BUS-65112 AND BUS-65117

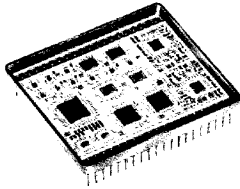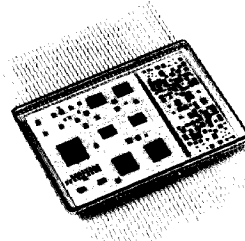## MIL-STD-1553 DUAL REDUNDANT REMOTE TERMINAL HYBRID

BUS-65112 DDIP

BUS-65117 FLATPACK

FEATURES

- *SMALL SIZE & LOW POWER*

- *COMPLETE RTU PROTOCOL*

- *SUPPORTS 13 MODE CODES: ANY COMBINATIONS CAN BE ILLEGALIZED*

- *TRANSFERS DATA WITH DMA TYPE HANDSHAKING*

- *LATCHED OUTPUTS FOR COMMAND WORD AND WORD COUNT*

- *14 BIT BUILT-IN-TEST WORD REGISTER*

- *4 ERROR FLAG OUTPUTS*

- *CONTINUOUS ONLINE SELF-TEST*

- *PLUG-IN & FLATPACK PACKAGING*

DESCRIPTION

The BUS-65112 is a complete dual redundant MIL-STD-1553 Remote Terminal Unit (RTU) packaged in a small 1.9" x 2.1" hybrid. Based upon DDC custom ICs, it includes 2 transceivers, 2 encoder/decoders, 2 bit processors, RTU protocol, data buffers, and timing control logic. It supports all 13 mode codes for dual redundant operation, any combination of which can be illegalized.

Parallel data transfers are accomplished with a DMA type handshaking, compatible with most CPU types. Data transfers to/from memory are simplified by the latched command word and word count outputs. Error detection and recovery are enhanced by BUS-65112 special features. A 14 bit built-in-test word register stores RTU information, and sends it to the Bus Controller in response to the Mode Command Transmit Bit Word. The BUS-65112 performs continuous on-line wraparound self-test, and provides 4 error flags to the host CPU. Inputs are provided for host CPU control of 6 bits of the RTU Status Word.

Its small hermetic package, −55°C to +125°C operating temperature range, and complete RTU operation make the BUS-65112 ideal for most MIL-STD-1553 applications.
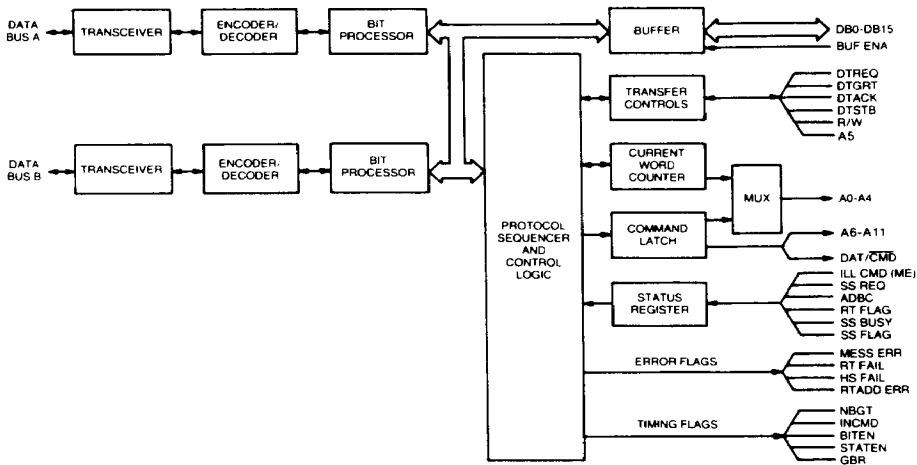

