

May 1979

The *RT-11 FORTRAN IV Installation Guide* contains the procedures for installing the FORTRAN IV system. This document describes the minimal system requirements, the files distributed in the kits, the options available for planning and configuring the system to user needs and system build verification. The appendices present a further treatment of material covered in the guide. In particular, Appendix F provides the user with a method for obtaining quick responses from DIGITAL on specific software problems.

## RT-11 FORTRAN IV Installation Guide

Order No. AA-5240D-TC

<b>SUPERSESSION/UPDATE INFORMATION:</b>	This document supersedes the previous issue of this Installation Guide, AA-5240C-TC.
<b>OPERATING SYSTEM AND VERSION:</b>	RT-11 V03B
<b>SOFTWARE VERSION:</b>	FORTTRAN IV VO2.1

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First Printing, September 1977  
Revised July 1978  
Revised May 1979

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PREFACE

This guide provides the procedures for installing FORTRAN IV on the RT-11 operating system. It describes the build procedures for each distribution medium and system device, and covers system requirements, distribution files, installation options, and verification.

ASSOCIATED DOCUMENTS

Consult the RT-11/RSTS/E FORTRAN IV User's Guide for information on using the FORTRAN IV system. Consult the PDP-11 FORTRAN Language Reference Manual for details on the FORTRAN language as implemented in FORTRAN IV.

DOCUMENTATION CONVENTIONS

- |                      |   |
|----------------------|---|
| <u>RET</u>           | The symbol represents the non-printing RETURN key. You press this key to terminate all monitor and system program command lines.      |
| <u>^Z</u>            | The notation ^Z (where Z is an alphabetic character) results from pressing the CTRL key and the appropriate character simultaneously. |
| uppercase characters | Uppercase characters in format descriptions represent information you must enter exactly as shown.                                    |
| lowercase characters | Lowercase characters in format descriptions represent variable information that you must supply.                                      |
| <u>.R LIBR</u>       | Underlined text in examples indicates information that you must type.   |



# RT-11 FORTRAN IV INSTALLATION GUIDE

## 1.0 INTRODUCTION

This installation guide provides you with the step-by-step instructions you need to install the FORTRAN IV compiler and Object Time System (OTS) in the RT-11 operating system. These procedures require a booted and running RT-11 system. Table 1 lists the sources of additional information you may find useful in building your FORTRAN IV system.

Table 1  
Where to Find More Information

Subject	Source of Information
Formatting a blank disk	SUG
Bootstrapping	INTRO
Configuring (creating) a minimal system device	SGM
Performing a system generation on a diskette system	SGM
VIRTUAL arrays	LRM

### Key:

INTRO - Introduction to RT-11  
LRM - PDP-11 FORTRAN Language Reference Manual  
SGM - RT-11 System Generation Manual  
SUG - RT-11 System User's Guide

## 1.1 Installation Errors

If you make errors within an installation section, go back to the beginning of the section and repeat the steps. Correct any typing errors by using the standard RT-11 input techniques RUBOUT and CTRL/U.

## 1.2 Installation Requirements

Take the following steps to install FORTRAN IV:

- Select the installation options
- Copy files from the distribution medium to the system device (MT only)
- Select the compiler defaults
- Build the compiler
- Build the OTS
- Verify (system build and test)

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### 1.3 System Requirements

The software included in this distribution requires the following system components for normal use.

- RT-11, Version 3 or later, Single Job (SJ), Foreground/Background (FB), or Extended Memory (XM) monitor
- PDP-11 processor (any)
- Minimum 8K words of memory for installation and compilation. FORTRAN installation requires the baseline SJ monitor if the hardware configuration provides only 8K words of memory.
- Minimum 135-209 contiguous blocks for compiler .SAV image.
- Minimum 130-180 contiguous blocks for the OTS library.

### 1.4 Distribution Files

DIGITAL supplies the FORTRAN IV, Version 2.1, software on the media specified in the Software Product Description (SPD).

When you install FORTRAN, you must WRITE PROTECT or WRITE LOCK (whichever is applicable) the distribution medium. Use special caution with a diskette system, because you cannot WRITE LOCK a diskette. If your distribution medium is magtape, be sure that no write ring is inserted at the back of the tape reel. Make certain, if the tape is TM-11, that the magtape is positioned at the load point. If it is not, rewind it manually. For a TU58 DECTape II tape cartridge, ensure that the RECORD switch is not set.

1.4.1 File Contents - See Appendix A for a complete listing of the distribution files.

#### 1.4.2 Adapting Your System Device for FORTRAN IV

Before you can build the FORTRAN IV system, the system device must contain at least a minimal RT-11 system and enough free space for the FORTRAN files.

If the system device is RL01, RK05, RK06, RP02, RP03, multiple platter RF11, or multiple platter RJS03/04, sufficient space is already available and you need not follow any special procedures.

If the system device is DECTape, single platter RF11 disk, single platter RJS03/04 disk, flexible diskette, or TU58 DECTape II, you must delete some files to create a minimal system device and make room for FORTRAN. This procedure is described in the RT-11 System Generation Manual and in Section 3.1 of this installation guide. The RT-11 System Generation Manual describes the procedure for system generation on a diskette system.



## 2.0 INSTALLATION OPTIONS

At installation time, you must specify the default library and the kind of code the compiler generates. Section 2.1 lists other available options and parameters. Appendix B.1 shows examples of compiler installation.

Before you install, you must decide on the default library. You can use the Librarian to build a library file (SYSLIB). When you place SYSLIB in a default system library, it becomes SYSLIB.OBJ and the Linker uses it to resolve undefined globals. SYSLIB.OBJ then resides on the system device (SY:). The RT-11 System Generation Manual includes directions for customizing the RT-11 system so that SYSLIB can reside by default on a device other than SY:. SYSLIB.OBJ can also include FORLIB as well as user routines. This process is covered in detail later in this Guide.

