GENERAL DISCUSSION
of the
NTDS TYPE D SERIAL INTERFACE

REVISION: 1.00

PRINTING DATE
MAY 5, 1998

9350 Bond Avenue, El Cajon, CA 92021 • (619) 443-8295 • Fax (619) 443-8613

* * NOTICE * *

The information in this document was developed to assist G.E.T. Engineering Corporation (GET) personnel in the development, installation, and maintenance of GET products. The information contained in this document is subject to change without notice.

GET makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. GET shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance or use of this material.

For further information or comments regarding this document, contact the GET Sales Office at:

GET Engineering Corporation
9350 Bond Avenue
El Cajon, CA 92021

Telephone (619) 443 - 8295
FAX (619) 443 - 8613
EMail sales@getntds.com
WWW http://www.getntds.com

* * REVISION HISTORY * *

New editions are complete revisions of this document and will be reissued as necessary to incorporate any updates and corrections.

VERSION: 1.00 (PDF) MAY 5, 1998

TABLE OF CONTENTS

ILLUSTRATIONS

SECTION 1
NTDS TYPE D SERIAL INTERFACE DISCUSSION

1.1 SCOPE

This document contains information discussing the general design philosophy used in implementation of GET NTDS TYPE D SERIAL Interface Adaptors. This document is intended to assist qualified personnel in the development, operation, installation, and diagnosis of these adaptors. It is not the intent or purpose of this document to define the actual uses or applications of NTDS interfaces. Programming and application examples or outlines and diagrams which may be found in this document are intended only to illustrate the operation of the NTDS interface.

1.2 NTDS TYPE D SERIAL OVERVIEW

The GET NTDS Type D Serial Interface Adaptors transfer 10 Mb/s binary information using bipolar serial pulse trains on two coaxial cables. An NTDS Type D I/O CHANNEL consists of an Input Channel and an Output Channel, each of which can transact a 34 bit information frame using two types of 3 bit control frames. The signals required for an input transaction occur entirely on the single coaxial cable used for the Input Channel. The signals required for an output transaction occur entirely on the single coaxial cable used for the Output Channel. The following description of the operation of an NTDS Type D Serial channel is intended only as an aid in explaining the interface operation of the typical NTDS Serial interface and as such does not cover all aspects of NTDS protocols. For a complete description of NTDS information exchange protocols refer to MIL-STD-1397C (SHIPS) Military Standard Document.

1.3 NTDS TYPE D SERIAL TRANSACTIONS

Transfers of information between two serial devices is accomplished using 10 Mb/s control and data frame bipolar pulse trains. The transmitting device sends a control frame requesting an eventual word transfer to the receiving equipment. The receiving equipment then sends a control frame granting or denying permission to the requesting device to transmit the data frame. If the transmission request is denied the transmitting device may elect to send another output request control frame. If the control frame indicates that permission has been granted the transmitting device sends the data frame.

1.4 NTDS TYPE D SERIAL TIMING

The encoding scheme used is called Manchester Encoding. In this scheme the transmission clock and data are encoded into each bit. This 10 Mb/s timing has a 100 nanosec period for each bit time. Each bit time is in turn divided into two 50 nanosec pulse periods. A logical 1 is represented by a positive pulse followed by a negative pulse. A logical 0 is a negative pulse followed by a positive pulse.

1.4.1 TYPE D INTERFACE VOLTAGES

At the transmitter end of the coaxial cable the serial data line has an amplitude of +/- 3.25 Volts. The switching threshold at the receiver end of the coaxial cable is +/- 1.25 VDC. Additionally, the receiver outputs must remain stable and not switch state for all open input conditions or when the input voltage is between 0.00 and +/- 0.5 VDC. With RG-12A coaxial cable and 75 Ohm termination the maximum specified cable length is 1000 ft.

1.4.2 CONTROL FRAME FORMAT

The first bit of each three bit control frame pulse train is a logic 1 synchronization bit. The next two bits represent the Data and Function requests and enables, as shown in Figure 1.1. Both bits may be set in any control frame. The word transmitted following the control frame exchange will be identified in the data frame identifier bit.

1.4.3 DATA FRAME FORMAT

The first bit of each thirty four bit data frame pulse train is a logic 1 synchronization bit. The next bit is the word identifier (0 for Data and 1 for Functions/Interrupts). The next 32 bits represent the transmitted data. No parity or other check bits are specified.