FIGURE 1. BUS-65112 BLOCK DIAGRAM

TABLE 1. BUS-65112 SPECIFICATIONS

PARAMETER	UNITS	VALUE
RECEIVER		
Differential Input Impedance (DC to 1MHz)	KΩ	4 min
Differential Input Voltage	V_{p-p}	40 max
Input Threshold (Direct Coupled)	V_{p-p}	1 typ
CMRR (DC to 2MHz)	dB	40 min
CMV (DC to 2MHz)	V	±10 min
TRANSMITTER		
Differential Output Voltage		
Direct Coupled (Across 145Ω Load)	V_{p-p}	30 typ
Transformer Coupled (at Stub)	V_{p-p}	21 typ
Output Rise and Fall Times	ns	130 typ
Output Noise	mV_{p-p}	10 max
LOGIC		
V_{IH}	V	2.4 min
V_{IL}	V	0.7 max
I_{IH} (Note 1) ($V_{IH} = 2.7V$)	mA	-0.7 max
I_{IH} (Note 2) ($V_{IH} \geqslant 2.4V$)	μA	±20 max
I_{IL} (Note 1) ($V_{IL} = 0.4V$)	mA	-1.6 max
I_{IL} (Note 2) ($V_{IL} \leqslant 0.7V$)	μA	±20 max
V_{OH} (Note 3) ($I_{OH} = 0.3$ mA)	V	2.4 min
V_{OH} (Note 4) ($I_{OH} = 3$ mA)	V	2.4 min
V_{OH} (Note 6) ($I_{OH} = -3$ mA)	V	2.4 min
V_{OL} (Note 3) ($I_{OL} = -1.6$ mA)	V	0.4 max
V_{OL} (Note 5) ($I_{OL} = -4$ mA)	V	0.4 max
V_{OL} (Note 6) ($I_{OL} = -6$ mA)	V	0.4 max
C_I (f = 1 MHz)	pF	50 typ
C_{IO} (Note 6) (f = 1 MHz)	pF	50 typ
POWER SUPPLIES		
+5VDC		
Tolerance, max	%	±10
Current Drain, max	mA	160
+15VDC		
Tolerance, max	%	±5
Current Drain, max		
Idle, max	mA	80
50% Transmit, max	mA	180
100% Transmit, max	mA	280
—15VDC		
Tolerance, max	%	±5
Current Drain		
Idle, max	mA	60
50% Transmit, max	mA	60
100% Transmit, max	mA	60
TEMPERATURE RANGE		
Operating (Case)	°C	—55 to +125
Storage	°C	—65 to +150
PHYSICAL		
Size		
DDIP	in.	1.9x2.1x0.25
	(mm)	(48x53x6)
Flatpack	in.	1.6x2.19x0.171
	(mm)	(40.6x55.6x4.34)
Weight	oz (g)	1.7 (41)

Notes:
1. I_{IH} and I_{IL} for input pins 12, 13, 14, 15, 53, 54, 55.
2. I_{IH} and I_{IL} for input pins other than in Note 1.
3. V_{OH} and V_{OL} for output pins, 1, 2, 3, 16, 25, 27, 28, 35, 40, 41, 42, 65, 73, 78.
4. V_{OH} for all output pins other than in Note 3.
5. V_{OL} for output pins 21, 22, 24, 26, 29, 60, 61, 62, 63, 64.
6. V_{OL} and C_{IO} for pins 43 thru 50 and 4 thru 11.

GENERAL

The BUS-65112 is a complete dual redundant Remote Terminal Unit (RTU) packaged in a small 1.9" x 2.1" hybrid. It is fully compliant with MIL-STD-1553B and supports all message formats. As shown in Figure 1, it includes 2 transceivers, 2 encoder/decoders, 2 bit processors, an RTU protocol sequencer, control logic and output latches and buffers. With the addition of 2 data bus transformers (DDC P/N BUS-25679), BUS-65112 is ready to connect to the MIL-STD-1553 data bus.