### 2.1 FORTRAN IV Compiler Installation Options

When you install the FORTRAN IV compiler, you can change the maximum listing page size, record size, and number of logical channels. The installation program FORGEN.SAV incorporates the changes in the compiler .SAV image.

**2.1.1 Listing Page Size** - The maximum number of lines per page for a compilation listing is set at 56(10) in the compiler, as supplied. You can change this parameter to any value greater than 0 for non-standard line printers.

**2.1.2 Record Size** - The default maximum formatted record size for run-time I/O is 136(10) characters (bytes). You can change this default to any value from 4 through 4095. At compile time you can override the default by using the /RECORDSIZE:n compiler command option.

**2.1.3 Number of Logical Channels** - This parameter specifies the default maximum number of logical channels that can be open simultaneously under a FORTRAN IV program. The compiler, as supplied, pre-sets this value to 6 for the allocation of file descriptor blocks at runtime. At installation time, you can change the default to any number from 1 to 15. You can change it at compile time by using the /UNITS:n compiler command option.

### 2.2 Keywords and Options

The FORTRAN IV OPEN and CLOSE statements provide several keywords and options that are valid only for particular operating systems and apply uniquely to the file services of each system. The RT-11/RSTS/E FORTRAN IV User's Guide describes these in detail. You can use the RSTS/E switch /X:xxx (cross compile) to specify which of the three

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systems you are selecting for your FORTRAN IV program. The values are:

```

RT   (for RT-11)
RST  (for RSTS/E)
RSX  (for RSX-11)
    
```

The default value for this switch is RT. You can set this value at installation time to any of the three values. At compile time, you can override the default on a per program unit basis by invoking FORTRAN with the RUN command and using the RSTS/E /X switch.

### 2.3 Compiler Generated Code

The FORTRAN IV compiler produces both threaded code and inline code. You can select either or both at installation time. Threaded code consists of the addresses of routines that FORTRAN invokes to perform specified actions. Inline code consists of PDP-11 machine instructions which interface with the following hardware options:

```

Kell-A,B   Extended Arithmetic Element   (EAE)
Kell-E     Extended Instruction Set      (EIS)
Kell-F     Floating Instruction Set      (FIS) and (EIS)
KEV11      Extended Arithmetic Chip      (EIS, FIS or THR)
    
```

Table 2 shows valid code generation options for each hardware configuration.

Table 2  
OTS Module/Hardware Option

Hardware Configuration	Hardware Arithmetic Options					Valid Code Options /CD:
	KEV11	Kell-A	Kell-B	Kell-E	Kell-F	
11/04, 11/05 11/10	-	NO	NO	-	-	THR
11/15, 11/20	-	YES	YES	-	-	EAE or THR
11/03 or LSI-11	NO	-	-	-	-	THR
	YES	-	-	-	-	EIS, FIS or THR
11/35 or 11/40	-	NO	NO	NO	NO	THR
	-	YES	NO	NO	NO	EAE or THR
	-	NO	YES	NO	NO	EAE or THR
	-	NO	NO	YES	NO	EIS or THR
	-	NO	NO	YES	YES	EIS, FIS or THR
11/34, 11/45, 11/55, 11/50, 11/70, 11/60	EIS is standard on these processors					EIS or THR

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Inline code generally produces superior run-time results in terms of faster execution speed and minimal program size. You can take advantage of the arithmetic hardware by changing the default type code (threaded) supplied with the compiler. At compile time, you can override the default selected at installation by using the /CODE:xxx compiler command option.

**2.3.1 Speed or Size Optimization for Inline Code** - The inline compiler can optimize for either speed or size in generating certain code sequences. Your selection of one excludes the other. When you choose optimization for size, floating point code sequences can be as much as four times smaller, but can take longer to run because OTS routines are called to pass floating point values on the stack. Optimization for speed is beneficial if your program need not be minimized for size and does not require many floating point operations. You select the default optimization at installation time, but you can override at compile time as follows:

To optimize for size, use  
/NOOPTIMIZE:SPD compiler command option

To optimize for speed, use  
/OPTIMIZE:SPD compiler command option

**2.3.2 Compiler Build Selection** - When you select the default code, the system prompts you for your choice of a copy of a threaded-only compiler, or an inline-only, or both. Thus, you can build a full compiler (both codes) or a streamlined compiler (one code only). Your intended use of the system will determine your choice. If you plan to use the default code selected all the time, you might want to save space on the system device by accepting the streamlined compiler. The approximate size of each compiler is:

Threaded only	135 blocks
Inline only	180 blocks
Full compiler	209 blocks

**2.3.2.1 V2S and V2NS Modules** - If you choose only inline code, you can make the FORTRAN OTS smaller by omitting the two modules V2S and V2NS. Only the threaded compiler uses these. Conversely, if you select the threaded code compiler, you should direct that either V2S or V2NS -- but not both -- be built into the FORTRAN OTS. V2S modules check subscripts to determine whether an array subscript reference is within the bounds of the program. V2NS modules do not check array subscripts. You need use them only when you do not require bounds checking.

## 2.4 OTS Library Installation Options

Because some OTS modules run only on certain hardware, you should select your options in accordance with your hardware configuration. Refer to Table 3.

2.4.1 **SYSLIB or FORLIB Decision** - Although you ordinarily install the FORTRAN OTS into the default system library SYSLIB.OBJ, you can place the OTS in its own individual file FORLIB.OBJ. This separates FORLIB.OBJ from the other routines in the system library. When the OTS is in SYSLIB, the Linker automatically searches SYSLIB to resolve compiler-generated global references. However, if SYSLIB has user-written routines that link with non-FORTRAN programs more often than the FORTRAN OTS links with FORTRAN programs, you might choose the separate FORLIB.OBJ. In addition, using a separate FORLIB tends to decrease the SYSLIB search time the Linker requires for non-FORTRAN programs. You can also combine all the user-written routines into a third and separate library.

