedure:</p> <pre>\$ @SYS\$STARTUP:VOX\$STARTUP.COM</pre> <p>This procedure mounts the DECvoice modules with the telephone control ACP and defines the necessary logical names that point to the loadable microcode files.</p>

Table 5-1 (Cont.) Troubleshooting Table

Problem	Possible Cause	Corrective Action
In a newly installed system or in a system that has just had the Q22-bus hardware reconfigured, the system hangs or drops off the VAXcluster shortly after the DECvoice ACP OPCOM "starting" message is displayed.	Invalid Q22-bus configuration.	For information about configuring the Q22-bus, see Section 1.3 in this manual.

NOTE

The DECvoice device driver (VXDRIVER) currently supports *only* the MicroVAX-II processor. Do not attempt to use the driver on any other VAX processor.

5.2 Diagnostic Procedures

This section describes the diagnostic programs available to check the operating status of the DECvoice module and telephone line interface (TLI).

5.2.1 DECvoice Test Programs

The DECvoice test programs let users check the operating status of the DTC04 module and the TLI. These programs are included with the DECvoice software package in the `SYS$SYSROOT:[VOX$DTC.SYSTEM]` directory. There are three programs available: `VOX$TEST.EXE`, `VOX$DIAL.EXE`, and `VOX$DIAG.EXE`.

5.2.1.1 VOX\$TEST.EXE

This standalone test program runs the DTC04 module through various self-tests and verifies the operation of the Q22-bus interface. To run this test program, the user must have operator's privileges.

Operators can run `VOX$TEST.EXE` from a terminal by typing the following:

```
$ RUN VOX$TEST
```

In the previous case, `VOX$TEST.EXE` tests the first available DTC04 module in the Q-bus backplane.

Operators can also define a DCL foreign command to test individual modules. For example, operators can include the following line in the `LOGIN.COM` file or in the `SYS$MANAGER:SYSLOGIN.COM` file:

```
$ VOX$TEST ::= $VOX$SYSTEM:VOX$TEST.EXE
```

After the VOX\$TEST symbol is declared, operators can test individual modules by including the device in the command line. Operators can test the DECvoice device VXB0: by typing the following:

\$ VOX\$TEST VXB0:

5.2.1.2 VOX\$DIAL.EXE

This standalone test program runs the DTC04 module through a program that verifies the TLI and telephone wiring. Users must have operator privileges to run VOX\$DIAL.EXE. VOX\$DIAL.EXE is run the same way as VOX\$TEST.EXE. VOX\$DIAL.EXE displays the line "Waiting for a call" when it is ready to accept a phone call.

5.2.1.3 VOX\$DIAG.EXE

This program is a test program sequencer. VOX\$DIAG.EXE can run versions of VOX\$TEST and VOX\$DIAL on DTC04 modules. VOX\$DIAG.EXE has a built-in help feature that users can access with the HELP command. Users must have operator privileges to run VOX\$DIAG.EXE.

Operators can run VOX\$DIAG.EXE by typing the following:

\$ RUN VOX\$DIAG

5.2.2 MDM Diagnostics

You need to have access to the system controls before you can run the MDM system diagnostics. Refer to the system documentation for procedures on accessing the system controls. Test the system as follows:

1. Insert the MDM tape cartridge or diskette into the drive.
2. Boot the MDM drive.
3. At the MDM prompt (MDM>>>), in command mode, type the following:

MDM>>> SHOW BUS

In the SHOW BUS display, DECvoice modules appear with the diagnostic name NADTA. The display shows the correct vector setting, **not** the actual setting. If the vector settings are correct, type the following:

MDM>>> CONFIG

MDM>>> SHOW CONFIG

The configuration display shows the current ROM revisions and the TLI type. In this display, DECvoice modules appear as DTC04.

4. Test the existing system to make sure it is running properly. For information on testing and troubleshooting, see the *MicroVAX Systems Maintenance Guide*
5. After the test runs successfully, remove the tape cartridge or diskette and turn the I/O power switch off (0).

CAUTION

If you are using a tape cartridge, always remove it from the drive before turning power off.

A

Connector Pinouts

A.1 Q-bus Connector

The module connects only to the AB row of the Q-bus. However, the module does connect to the power pins in the CD row. The module also reroutes the DMG(IO) and IAK(IO) signals in the CD rows, so that these signals are passed to the next slot in the bus.