Data is transferred to and from the subsystem host CPU over a 16 bit parallel highway, which is isolated by a set of bidirectional buffers. All transfers are made with a DMA type handshaking of request, grant, acknowledge. Read/write and data strobes are provided to simplify interfacing to external RAM memory. Also simplifying the RAM interface, is the availability of latched command word and word counter. These signals may be used as an address to map the data directly to and from RAM.

BUS-65112 allows the subsystem host CPU to control 6 of the bits in the RTU status word. Of particular interest is the Illegal Command input which may be used to set the message error bit and illegalize any command word. Four error flags are provided to the subsystem host CPU by the BUS-65112, to aid in assessing its condition. In addition, a continuous online self-test is performed by the BUS-65112 on every transmission. Each transmitted message is wrapped around to the decoder and compared to the intended message. Any discrepancy is flagged as an error.

TIMING

The subsystem host CPU interface to the BUS-65112 is simple and compatible with most microprocessors. Figures 3 and 4 illustrate typical MIL-STD-1553 messages of transmit data and receive data, and figures 5 and 6 show RT to RT transfers. In each case, $\overline{NBGT}$ identifies the start of the message, and INCMD identifies that a command is being processed. The handshake sequence $\overline{DTREQ}$, $\overline{DTGRT}$, and $\overline{DTACK}$ is used to transfer each word over the parallel data highway. DTSTR and R/$\overline{W}$ are used to control transfers to RAM memory. $\overline{GBR}$ identifies a "good block received", when a received message has passed all validation checks and has the correct word count. Buffer enable ($\overline{BUFENA}$) must be applied to enable the internal three-state buffers.

ERROR FLAGS

Four error flags are output to the subsystem to provide information on the condition of the BUS-65112. The Message Error ($\overline{ME}$) line goes LOW if any of the following error conditions exist: format error, word count error, invalid word, sync error, RT to RT address error or T/R bit error. The Remote Terminal Failure ($\overline{RT\ FAIL}$) line goes LOW whenever the results of the continuous wraparound self-test shows a discrepancy, or the transmitter watchdog timeout has occurred. The Handshake Failure ($\overline{HS\ FAIL}$) line goes LOW whenever the subsystem has not responded to a $\overline{DTREQ}$ request soon enough with a $\overline{DTGRT}$ grant. The RT Address Error ($\overline{RTAD\ ERR}$) line goes LOW whenever the sum of the 5 address lines and parity line shows a parity error.

STATUS REGISTER

Six inputs to the BUS-65112 allow the subsystem host CPU to control bits in the RTU Status Word. The Illegal Command input may be used to set the Message Error bit in the Status Word. This line is particularly useful in illegalizing any combination of mode commands. An external PROM may be used to monitor the latched Command Word. This PROM would drive the Illegal Command input LOW when it identifies a mode command that is programmed to be illegal.

The Subsystem Request (SRQ) line is used to set the service request bit in the Status Word. The Accept Dynamic Bus Control (ADBC) line is used to set the Bus Control acceptance bit in the Status Word, if that mode command was sent. The Remote Terminal Flag (RT FLAG) line is used to set the terminal flag bit in the Status Word. The Subsystem Busy

(BUSY) line is used to set the busy bit in the Status Word, and to inhibit requests for data from the subsystem. The Subsystem Flag (SS FLAG) line is used to set subsystem flag (fault) bit in the Status Word.