2.4.1.1 **RT-11 Constraints** - Unless your system is subject to file storage constraints, your operation will benefit when you add the OTS modules to SYSLIB, thus forming the file SY:SYSLIB.OBJ. When the linker attempts to locate SYSLIB.OBJ, it normally searches the system device (SY:). If you want to place SYSLIB.OBJ on a different device, use the procedure given in the RT-11 System Generation Manual for modifying LINK to change the default SYSLIB device.

2.4.2 **VIRTUAL Support** - FORTRAN IV supports the use of VIRTUAL arrays on PDP-11 processors equipped with the K11 Memory Management Unit. See the PDP-11 FORTRAN Language Reference Manual for a description of VIRTUAL; and the RT-11/RSTS/E FORTRAN User's Guide for some applications of VIRTUAL. RT-11 supports VIRTUAL under the SJ and FB monitors and under the XM monitor. Since the SJ/FB monitor routines differ from those for the XM monitor, you must decide which library will support VIRTUAL. Programs using VIRTUAL arrays linked with a library for the SJ/FB monitors cannot run under the XM monitor. The converse is also true.

However, if your FORTRAN IV programs use VIRTUAL arrays and are run under both the SJ/FB and the XM monitors, you must generate an alternate library. In this case you should cause two .SAV images of the program to be made -- one linked with an SJ/FB VIRTUAL library, the other linked with an XM VIRTUAL library.

2.4.2.1 **VIRTUAL Array Options** - The three VIRTUAL array options available in building the RT-11 OTS are:

1. NOVIR.OBJ. This module provides no VIRTUAL array support.
2. VIRP.OBJ. This module is for Program Logical Address Space (PLAS) support and requires the XM monitor. The EIS, FIS, or FPU hardware is also required for program execution.
3. VIRNP.OBJ. This module provides VIRTUAL array support for the Single Job (SJ) and the Foreground/Background (FB) monitors.

Refer to Section 2.2.2 of the RT-11/RSTS/E FORTRAN IV User's Guide for a detailed treatment of VIRTUAL and these three modules.

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2.4.3 **RUNTIME Bounds Checking for Threaded Code** - The FORTRAN OTS provides run-time array subscript checking for compiler-generated threaded code. Refer to Section 2.3.2.1 for information about the V2S and V2NS modules. If you select V2S, the OTS will check every destructive array reference to ensure that the element to be stored is within program bounds.

Consider the following effects when you decide whether to use these OTS modules:

1. The check ensures only that the referenced element is within program bounds -- not array bounds.

The user program, including OTS routines, could be corrupted if the reference subscript exceeds the bounds of the array.

2. Program execution time is slower because of the extra overhead involved in checking accesses to arrays.
3. Only non-VIRTUAL arrays are checked. See Section 2.3.2.

## 2.5 OTS Support for Optional Arithmetic Hardware

The optional arithmetic hardware present on your system configuration interfaces with certain OTS object modules. You can improve FORTRAN performance by choosing the appropriate OTS support for this interface. If you are building alternate FORTRAN OTS libraries, you must specify what type of hardware support they will include. The optional OTS object modules and their hardware interfaces are shown in Table 3. See also Table 2.

Table 3  
OTS Module Interface with Hardware Options

OTS Module	Hardware Option Interface
FPU.OBJ	FP11 Floating Point Processor
EIS.OBJ	KE11-E Extended Instruction Set
FIS.OBJ	KE11-F Floating Instruction Set
	KEV11 Extended Arithmetic Chip
EAE.OBJ	KE11-A,B Extended Arithmetic Element
NHD.OBJ	No specific arithmetic hardware (bare machine). Software performs the arithmetic operations.

The FORTRAN IV compiler does not generate inline code for the FP11 Floating Point Processor. However, you can use the FPU library with either inline or threaded code. To assure the maximum use of your FP11 hardware, use threaded code with the FPU library.

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2.5.1 Stand Alone (\$SIMRT) Support - If you do not expect to use stand-alone FORTRAN support, you can reduce the space required for the FORTRAN OTS by omitting UNI.OBJ from the OTS library.

### 3.0 INSTALLATION PROCEDURES

Once you have read and understood Sections 1 and 2, you are ready to install the FORTRAN IV compiler and the FORTRAN OTS into your RT-11 system. Section 3.2 describes compiler installation, and Section 3.3 describes OTS installation.

The devices you work with and their specifications are shown in Table 4.

Table 4  
Device Identification

(n is the numerical designation of the drive unit)

Device	Device Specification
RL01 disk cartridge	DLn:
RK06 disk cartridge	DMn:
RP02 or RP03 disk	DPn:
RJS03/4 disk	DSn:
TC11 DECTape	DTn:
RX01 diskette	DXn:
TU16 magtape	MMn:
TU10 or TS03 magtape	MTn:
RF11 fixed head disk drive	RFn:
RK05 disk cartridge	RKn:
TU58 DECTape II	DDn:

If you install FORTRAN on diskette, be sure that the compiler is installed on target diskette 1 of 2, and that the OTS is installed on target diskette 2 of 2. You install the OTS manually and not through indirect command files as you do for the compiler installation.

### 3.1 General Guidelines

The installation process copies from the distribution medium to the target (system) device. In some cases, you install the compiler and the OTS on the same system device (SY:). In other cases, you install the compiler on the first and the OTS on the second of two identical devices, such as diskettes.