Table A-1 lists the pin assignments for the module plugged into the AB row of the Q-bus.

Table A-1 Q-bus Connector Pin Assignments

Pin	Assignment	Pin	Assignment
AA1	-	AA2	+5 V
AB1	-	AB2	
AC1	BDAL16 L	AC2	GND
AD1	BDAL17 L	AD2	+12 V
AE1	-	AE2	BDOUT L
AF1	-	AF2	BRPLY L
AH1	-	AH2	BDIN L
AJ1	GND	AJ2	BSYNC L
AK1	-	AK2	BWTBT L
AL1	-	AL2	BIRQ4 L
AM1	GND	AM2	BIAKI L
AN1	-	AN2	BIAKO L

Table A-1 (Cont.) Q-bus Connector Pin Assignments

Pin	Assignment	Pin	Assignment
AP1	-	AP2	BBS7 L
AR1	BREF L	AR2	BDMGI L
AS1	-	AS2	BDMGO L
AT1	GND	AT2	BINIT L
AU1	-	AU2	BDAL00 L
AV1	-	AV2	BDAL01 L
BA1	-	BA2	+5 V
BB1	-	BB2	
BC1	BDAL18 L	BC2	GND
BD1	BDAL19 L	BD2	+12 V
BE1	BDAL20 L	BE2	BDAL02 L
BF1	BDAL21 L	BF2	BDAL03 L
BH1	-	BH2	BDAL04 L
BJ1	GND	BJ2	BDAL05 L
BK1	-	BK2	BDAL06 L
BL1	-	BL2	BDAL07 L
BM1	GND	BM2	BDAL08 L
BN1	-	BN2	BDAL09 L
BP1	-	BP2	BDAL10 L
BR1	-	BR2	BDAL11 L
BS1	-	BS2	BDAL12 L
BT1	GND	BT2	BDAL13 L
BU1	-	BU2	BDAL14 L
BV1	+5 V	BV2	BDAL15 L

A.2 SLD Connector

The SLD connector is a 20-pin, ribbon cable connector. Figure A-2 is a diagram of the connector. Table A-2 lists the pin assignments for each pin on the SLD connector.

connector diagram

Figure A-1 SLD 20-Pin Connector

Table A-2 SLD Connector Pin Assignments

Pin	Assignment
1	+12 V
2	+5 V
3	TLI INSTALLED L
4	GND
5	ONE WIRE TLI
6	GND
7	SCL H
8	GND
9	SDIR H
10	GND
11	TX DATA H
12	GND
13	RX DATA H
14	GND
15	TLI GO H
16	GND

Table A-2 (Cont.) SLD Connector Pin Assignments

Pin	Assignment
17	MODULE INSTALLED L
18	GND
19	+5 V
20	+12 V

B

Telephonics

DECvoice works with standard analog loopstart telephone lines. Each individual DECvoice system acts like a separate subscriber telephone terminal on the telephone network.

This appendix describes the telephonic characteristics of the DECvoice DTC04 system.

B.1 Connection

DECvoice telephone lines are connected using RJ11 telephone service in the USA, and using CA11 telephone service in Canada.

B.2 Certification

DECvoice is certified to comply with Part 68 of the FCC rules. DECvoice is also certified by the Canadian Department of Communications. See Appendix C for more information.

B.3 Voice Signal Level

DECvoice provides a maximum voice level of -9 dBm to the telephone line, as telephone regulations specify. This level is measured into a 600 ohm load with a 3 second average. The level of DECvoice does not exceed -9 dBm. The level is dependent on the voice selected.

B.4 Ring Detection

Ringer Equivalence

The DECvoice ring detection circuit has a ringer equivalence of .3B, as determined by FCC test methods. The ring detection circuit has a load number of 10 by DOC test methods.

Ring Characteristics

DECvoice detects rings with frequencies between 15.3 Hz and 68.0 Hz and voltages between 40 and 150 volts rms.

B.5 Tone Detection

DECvoice can detect DTMF signals. DTMF signals are the signals that a Touch-Tone phone creates. DECvoice cannot detect digipulse signals. Digipulse signals are the signals that a rotary phone creates. A digipulse phone has keys like a Touch-Tone phone, but does not create DTMF signals.