1.5 SERIAL INTERFACE CATEGORIES

The NTDS Type D Serial interface channels are specified to operate as Computer or Peripheral channels in order to support the three NTDS equipment categories defined in MIL-STD-1397C. These equipment categories are:

A. Category I - Computer to Peripheral
B. Category II - Computer to Computer (Inter-Computer)
C. Category III - Peripheral to Peripheral (Inter-Peripheral)

1.5.1 CATEGORY I OUTPUT OPERATION

In Category I Computer Output operation the Computer Output Channel is connected to a Peripheral Input Channel. The Computer transmits Output Enable Control Frames (OECF) with the Output Data Enable (ODE) and External Function Enable (EFE) bits indicating its readiness to transmit. The Peripheral device's Input Channel transmits Output Request Control Frames (ORCF) with the Output Data Request (ODR) and External Function Request (EFR) bits indicating its ability to receive. The actual data frame transaction follows the sequence described in Paragraph 1.6.

1.5.2 CATEGORY I INPUT OPERATION

In Category I Computer Input operation the Computer Input Channel is connected to a Peripheral Output Channel. The Peripheral transmits Input Request Control Frames (IRCF) with the Input Data Request (IDR) and External Interrupt Request (EIR) bits indicating its readiness to transmit. The Computer device's Input Channel transmits Input Enable Control Frames (IECF) with the Input Data Enable (IDE) and External Interrupt Enable (EIE) bits indicating its ability to receive. The actual data frame transaction follows the sequence described in Paragraph 1.6.

1.5.3 CATEGORY II OPERATION

In Category II operation the Computer Output Channel is connected to a Computer Input Channel. The transmitting Computer sends an OECF with the ODE and EFE bits indicating its readiness to transmit. The receiving Computer Input Channel interprets the OECF as an IRCF, with the ODE as the IDR and the EFE as the EIR. The receiving Computer Input Channel transmits an IECF with the IDE and EIE bits indicating its ability to receive. The transmitting Computer Output Channel interprets the IECF as an ORCF, with the IDE as the ODR and the EIE as the EFR. The actual data frame transaction follows the sequence described in Paragraph 1.6.

1.5.4 CATEGORY III OPERATION

In Category III operation the Peripheral Output Channel is connected to a Peripheral Input Channel. The transmitting Peripheral transmits an IRCF with the IDR and EIR bits indicating its readiness to transmit. The receiving Peripheral Input Channel interprets the IRCF as an OECF, with the IDR as the ODE and the EIR as the EFE. The receiving Peripheral Input Channel transmits an ORCF with the ODR and EFR bits indicating its ability to receive. The transmitting Peripheral Output Channel interprets the ORCF as an IECF, with the ODR as the IDE and the EFR as the EFE. The actual data frame transaction follows the sequence described in Paragraph 1.6.

1.6 SERIAL TRANSFERS

When viewed on a bit by bit basis, the data frame transaction operations between Computer and Peripheral devices is essentially the same regardless of Category. The main difference is in the control frame and bit naming conventions used. In short, the transmitter to receiver link works the same for all three categories, with the similar timing and event sequences. Therefore, only the Category 1, Computer Output to Peripheral Input transaction, will be described in detail in the following paragraphs. The transmitting device sends a control frame requesting that the receiving device accept it. The receiving device responds with a control frame indicating its ability to accept the data frame. The transmitting device, in accordance with internal priorities, sends another control frame or sends the data frame.

1.6.1 DATA FRAME TRANSFERS

Transfers of information between NTDS Input and Output devices are accomplished in two major methods: Data and Functions. An OUTPUT device sets the Output Data Enable (ODE) bit or External Function Enable (EFE) bit when it is in a condition to transmit a Data or External Function word to the INPUT device. The OUTPUT device then sends an Output Enable Control Frame (OECF) with the ODE or EFE bits (or both) set. The INPUT device responds by transmitting an Output Request Control Frame (ORCF). The ORCF indicates the INPUT Channel's ability to accept the data frame offered by the OUTPUT device, as determined by the condition of the Output Data Request (ODR) or External Function Request (EFR) bits. The active request bit indicates to the OUTPUT device that the INPUT device can accept the requested transfer. The OUTPUT device, at its convenience, sends the OD or EF data frame to the INPUT device. Note that both ODE and EFE bits may be active at any one time. The INPUT device acknowledges the receipt of data frame and its ability to accept another data frame by transmitting another ORCF frame. Figures 2.1 and 2.2 illustrate the TYPE D control and data frame formats.