The system device must contain at least 308 free blocks to build a FORTRAN system. If your system device is RL01 or RK05 disk, TC11 DECTape, RX01 flexible diskette, or TU58 DECTape II, you must delete

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files to make room for FORTRAN. You must retain the following files as a minimum:

- xxMNyy.SYS<sup>1</sup>
- TT.SYS
- LP.SYS (if your system has a line printer)
- DT.SYS (if your system is not DECTape)
- EDIT.SAV
- LIBR.SAV
- LINK.SAV
- PIP.SAV

Note that you will need the DECTape handler, DT.SYS, if your distribution medium is DECTape, but your system device is not.

The RT-11 System Generation Manual describes how to build a system back-up for your FORTRAN installation. You delete unnecessary files from the back-up when you make room for FORTRAN. The back-up device then becomes your system master and you treat it with the same care as the distribution medium.

After building the system back-up, remove both the distribution medium and the back-up and store them in a safe place. Whenever you mount either device, be sure to WRITE LOCK or WRITE PROTECT it; if magtape, ensure that no write ring is inserted. At installation, you logically assign the distribution medium to input (INP) and the system medium to output (OUP).

**3.1.1 Exceptions to Installation Procedures** - Space constraints require exceptions in three cases from the general installation procedures. These exceptions apply to magtape distribution, 8K systems, and TU58 DECTape II distribution.

If your distribution medium is magtape, your system device must have at least 800 to 1000 free blocks to accommodate the magtape files. After you have built the compiler and the OTS, you can delete the temporary files you have copied from the magtape.

The 8K and the diskette systems require that you retain only a minimum of system files. These procedures are covered in detail in Sections 3.2 and 3.2.1.

**3.1.2 TU58 DECTape II Distribution Kit** - The DECTape II distribution kit consists of three tape cartridges, which contain the compiler and OTS modules as well as three prebuilt compilers and an OTS library. The contents of each tape are as follows:

Tape 1 -- All compiler object modules

Tape 2 -- All OTS object modules and a prebuilt compiler named FORTRA.SAV, which is set to generate EIS code

Tape 3 -- An inline code-only compiler named FORTRA.INL, which is set to generate EIS code; a threaded-only compiler named FORTRA.THR; and a prebuilt library named FORLIB.OBJ that includes the modules NHD, OTSCOM, NOVIR, and V2NS

---

<sup>1</sup>Substitute the monitor appropriate to your system device; for example, DXMNSJ.SYS for RX01 systems.





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### 4. DECTape distribution

You are working with two DECTapes -- DECTape 1 is for the compiler installation; DECTape 2 for the OTS. Mount DECTape 1 in a free TC11 drive and assign the drive to input:

```
.ASSIGN DTn: INP
```

### 5. Magtape distribution

Mount the distribution tape on a free drive and assign the drive to input:

```
.ASSIGN MTn: INP      (for TU10 drive)  
.ASSIGN MMn: INP      (for TU16 drive)
```

### 6. TU58 DECTape II distribution

If you do not plan to copy a prebuilt compiler, use tape 1. To copy the prebuilt inline and threaded code compiler, use tape 2. For a prebuilt inline-only or threaded-only compiler, use tape 3.

Mount the distribution tape on a free drive and assign the drive to input:

```
.ASSIGN DDn: INP
```

## C. Now begin the compiler installation process.

### 1. TU58 DECTape II distribution

To use a prebuilt compiler, copy it from the distribution tape cartridge to the system device.

For both threaded and inline code with EIS, type:

```
.COPY INP:FORTRA.SAV SY:
```

For inline code only with EIS, type:

```
.COPY INP:FORTRA.INL SY:FORTRA.SAV
```

For threaded code only, type:

```
.COPY INP:FORTRA.THR SY:FORTRA.SAV
```

Proceed to Section 3.3 to install the OTS.

If you do not plan to use a prebuilt compiler, follow the procedures in Step 2 below for installation.

### 2. RL01/RK05/RK06/RX01/DECTape/TU58 DECTape II distribution

If your distribution medium is TU58 DECTape II, follow the procedures in this step only if you do not plan to use one of the prebuilt compilers. Note that the installation process takes several hours.

Type in the following:

```
.R PIP  
*SY:*.*=INP:FORTRA.HLP,DEMO.FOR  
*^C
```

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After you enter the command shown below, the installation program will pose questions that you must answer. See Appendix B.1 for a sample compiler installation dialog.

To invoke the dialog, type:

```
.RUN INP:FORGEN
```

If you have an 8K system, go directly to Section 3.2.1. Otherwise, continue as follows.

Type in one of the following files appropriate to the type of compiler you are building (see Section 2.3):

```
@INP:F4LINK   for both threaded and inline code  
@INP:F4LINL  inline code only  
@INP:F4LTHR  threaded code only
```

The compiler now resides on the output device and is called FORTRA.SAV. Preserve the compiler files as described in Section 4.4.

### 3. Magtape distribution

Copy the installation indirect command file from the distribution tape to the system device, and then invoke the file from the system device:

```
.COPY INP:COPCOM.COM SY:  
.COPY INP:DELCOM.COM SY:  
.@COPCOM
```

The final command copies the files from the distribution magtape to the system device.

Now reassign INP as follows, where XX is the physical device originally assigned to OUP:

```
.DEASSIGN INP:  
.ASSIGN XX INP:
```

Then type:

```
.RUN INP:FORGEN
```

Type in one of the following files appropriate to the type of compiler you are building (see Section 2.3):

```
@INP:F4LINK   for both threaded and inline code  
@INP:F4LINL  inline code only  
@INP:F4LTHR  threaded code only
```

The compiler now resides on the output device and is called FORTRA.SAV. Preserve the compiler files as described in Section 4.4.