Tone Frequencies

DECvoice accepts DTMF tones that are within $\pm 1.5\%$ (± 2 Hz) of the nominal frequency. DECvoice rejects DTMF tones that are outside of 3.5% of the nominal frequency. DTMF tones are a combination of two tones, one from the row group, and one from the column group.

The row group tones are 697 Hz, 770 Hz, 852 Hz, and 941 Hz, moving from the top row (containing 1) to the bottom row (containing 0). The column group tones are 1209 Hz, 1336 Hz, 1477 Hz, and 1633 Hz, moving from the leftmost row (containing 1) to the rightmost row (containing 3). The column group also includes the extra row of keys that are occasionally present in PBX installations (often labeled A, B, C, and D).

Tone Timing

DECvoice is designed to recognize a DTMF tone that is present for at least 55 ms. DECvoice ignores a tone burst of less than 35 ms, interpreting it as a noise burst. A DTMF tone should be absent for at least 55 ms before it can detect the next DTMF tone. DECvoice ignores a tone that is absent for 40 ms or less, interpreting it as a dropout.

Tone Levels

The DTMF tones must typically be at least 12 dB louder than the noise floor and 16 dB louder than any other tone within the DTMF detection band. Each frequency of the DTMF tone must be between -5 dBm and -26 dBm when measured at the DECvoice telephone line connections.

B.6 Wink Detection

DECvoice can detect momentary losses in loop current. DECvoice can use these losses to detect that the other end of the telephone call has cleared down. The wink detector must see a current absence of 30 ms or more. DECvoice detects the trailing edge of the current loss. In other words, DECvoice detects the reestablishment of loop current. Not all telephone systems generate winks to signal call disconnect. Some telephone systems may generate winks at other times (the call waiting beep is often accompanied by one or more winks).

B.7 DTMF Dialing

DECvoice can generate outgoing calls using DTMF tone dialing. DTMF dialing uses the standard DTMF frequencies (see the Tone Frequencies section). There is a 0.1% maximum frequency error. Country-specific regulations determine the timing and power.

B.8 Pulse Dialing

DECvoice can generate outgoing calls using pulse (rotary) dialing. The digits are pulse dialed at a rate of 10 pulses/s. The average make interval is 40 ms. The average break interval is 60 ms. The interdigit interval is 0.8 seconds. These characteristics may change as country-specific regulations require.

C

Communication Requirements

C.1 FCC Requirements

1. The Federal Communications Commission (FCC) has established rules that permit this device to be directly connected to the telephone network. Standardized jacks are used for these connections. This equipment should not be used on party lines or coin lines.
2. If this device is malfunctioning, it may also be causing harm to the telephone network. This device should be disconnected until the source of the problem can be determined and until repair has been made. If this is not done, the telephone company may temporarily disconnect service.
3. The telephone company may make changes in its technical operations and procedures. If such changes affect the compatibility or use of this device, the telephone company is required to give adequate notice of the changes.
4. If the telephone company requests information on what equipment is connected to their lines, inform them of:
 - a. The telephone number this unit connected to
 - b. The ringer equivalence (REN) number
 - c. The USOC jack required
 - d. The FCC registration number

Items **b** and **d** are indicated on the label. The REN is used to determine how many devices can be connected to your telephone line. In most areas, the sum of RENs of all devices on any one line should not exceed five (5). If too many devices are attached, they may not ring properly.

C.2 Communication Requirements in Canada

The Canadian Department of Communications (DOC) label on the DECvoice CK-DTC04 identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational, and safety requirements. The DOC does not guarantee the equipment will operate to the user's satisfaction.

DOC regulations require that you provide the business office of your local telecommunications company with the following information before you install DECvoice.

Make:	DECvoice
Model:	DTC04-AA
DOC certification:	192 2747 A
Load number:	10
Type of service:	CA11A
Cable:	17-00089 or equivalent approved cable

Before you install this equipment, make sure it is permissible to connect it to the telecommunications company's facilities. You must also install the equipment by using an approved connection method. Be aware that complying with the above conditions may not prevent degradation of service in some situations. Telecommunications company requirements do not allow you to connect their equipment to customer-provided jacks, except where specified by individual telecommunications company tariffs.