BUILT-IN-TEST WORD

The BUS-65112 contains a 14 bit Built-In-Test (BIT) word register which stores information about the condition of the Remote Terminal. When a Mode Command is received to transmit BIT word, the contents of this register are transmitted over the 1553 data bus. Figure 2 shows the meaning of each bit in the BIT register. Information is included regarding transmitter timeouts, loop test failures, transmitter shutdown, subsystem handshake failure, and the results of individual message validations.
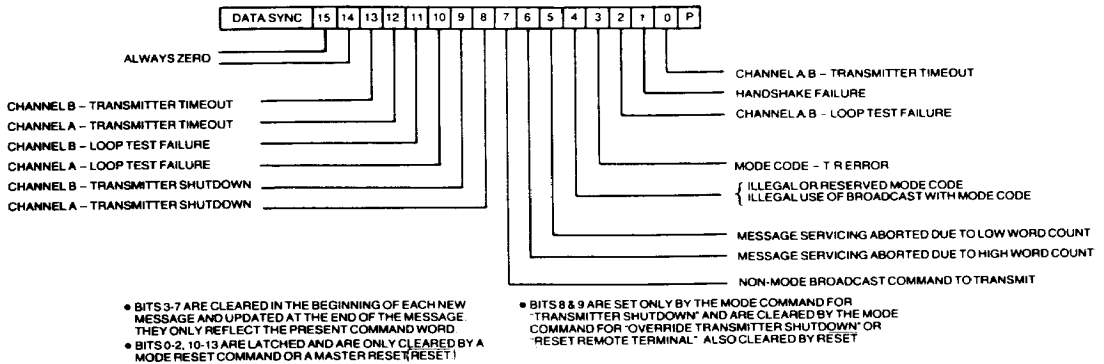

FIGURE 2. BUILT-IN-TEST (BIT) WORD REGISTER

MODE CODES

The BUS-65112 recognizes all MIL-STD-1553 mode codes. The hybrids responses to the mode codes and error conditions are described below.

DYNAMIC BUS CONTROL [00000]

message sequence = [DBC] * [STATUS]

The super hybrid will respond with status; if the terminal wishes to control the bus, it must set the DBACC bit within 2.5μs after NBGT.

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address	Broadcast address
No response—command ignored	No status response Set message error BIT hi word count	No status response Set message error BIT T/R mode error	No status response BIT illegal mode code & T/R error Set brdcst received	No status response Set message error Set brdcst recved BIT illegal mode

(* = status response time)

TRANSMIT 2 WORDS

DATA | 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 P | DATA | 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 P