Finally, delete the files with:

```
@DELCOM
```

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3.2.1 Installing 8K Systems - You must enter manually the entire file, as shown below, for the type of compiler you have chosen. After you make each entry, the system responds with the asterisk symbol (\*). The contents of each file are as follows:

Both threaded and inline code (F4LINK.COM)

```
.R LINK
*OUP:FORTRA=INP:FROOT///S
*INP:F0,OUP:DEFLTS/O:1
*INP:F1/O:1
*INP:F2/O:1
*INP:F3/O:1
*INP:F4/O:1
*INP:F5/O:1
*INP:F6/O:1
*INP:F7/O:1
*INP:F8/O:1
*INP:F9/O:1
*INP:F10/O:1
*INP:LOOP/O:1
*INP:F11/O:1
*INP:F12/O:1
*INP:CONVRT/O:1
*INP:REGALO/O:1
*INP:F14/O:1
*INP:F20/O:1
*INP:F19/O:1
*INP:F21/O:1
*INP:PEEP/O:1
*INP:OBJGSD/O:1
*INP:F18/O:1
*INP:F13/O:1
*INP:F15/O:1
*INP:F16/O:1
*INP:F17/O:1
*INP:CDUMP/O:1//
^C
```

Threaded code only (F4LTHR.COM)

```
.R LINK
*OUP:FORTRA=INP:FROOT///S
*INP:F0,INLINE,OUP:DEFLTS/O:1
*INP:F1/O:1
*INP:F2/O:1
*INP:F3/O:1
*INP:F4/O:1
*INP:F5/O:1
*INP:F6/O:1
*INP:F7/O:1
*INP:F8/O:1
*INP:F9/O:1
*INP:F10/O:1
*INP:LOOP/O:1
*INP:F11/O:1
*INP:F12/O:1
*INP:F13/O:1
*INP:F14/O:1
*INP:F15/O:1
*INP:F16/O:1
*INP:F17/O:1
*INP:CDUMP/O:1//
^C
```

Inline code only (F4LINL.COM)

```
.R LINK
*OUP:FORTRA=INP:FROOT///S
*INP:F0,THREAD,OUP:DEFLTS/O:1
*INP:F1/O:1
*INP:F2/O:1
*INP:F3/O:1
*INP:F4/O:1
*INP:F5/O:1
*INP:F6/O:1
*INP:F7/O:1
*INP:F8/O:1
*INP:F9/O:1
*INP:F10/O:1
*INP:LOOP/O:1
*INP:F11/O:1
*INP:F12/O:1
*INP:CONVRT/O:1
*INP:REGALO/O:1
*INP:F14/O:1
*INP:F20/O:1
*INP:F19/O:1
*INP:F21/O:1
*INP:PEEP/O:1
*INP:OBJGSD/O:1
*INP:F18/O:1
*INP:CDUMP/O:1//
^C
```

The compiler now resides on the output device and is called FORTRA.SAV. Preserve the compiler files as described in Section 4.4.

### 3.3 Installing the FORTRAN OTS

You build the OTS manually after you have decided which libraries you want and the modules (see Section 2.4) they will contain.

The device assignment procedures for installing the OTS are essentially the same as those for installing the FORTRAN compiler. In some cases, you build the OTS onto the same system device as the compiler (SY:). If your system device is TC11 DECTape (DTn:), RX01 diskette (DXn:), or TU58 cartridge (DDn:), install the OTS on a second, separate device from the compiler. You build the system back-up from the distribution medium and carefully preserve both when you have completed copying. Use the system back-up when you delete files, as described in the RT-11 System Generation Manual, to make room for FORTRAN. You must retain at least the same files as prescribed for the FORTRAN compiler in Section 3.1 of this guide.

When you copy, WRITE LOCK or WRITE PROTECT both the distribution medium and the system back-up. Remove the write ring from a magtape reel. Proceed carefully if your system is diskette, because you cannot WRITE LOCK this device. For copying, you must WRITE ENABLE the target device. As with the compiler installation, you logically assign the distribution medium to input (INP) and the target medium to output (OUP). Follow these procedures for a correct OTS installation:

- A. Assign the target physical device to OUP, for example:

```
.ASSIGN RK0: OUP
```

## RT-11 FORTRAN IV INSTALLATION GUIDE

B. Mount the distribution medium and make the physical to logical assignment for each different medium as follows:

1. RL01/RK05 distribution

Mount the distribution device in a free RL01 or RK05 drive and assign the drive to input:

```
RL01                    RK05
.ASSIGN DLn: INP       .ASSIGN RKn: INP
```

2. RK06 distribution

Mount the distribution device in a free RK06 drive and assign the drive to input:

```
.ASSIGN DMn: INP
```

3. Diskette distribution

You are working with the second of two diskettes (you used the first for the compiler). Mount distribution diskette 2 in DX drive 1 and mount system diskette 2 in DX drive 0. Assign drive 1 to input:

```
.ASSIGN DX1: INP
.ASSIGN DX0: OUP
```

4. DECTape distribution

You are working with the second of two DECTapes (you used the first for the compiler). Mount DECTape 2 in a free TC11 drive and assign the drive to input:

```
.ASSIGN DTn: INP
```

5. Magtape distribution

Mount the distribution tape on a free drive and assign the drive to input:

```
.ASSIGN MTn: INP      (for TU10 drive)
.ASSIGN MMn: INP      (for TU16 drive)
```

6. TU58 DECTape II distribution

If you plan to use the prebuilt OTS, use tape 3. If you plan to build your own OTS, use tape 2. Mount the distribution tape on a free drive and assign the drive to input:

```
.ASSIGN DDn: INP
```

The prebuilt library contains the modules NHD, OTSCOM, NOVIR, and V2NS. To use this library, proceed as follows:

```
.COPY INP:FORLIB.OBJ SY:
```

Now proceed to Section 4.0 for installation verification.