Only authorized Canadian maintenance facilities, designated by the supplier, should repair certified equipment. If you repair or alter certified equipment yourself, or if the equipment malfunctions, the telecommunications company has cause to ask you to disconnect the equipment.

You should ensure (for your own protection) that the electrical ground connections for the power utility, telephone lines, and internal metallic water-pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION

Do not try to make such connections yourself. Contact the appropriate electric inspection authority or electrician.

C.3 Service Requirements

In the event of equipment malfunction, all repairs should be performed by Digital or an authorized agent. It is the responsibility of the user requiring service to report the need for service to Digital or to one of our authorized agents.

To obtain service, contact:

Digital Equipment Corporation
146 Main Street
Maynard, MA 01754
(508) 493-5111

Glossary

Algorithm conversion

The conversion from one voice encoding algorithm to another. DECvoice supports three voice encoding algorithms: full bandwidth 64 Kbits/s μ -law, full bandwidth 64 Kbits/s A-law, and 16 Kbits/s subband compressed encoding.

Ancilliary Control Process (ACP)

A software component of the DECvoice system.

Backplane

A connector block that printed circuit boards plug into. A printed circuit board containing the bus.

Binary

A number system that uses only two digits: 0 and 1. These digits are represented in system circuitry by two voltage levels.

Bit

A binary digit, the smallest unit of information in a binary system of notation, designated as a 0 or a 1.

Boot

To use a bootstrap program for the purpose of bringing a system to a defined state where the system can operate on its own.

Bug

An error in the design or implementation of hardware or software system components.

Bus

A printed circuit board that is part of the backplane. The bus permits communication among the MicroVAX printed circuit boards.

Byte

A group of eight binary digits (bits).

Call progress detection

The monitoring of a call to determine if the call was answered, the line was busy, or no one was home (the call timed out).

Computer system

A combination of hardware, software, and external devices that performs specific operations or tasks.

Console terminal

The terminal that you use when installing software and running diagnostic programs.

Data

A representation of facts, concepts, or instructions suitable for communication, interpretation, or processing by humans or by machines.

Data transmission

The movement of data, in the form of electrical signals, along a communication line.

Debug

To detect, locate, and correct errors (bugs) in system hardware or software.

DECvoice message

Text and stored-voice data in the special internal format that DECvoice uses. Once voice and text data is in the form of a DECvoice message, DECvoice can perform many different types of operations on the message.

DECvoice microcode

All the soft-loadable voice functionality available on the DECvoice module. Included in the microcode is the system, audio, text-to-speech, stored voice, and word recognition subsystems. The microcode is down-loaded from the host.

DECvoice RTL

The DECvoice Run-Time Library is a group of routines that lets applications program the DECvoice features. The routines cover module initialization, data manipulation, voice storage, playback, recognition, and telephone line control.

DECvoice system

An integrated hardware and software product that provides a computer with a voice application platform.

Device

The general name for any entity connected to a system that can receive, store, or transmit data.

Diagnostic program

A program that detects and identifies abnormal system hardware operation. The MicroVAX Diagnostic Monitor software used to test a system contains several diagnostic programs.

DTC04 module

The DECvoice module board that provides computers with voice capability. The module is a Q-bus option that installs in the MicroVAX II Q-bus backplane.

DTMF key

The telephone keys that produce the tone signals that a Touch-Tone phone creates.

Encoding algorithm

The voice encoding algorithm that DECvoice uses to store voice data. DECvoice supports three voice encoding algorithms: full bandwidth 64 Kbits/s μ -law, full bandwidth 64 Kbits/s A-law, and 16 Kbits/s subband compressed encoding.

Event

A response to an RTL routine that DECvoice communicates to the application. Applications can use the VOX\$GET_EVENT routine to retrieve events from DECvoice.

Formatted data

Data laid out in a particular pattern to conform to a predetermined structure. The structure is dictated by the system software.

Hardware

The physical components—mechanical and electrical—that make up the DECvoice system. (*Compare* Software.)

Initialization

The process that the host performs on DECvoice at the beginning of a working session. On initialization, the host allocates and assigns a channel to the DECvoice module, sets up communication between the DECvoice module and device driver, runs the DECvoice on-board diagnostics, and optionally loads all the default DECvoice subsystems.

Interface

A device or piece of software that lets the DECvoice system communicate with the Q-bus or telephone network.

