

SSI Data Procedures

Chapter G: EPROM and Memory Module Programming

Chapter G

1. Introduction

This chapter defines the processes to be followed in programming, checking, and labelling EPROMs for use with SSI, and for the populating of Memory Modules with new or updated program and/or data EPROMs.

The EPROM programming instructions replace those formerly given in specification BR1990, and shall be used for programming the following:

- EPROMs for use within SSI Memory Modules.
- Communications Processors, Signal and Points Module, and Long Distance Terminal program EPROMs. These are housed within the sealed carcass of the module concerned, and will only be accessible to the module manufacturer or authorised repairer.
- Program EPROMs for the Technician's Terminal. Instructions relating to the installation are contained in SSI8506 MkII Paged Technician's Terminal Installation Manual.
- Other signalling applications to which specification BR1990 formerly applied, and any other signalling applications as required by Railtrack.

The EPROMs for use within Memory Modules may contain either fixed programs or geographic data. Programs shall be of the type required for the particular version of CI in use, as defined in SSI8150 SSI Software Record. Data shall be prepared in accordance with SSI8003 SSI Data Preparation, and will be unique to each CI.

It is a fundamental requirement that all Vital Programs and Data be stored and handled in a manner such that the integrity of the information is protected against all credible failures of the storage and handling process.

This is achieved by:

- Keeping at least two copies of all programs and data
- Only handling one of these copies at any one time
- Comparisons of the output of every process involving the replication of programs or data against independently maintained verification masters
- Use of checksums to provide further confidence in the validity of stored programs and data.

Similar measures are applied to Non-Vital Programs and Data, although some of the controls required are relaxed. A definition of those Programs and Data classified as Vital or Non-Vital is given in SSI8150 SSI Software Record.

2. Program Source and Verification Masters

Program Source and Verification Masters will be supplied by the relevant program's Design Authority.

As part of the program development process, the program design authority will subject the program to rigorous checking and testing. As

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part of this process, a program EPROM will be produced, which will itself be subjected to rigorous validation. The outcome of the development will be a Master Program and a Validated Master EPROM.

The Program Design Authority will then produce a Source Master program, in the form of an object file on disk derived from the Master program, and a Verification Master EPROM, derived from the Validated Master EPROM, and will distribute these to those bodies authorised to undertake EPROM Programming.

3. Data Source and Verification Masters

Geographic Data will normally be produced, checked and tested by the Data Producer on a SSI Design Workstation or an approved equivalent system. Two identical sets of files shall be produced on back-up disks when the CISR is first locked. These become the Source Masters.

Verification Master EPROMs shall then be produced from the Source Masters using the process described in Section 5.6 below. These then become the standard against which Production EPROMs are verified.

4. Storage

A copy of every Source Master and Verification Master shall be stored at two separate locations to ensure that at least one of each survives intact in the event of corruption, fire or other catastrophe.

If a Source Master or Verification Master has not been used for more than twelve months, it shall be verified against another Master before use.

The use of Source Masters implies the availability of a Design Workstation or some other Host computer system capable of reading the storage media and downloading the program or data to the EPROM programmer. Where direct access to the Source Master is not available, a Source Master Copy in EPROM form maybe substituted for the Source Master. This copy shall be programmed and checked as for a Verification Master as defined in Sections 5.5 or 5.6 but labelled as a Source Master Copy.

5. EPROM Programming

5.1 General

The following equipment is required:

- Two EPROM programmers (referred to below as Programmers A and B) capable of displaying download and device checksums, and set to EPROM type and manufacturer to be programmed. For non-vital EPROMs (see Section 5.2 below), a single programmer only is required.
- A Host computer system (usually a SSI Design Workstation) to read Source Masters from disk or tape and provide download/upload facilities to Programmers A & B. It must also be capable of displaying download checksums. Not required if a Source Master Copy is used as described above.

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- An EPROM Eraser of a type suitable for the EPROMs being handled.

EPROM programmers and erasers must be calibrated and used in accordance with the manufacturer's instructions. All precautions recommended by the manufacturers of the EPROMs and the EPROM programmer must be scrupulously observed.

All activities involving the handling of EPROMs shall observe electrostatic precautions in accordance with BS IEC 61340-5-1.

New EPROMs must always be used for Master EPROMs.

Production EPROMs may re-use existing EPROMs subject to the following rules.

- All previously used EPROMs must be fully erased before programming in accordance with the instructions of the manufacturers of the EPROMs and the eraser in use.
- All EPROMs must pass a blank check, i.e. all addresses to be in the correct unprogrammed state (usually FFH), before programming.
- Any EPROMs failing the blank check or failing to program correctly must be destroyed.
- A method shall be employed to record the number of times that an EPROM has been erased. A recommended method is an underside label on the EPROM to record erasures, this being endorsed immediately before erasure.