To build your own OTS library, continue with Steps C through G and Section 3.4.

## RT-11 FORTRAN IV INSTALLATION GUIDE

- C. Select from the following arithmetic modules to satisfy your system configuration (see Table 3):

NHD  
EAE<sup>1</sup>  
EIS  
FIS  
FPUL

This module is designated xxx in the subsequent Librarian command string.

- D. Select from the following VIRTUAL array modules (see 2.4.2.1):

NOVIR  
VIRP  
VIRNP

This module is designated vvv.

- E. Select either of the following subscripting modules (see 2.4.3):

V2S  
V2NS

Remember that neither module is required for an inline-only library. This module is designated sss.

- F. Decide whether you require stand-alone (\$SIMRT) support (UNI.OBJ).  
G. Decide whether to incorporate FORLIB into SYSLIB.

### 3.4 Creating the OTS Library

Enter the items underlined exactly as they are shown except for designations xxx, sss, and vvv. Substitute the actual module names for the designations. Items enclosed in braces are optional; you need not include them in the command string. See Appendix B.2 for an example of OTS installation.

- A. If you want FORLIB included in SYSLIB, enter:

```
.R LIBR  
*OUP:SYSLIB[-1]=INP:xxx,OTSCOM,vvv {,sss} {,UNI}/G  
Global? $ERRS  
Global? $ERRTB  
Global? $VRINT  
Global? RET
```

---

<sup>1</sup>These modules are not included in the DEctape II distribution kit.

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### NOTE

This procedure assumes that SYSLIB contains no modules. If you have system subroutines or other routines to be included in SYSLIB, place them in a separate module and then include them in the command line. For example, to include the system subroutine SYSF4, type the following:

```
.R LIBR  
*OUP:SYSLIB[-1]=SYSF4, INP:xxx,OTSCOM,vvv {,sss}{,UNI}/G  
Global? $ERRS  
Global? $ERRTB  
Global? $VRINT  
Global? (RET)
```

- B. If you do not want FORLIB incorporated into SYSLIB, enter:

```
.R LIBR  
*OUP:FORLIB[-1]=INP:xxx,OTSCOM,vvv {,sss} {,UNI}/G  
Global? $ERRS  
Global? $ERRTB  
Global? $VRINT  
Global? (RET)
```

- C. You follow the same procedure to generate other libraries. Give each library its own name to distinguish it from FORLIB and SYSLIB. For example:

```
.R LIBR  
*OUP:MYLIB[-1]=INP:EIS,OTSCOM,NOVIR,V2NS/G  
Global? $ERRS  
Global? $ERRTB  
Global? $VRINT  
Global? (RET)
```

### 3.4.1 Magtape Distribution - Enter the following:

```
.COPY INP:COPOTS.COM SY:  
.COPY INP:DELOTS.COM SY:  
.@COPOTS
```

The final command copies the files from the distribution magtape to the system device.

Now reassign INP as follows, where XX is the physical device originally assigned to OUP:

```
.DEASSIGN INP:  
.ASSIGN XX INP:
```

Now repeat the procedures of Section 3.4 in accordance with the type of library you are building.

Finally, delete the files with:

```
.@DELOTS
```

Next, preserve the OTS files as described in Section 4.4.

#### 4.0 INSTALLATION VERIFICATION

The final stage in the installation of FORTRAN IV into the RT-11 operating system is verification -- a test to ascertain whether you installed FORTRAN correctly. You verify by compiling, linking, and executing the sample program (DEMO.FOR). See Appendix B.3 for a sample listing of DEMO.FOR.

##### 4.1 Compiling

If you built FORTRAN on the system device (SY:), compile by using the keyboard monitor COMPILE or FORTRAN command:

```
.COMPILE INP:DEMO
```

If you built FORTRAN on other than the system device, load the device handler for OUP. For example, issue the following command if the system device is RK05 and you built FORTRAN on an RK06:

```
.LOAD DM
```

Then issue the command:

```
.RU OUP:FORTRA  
*DEMO=DEMO  
.MAIN.  
*^C
```

##### 4.2 Linking

If you built FORLIB into SYSLIB, issue the command:

```
.LINK DEMO
```

If you built a separate FORLIB, issue either command:

```
.LINK DEMO,FORLIB
```

or

```
.LINK DEMO/LINKLIBRARY:FORLIB
```

##### 4.3 Executing

To execute the demonstration program, issue the command:

```
.RUN DEMO *
```

##### 4.4 Preserving the FORTRAN IV System

After completing each stage of the installation, you must preserve the FORTRAN IV system. Do this by copying the necessary files of the FORTRAN system to a file-structured (specifically, not magtape) device. This makes it easier to change compiler defaults and apply patches to the FORTRAN system. Remember that if the back-up device is DT or DX, you have two such devices: the first for the compiler, the



## RT-11 FORTRAN IV INSTALLATION GUIDE

second for the OTS. If the back-up device is DD, you have three tape cartridges. The files shown in Table 5 constitute the FORTRAN system. INP: is the distribution medium; OUP: is the output (system) device.