Interrupt

A break in the usual flow of a program to process an external request.

Load

To move software, usually from a peripheral device into memory. To place a disk in a disk drive, or tape in a tape drive.

Longword

A group of 32 bits, equal to 2 words or 4 bytes.

M7132 module

The heart of the DECvoice system. Provides text-to-speech conversion, voice recognition, digitized speech recording and playback, and control of the telephone line interface. (See also DTC04 module.)

Main processor

The main processor is part of the DTC04 module. It is an 8 MHz Intel 80186 microprocessor used to control communication with the host system.

Mbyte

Abbreviation for megabyte.

MDM

MicroVAX Diagnostic Monitor software used to isolate and identify system faults.

Megabyte

1,048,576 bytes.

Memory

The area where the DECvoice system finds the instructions and data it will process.

Message handle

The identifier of a particular DECvoice message. Applications use the message handle to access and reference a particular message. The message handle contains specific information about a message including the message size (in bytes), length (in milliseconds), encoding algorithm, reference count, language, RTL version number, creation date, and date of last modification.

North American Telephone Line Interface

A telephone network interface designed for use in North America.

Offhook

A telephonic condition that signals that the telephone is currently off the hook.

Onhook

A telephonic condition that signals that the telephone is currently on the hook.

Protocol

A basic procedure, or set of rules, that governs and controls the flow of messages between computers. Also, a set of conventions between communicating processes regarding the format and content of messages to be exchanged.

Pulse dialing

The kind of dialing that a rotary telephone creates. The telephone digits are pulsed at a rate of 10 pulses per second.

Q-bus interface

An interface used to control communication between the DECvoice DTC04 module and the host system.

Real time

Pertaining to computer actions controlled by external conditions and actual times.

Run

A single continuous execution of a program. To execute a program.

Run-Time Library (RTL)

A software component of the DECvoice system.

Signal processor

A digital signal processor providing 64 Kbytes of high speed static random access memory, and a shared-memory interface to perform speech processing. A Texas Instruments TMS320C25 or TMS320 family chip that is part of the DTC04 module.

SLD interconnect

A serial bus used to transmit voice, data and control information.

Software

Programs executed by the DECvoice system to perform a chosen or required function. (*Compare* Hardware.)

Store

To enter information into a storage device, such as a disk, or into memory.

Subscriber Line Datalink (SLD) Interface

The SLD interface controls communication with the telephone network. The Intel SLD is a three-wire interface used for synchronous data transfer.

Subsystem

A section of microcode that performs certain DECvoice functions. DECvoice has five default subsystems: system, audio, text-to-speech, stored voice, and word recognition.

Switch hook flash

Any interruption in telephone line current caused by pressing the switch hook on a phone.

System firmware

A combination of DECvoice hardware and software that performs specific voice processing operations.

Telephone Line Interface (TLI)

That part of the DECvoice hardware and microcode that controls communication between the DECvoice module and the telephone line.

Text to Speech

The act of converting written text into speech. The DECvoice text-to-speech subsystem performs all of the text-to-speech tasks.

TLI to DTC04 module connection

The telephone line interface connects to the module through a modification of the Intel Subscriber Line Datalink (SLD) protocol.

TLI to telephone line connection

The circuit that connects the telephone line interface to the telephone network and meets certain North American telephone regulations. The TLI connects to the telephone line through modular telephone jacks for RJ11 service.

Tone dialing

The kind of dialing that a DTMF Touch-Tone phone uses in which each phone digit is associated with a particular tone.

User dictionary

User-specified phonemic dictionary that DECvoice uses to pronounce certain words. The user dictionary (1) ensures that DECvoice's speech synthesizer correctly pronounces words critical to the application and (2) lets applications perform application-specific pronunciations of a word that are different from the usual pronunciation.

VX\$ACP

The DECvoice ancilliary control process. The ACP provides communication between the Run-Time Library routines and the device driver.

VXDRIVER

The DECvoice device driver. The device driver provides the low-level support between the operating system and the DECvoice module.

Wink

A momentary interruption in line current on the telephone line that indicates the calling party has hung up. Winks are not always present on the line.

Wink detection

The detection of a momentary loss in line current. DECvoice can detect winks in the line current and thereby inform the application that the calling party has hung up.

Word

A word is 16 bits long.

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