5.2 Vital and Non-Vital Programs and Data

SSI8150 Chapter D identifies those programs and data which are classified as vital and those which are identified as non-vital.

Notwithstanding the above classification, all Master EPROMs shall be handled as vital EPROMs.

Various stages in the processes below may be omitted for the programming on non-vital Production EPROMs where specifically identified.

5.3 Verification of Correct Operation of Programmers (Vital Programs and Data)

When programming vital EPROMs, the following procedure shall be adopted to verify the correct operation of the programmers in use before and after program or data programming. In the case of verification masters, this shall be done before and after each set of EPROMs is programmed. In the case of production EPROMs all using the same type of EPROM device, the procedure may be performed before and after the entire production batch process.

Programming shall not be undertaken if the pre-programming checks fail. If the post-programming checks fail, all EPROMs programmed in the batch concerned shall be erased. If either check fails, the cause of the problem

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must be investigated and rectified before further programming is undertaken.

The test requires the use of a pair of EPROMs, known as the Compare Check Pair, one pair for each type of, and of the same capacity as, the EPROM used as a Verification Master. One EPROM shall be programmed with a random code. A second EPROM shall be programmed with the same code except that throughout the address range of the EPROM, each location with an address in the series 0001H, 0002H, 0004H, 0008H, 0010H, 0020H, etc. (relative to the start address) shall be edited by complementing one different data bit at each address for the first eight addresses and repeating this for higher addresses. The pair should then be verified against each other using both EPROM programmers, and if the differences detected do not correspond exactly with those specified, then the test fails.

5.4 Checksums

Checksums are used to verify the transfer of data. It is important to realise that two types of checksum exist, and are different.

5.4.1 Download Checksums

Download checksums shall be calculated from each byte of EPROM code downloaded from a Source Master into an EPROM programmer.

5.4.2 Device Checksums

Device checksums shall be calculated from each byte of code held at every address of an EPROM, including unprogrammed areas of memory.

5.4.3 Checksum Calculation

Each byte of code, either downloaded or held in EPROM, shall be added together - the checksum shall be the four least significant figures of the resulting total expressed in hexadecimal notation.

5.5 Programming and Checking Verification Masters (Program)

The RAM of Programmer A shall be set to the unprogrammed EPROM state, usually FFH, over the address range of the EPROMs. The program EPROM code shall then be downloaded from the Source Master into Programmer A. The download checksum on the host system and the programmer must agree.

The required quantity of EPROMs can then be programmed with this code using Programmer A.

Programmer B shall be used to take the device checksum of the Validated Master and to check that this is the same as that on the label of the latter.

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Each newly programmed EPROM shall then be compared with the Validated Master using Programmer B, and its device checksum compared with that of the Validated Master.

The newly programmed EPROMs shall be labelled as defined in Section 6 and, if the above checks are satisfactory, the tester shall check the contents of the two labels on each EPROM and initial or stamp the top label in the space provided. The EPROMs shall now be considered as Verification Masters.

5.6 Programming and Checking Verification Masters (Data)

The RAM of Programmer A shall be set to the unprogrammed EPROM state, usually FFH, over the address range of the EPROMs. The program EPROM code shall then be downloaded from the Source Master into Programmer A. The download checksum on the host system and the programmer must agree.

The required quantity of EPROMs can then be programmed with this code using Programmer A.

For each EPROM programmed, the RAM of Programmer B shall then be set to the unprogrammed EPROM state, usually FFH, over the address range of the EPROMs. The data EPROM code from the programmed EPROM shall be loaded into Programmer B and then uploaded into the host computer and compared within the host with the Source Master.

Programmer B shall then be used to take the device checksums of the programmed EPROMs and to check that they are the same.

If all the above checks are satisfactory, the newly programmed EPROMs shall be labelled as defined in Section 5, and the tester shall check the contents of the two labels on each EPROM and initial or stamp the top label in the space provided. The pair of EPROMs shall now be considered as Verification Masters.

It is permissible to program both Verification Masters (Data) and production data EPROMs simultaneously, but the checking of the Verification Masters must be completed before the checking of the production EPROMs commences.

5.7 Programming and Verifying Production EPROMs

5.7.1 All EPROMs

The RAM of Programmer A shall be set to the unprogrammed EPROM state, usually FFH, over the address range of the EPROMs. The data or program EPROM code shall then be downloaded from the Source Master on the host system. The displayed download checksums on the host system and Programmer A must agree. The required quantity of EPROMs may then be programmed with this code using Programmer A.