Table 5  
FORTRAN System Files

<u>COMPILER FILES</u>		<u>OTS FILES</u>
(DT1, DX1, DD1)		(DT2, DX2, DD2)
OUP: DEFLTS.OBJ	INP: CONVRT.OBJ	INP: NHD.OBJ
INP: FROOT.OBJ	INP: REGALO.OBJ	INP: EAE.OBJ <sup>1</sup>
INP: F0.OBJ	INP: F21.OBJ	INP: EIS.OBJ
INP: F1.OBJ	INP: F19.OBJ	INP: FIS.OBJ
INP: F2.OBJ	INP: PEEP.OBJ	INP: FPU.OBJ <sup>1</sup>
INP: F3.OBJ	INP: OBJGSD.OBJ	INP: OTSCOM.OBJ
INP: F4.OBJ	INP: F18.OBJ	INP: V2S.OBJ
INP: F5.OBJ	INP: F13.OBJ	INP: V2NS.OBJ
INP: F6.OBJ	INP: F15.OBJ	INP: NOVIR.OBJ
INP: F7.OBJ	INP: F16.OBJ	INP: VIRP.OBJ
INP: F8.OBJ	INP: F17.OBJ	INP: VIRNP.OBJ
INP: F9.OBJ	INP: F4LINK.COM	INP: UNI.OBJ
INP: F10.OBJ	INP: F4LTHR.COM	INP: FORTRA.SAV -- DD2 only
INP: LOOP.OBJ	INP: F4LINL.COM	
INP: F11.OBJ	INP: FORGEN.SAV	
INP: F12.OBJ	OUP: FORBLD.COM	
INP: CDUMP.OBJ		

### PREBUILT FILES

(DD3 only)

INP: FORTRA.THR  
INP: FORTRA.INL  
INP: FORLIB.OBJ

---

<sup>1</sup>Not present on DD2



APPENDIX A  
DISTRIBUTION FILES

The distribution media contain the following FORTRAN files.

A.1 COMPILER FILES

✓FROOT.OBJ  
✓F0.OBJ  
✓F1.OBJ  
✓F2.OBJ  
✓F3.OBJ  
✓F4.OBJ  
✓F5.OBJ  
✓F6.OBJ  
✓F7.OBJ  
✓F8.OBJ  
✓F9.OBJ  
✓F10.OBJ  
✓LOOP.OBJ  
✓F11.OBJ  
✓F12.OBJ  
✓F13.OBJ  
✓F14.OBJ  
✓F15.OBJ  
✓F16.OBJ  
✓F17.OBJ  
✓CONVRT.OBJ  
✓REGALO.OBJ  
✓F21.OBJ  
✓F19.OBJ  
✓F20.OBJ  
✓PEEP.OBJ  
✓CDUMP.OBJ  
✓OBJGSD.OBJ  
✓F18.OBJ  
✓INLINE.OBJ  
✓THREAD.OBJ  
{COPCOM.COM}  
{DELCOM.COM}  
✓F4LINK.COM  
✓F4LTHR.COM  
✓F4LINL.COM  
✓FORTRA.HLP  
✓DEMO.FOR  
✓FORGEN.SAV  
{FORTRA.SAV}  
{FORTRA.INL}  
{FORTRA.THR}

The files COPCOM.COM and DELCOM.COM appear only on the magtape distribution.

Compiler help file  
Installation verification program  
Compiler installation program  
The files FORTRA.SAV,  
FORTRA.INL, and  
FORTRA.THR appear only on the  
TU58 DECTape II distribuiton.

## DISTRIBUTION FILES

### A.2 OTS LIBRARY FILES

These files are distributed on a second tape or diskette in the TU56 DECTape and RX01 diskette kits.

{COPOTS.COM}                   The braces mark the files that  
{DELOTS.COM}                   appear on magtape only

The following OTS object modules:

✓EIS.OBJ  
✓EAE.OBJ<sup>1</sup>  
✓FIS.OBJ  
✓FPU.OBJ<sup>1</sup>  
✓NHD.OBJ  
✓UNI.OBJ  
✓VIRNP.OBJ  
✓VIRP.OBJ  
✓NOVIR.OBJ  
✓V2NS.OBJ  
✓V2S.OBJ  
✓OTSCOM.OBJ  
FORLIB.OBJ                   TU58 DECTape II cartridge only

<sup>1</sup> Not present on TU58 DECTape II

## APPENDIX B

### FORTRAN IV INSTALLATION PROGRAM

#### B.1 COMPILER INSTALLATION PROGRAM

The following listing is a sample of the installation program dialog for compiler installation.

```
.ASSIGN RK0: OUP
.ASSIGN RK1: INP

.R PIP
*SY:*,*=INP;FORTRA,HLP,DEMO,FOR
*~C

.RUN INP;FORGEN
Answer questions with:
"?" or carriage return (<CR>) for information,
YES(Y) for affirmation, anything else for NO.

A maximum of 56 lines are allowed per listing page.
Is this acceptable? Y
A maximum of 136 characters are allowed in a formatted
(ASCII) record. Is this acceptable? Y
A maximum of 6 channels may be open at a given time.
Is this acceptable? Y
The FORTRAN compiler can compile system-specific OPEN and CLOSE
statement keywords for RT-11, RSX-11, and RSTS/E systems. These
statements are currently compiled for the following system: RT-11
Is this acceptable? Y
FORTRAN can produce inline code for EAE, EIS or FIS hardware,
or it can produce threaded (THR) code which is hardware independent.
Should the compiler produce EAE code? N
Should the compiler produce EIS code? Y
The inline compiler can optimize for SPEED or for SIZE. These
optimizations are mutually exclusive. Do you want
the optimization to be for SPEED? Y
Do you wish an inline only compiler? N
Compiler options selection complete.
```