1.6.2 FORCED EXTERNAL FUNCTIONS

Some NTDS devices have the ability of sending External Functions with Force and do not require that the EFR bit be set in the ORCF frame from the INPUT device. The INPUT device has no control over the rate at which External Functions with Force are sent. If the INPUT device can not accept External Functions at a high rate, timing restrictions must be made in the computer programming or external data rate buffered devices may have to be used. The typical GET TYPE D interface contains an input FIFO buffer which can accept several consecutive Forced External Functions before the danger of lost data arises.

FIGURE 1.1

CONTROL FRAME TIMING

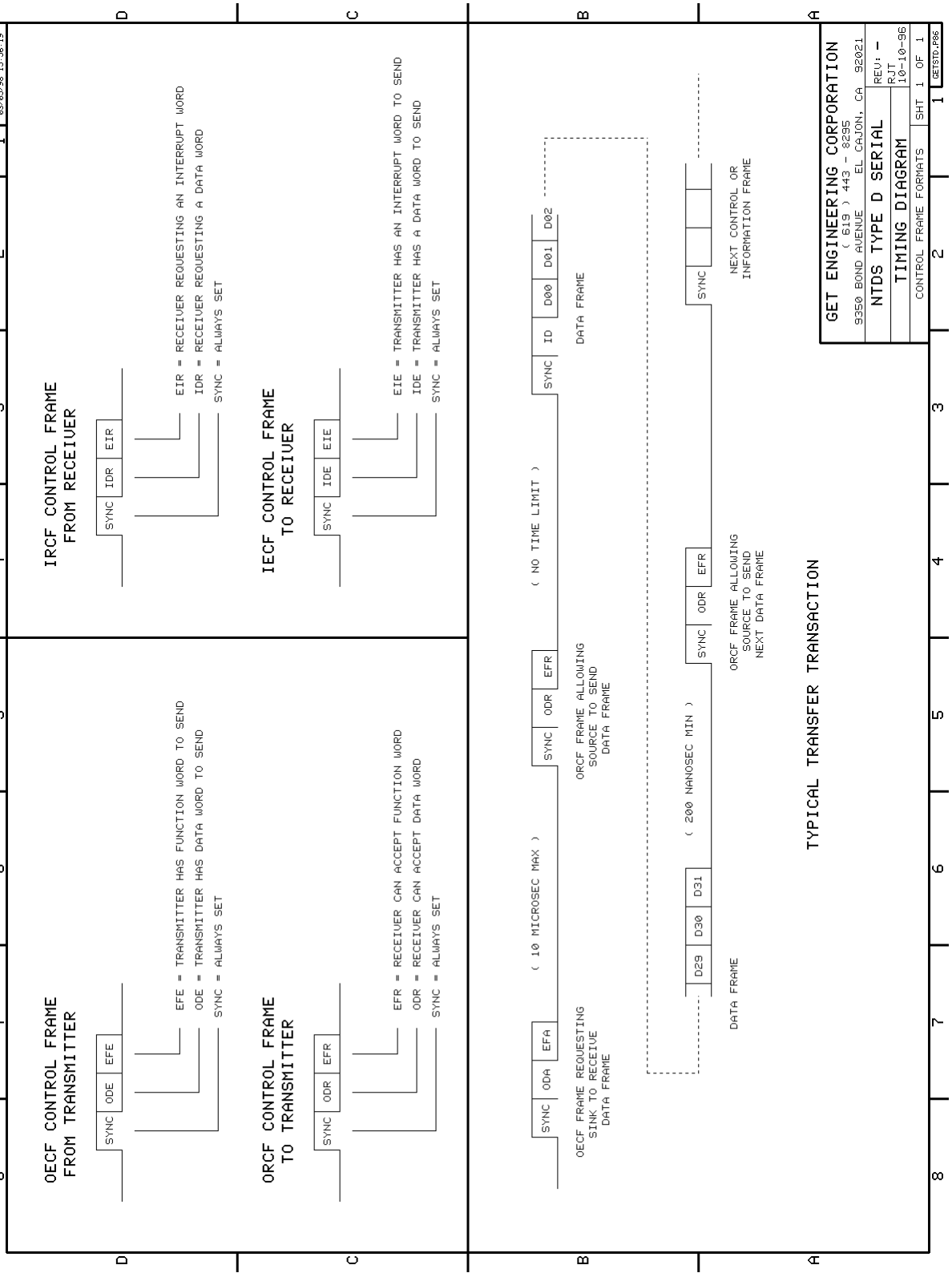

FIGURE 1.2

DATA FRAME TIMING