## FORTRAN IV INSTALLATION PROGRAM

```
.@INP:F4LINK

.R LINK
*OUP:FORTRA=INP:FROOT///S
*INP:F0,OUP:DEFLTS/O:1
*INP:F1/O:1
*INP:F2/O:1
*INP:F3/O:1
*INP:F4/O:1
*INP:F5/O:1
*INP:F6/O:1
*INP:F7/O:1
*INP:F8/O:1
*INP:F9/O:1
*INP:F10/O:1
*INP:LOOP/O:1
*INP:F11/O:1
*INP:F12/O:1
*INP:CONVRT/O:1
*INP:REGALO/O:1
*INP:F14/O:1
*INP:F20/O:1
*INP:F19/O:1
*INP:F21/O:1
*INP:PEEP/O:1
*INP:OBJGSD/O:1
*INP:F18/O:1
*INP:F13/O:1
*INP:F15/O:1
*INP:F16/O:1
*INP:F17/O:1
*INP:CDUMP/O:1//
*^C
```

### B.2 MANUAL INSTALLATION OF THE OTS

```
.ASSIGN RK0: OUP

.ASSIGN RK1: INP

.R LIBR
*OUP:SYSLIB[-1]=INP:EIS,OTSCOM,V2NS,NOVIR/G
Global? $ERRS
Global? $ERRTB
Global? $VRINT
Global? RET
*^C
```

### B.3 INSTALLATION VERIFICATION PROGRAM

The following listing is an example of the FORTRAN verification program DEMO.FOR.

```
.COMPILE INP:DEMO
.MAIN.

.LINK DEMO

.RUN DEMO
***** RT11 FORTRAN IV V2 DEMONSTRATION TEST *****

INSTALLATION SUCCESSFUL IF NO ERROR MESSAGES
WERE PRINTED ABOVE.

**** FORTRAN DEMONSTRATION TEST COMPLETE ****
```

APPENDIX C  
FORTRAN OTS

C.1 ASSEMBLING THE OTS FROM SOURCES

This appendix applies to the source version of the FORTRAN OTS as supplied in the RT-11 source kits. The sources are kept on logical device SRC:, and listing and map files are output to LST:.

You must modify BUILD.F.COM to make the proper assignments for SRC:, LST:, and OBJ:. Remember that the sources must be on SRC:, which must be file structured; that is, you cannot use magtape. The object files will be directed to OBJ:, which also must be file structured, again ruling out magtape. Listing files will be directed to LST: but if you do not want listings, assign the null device to LST:.

.ASSIGN NL LST

If you need to install the NL handler before you issue the ASSIGN command, use the monitor INSTALL command:

.INSTALL NL:

You can use magtape for the listings.





## APPENDIX D

### CHANGING COMPILER DEFAULTS

You can change the compiler defaults by following these steps:

1. Mount the back-up device you created for compiler installation on a free drive and assign it to input (INP). If the device is DECTape or floppy disk, it is 1 of 2 (the OTS is 2 of 2). If the device is DECTape II, it is 1 of 3. If the device is DECTape, the monitor ASSIGN command is:

```
.ASSIGN DTn: INP
```

2. Assign the target device to output (OUP). Assuming the system device to be RKn:, enter the monitor ASSIGN command:

```
.ASSIGN RKn: OUP
```

3. Next:

```
.RUN INP:FORGEN
```

4. Then:

```
.@FORBLD
```

5. Finally, copy OUP:DEFLTS:OBJ and FORBLD.COM to INP by entering the command:

```
.COP OUP:DEFLTS.OBJ INP:  
.COP OUP:FORBLD.COM INP:
```



## APPENDIX E

### APPLYING COMPILER AND OTS PATCHES

Follow these procedures for applying compiler patches:

- a. Mount the back-up device you created for the compiler installation on a free drive. This will be device 1 of 2 for DECTape or diskette, and 1 of 3 for DECTape II.
- b. Assign the device to INP:. Assuming DECTape, use the monitor ASSIGN command:  
  
.ASSIGN DTn: INP
- c. Assign the target device to OUP. Assuming RK05, use the monitor ASSIGN command:  
  
.ASSIGN RKn: OUP
- d. Copy the file DEFLTS.OBJ from INP to OUP.  
  
.COP INP: DEFLTS.OBJ OUP:
- e. Follow the directions in the patch and apply the patch.
- f. Build the compiler:  
  
@INP:FORBLD
- g. Copy any modified .OBJ or .COM files created by the patch to INP.

Follow these procedures for applying OTS patches:

- a. Mount the back-up device you created for the OTS installation on a free drive. This will be device 2 of 2 for DECTape or diskette, and 2 of 3 for DECTape II.
- b. Assign the device to INP. Assuming DECTape, use the monitor ASSIGN command:  
  
.ASSIGN DTn: INP
- c. Assign the target device to OUP. Assuming RK05, use the monitor ASSIGN command:  
  
.ASSIGN RKn: OUP
- d. Follow the directions in the patch and apply the patch.
- e. Build the OTS by following the procedures in Section 3.4.



## APPENDIX F

### REPORTING SOFTWARE PROBLEMS

To obtain quick and accurate answers to the problems and bugs you might encounter, include the following with your Software Performance Report (SPR).

1. Problem: Compiler generates a crash dump.

Your action: Send a copy of your program on a machine-readable medium if the program is larger than 30 lines. Also, send the console output and indicate what compiler installation options are available for your configuration and indicate what options you selected for the compilation that aborted.

2. Problem: Compiler generates incorrect code (program does not work or traps at run time).

Your action: Send a copy of your program on a machine-readable medium if the program is larger than 30 lines. Include any required data files on a machine readable medium. Also, send the console output and indicate:

- a. What compiler options were selected.
- b. What OTS installation options were selected.
- c. Which patches, if any, you have installed.



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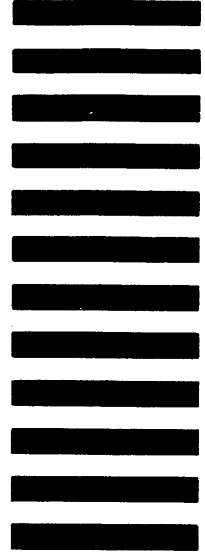
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