1.1 ± .2μs

5.0 ± .5μs

15.4 μs max

250ns max

250ns max

CURRENT WORD COUNT = 00001

CURRENT WORD COUNT = 00010

166ns

166ns

.5μs

166ns

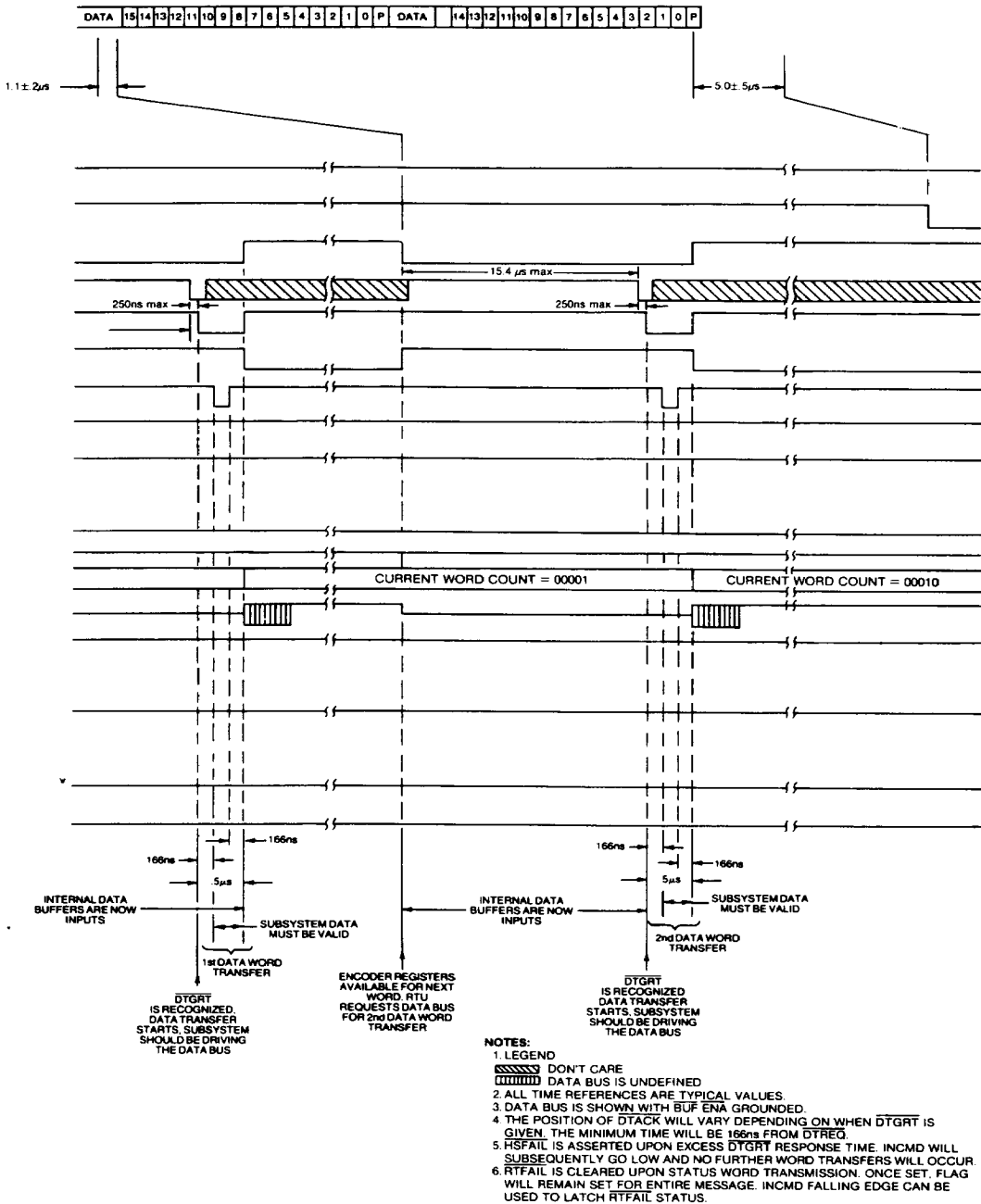166ns

5μs

INTERNAL DATA
BUFFERS ARE NOW
INPUTS

SUBSYSTEM DATA
MUST BE VALID

INTERNAL DATA
BUFFERS ARE NOW
INPUTS

SUBSYSTEM DATA
MUST BE VALID

SUBSYSTEM DATA
MUST BE VALID

1st DATA WORD
TRANSFER

2nd DATA WORD
TRANSFER

DTGRT
IS RECOGNIZED,
DATA TRANSFER
STARTS, SUBSYSTEM
SHOULD BE DRIVING
THE DATA BUS

ENCODER REGISTERS
AVAILABLE FOR NEXT
WORD. RTU
REQUESTS DATA BUS
FOR 2nd DATA WORD
TRANSFER

DTGRT
IS RECOGNIZED
DATA TRANSFER
STARTS, SUBSYSTEM
SHOULD BE DRIVING
THE DATA BUS

NOTES:
1. LEGEND
   DON'T CARE
   DATA BUS IS UNDEFINED
2. ALL TIME REFERENCES ARE TYPICAL VALUES.
3. DATA BUS IS SHOWN WITH BUF ENA GROUNDED.
4. THE POSITION OF DTACK WILL VARY DEPENDING ON WHEN DTGRT IS
   GIVEN. THE MINIMUM TIME WILL BE 166ns FROM DTREQ.
5. HSFAIL IS ASSERTED UPON EXCESS DTGRT RESPONSE TIME. INCMD WILL
   SUBSEQUENTLY GO LOW AND NO FURTHER WORD TRANSFERS WILL OCCUR.
6. RTFAIL IS CLEARED UPON STATUS WORD TRANSMISSION. ONCE SET, FLAG
   WILL REMAIN SET FOR ENTIRE MESSAGE. INCMD FALLING EDGE CAN BE
   USED TO LATCH RTFAIL STATUS.

FIGURE 3. TRANSMIT TIMING DIAGRAM
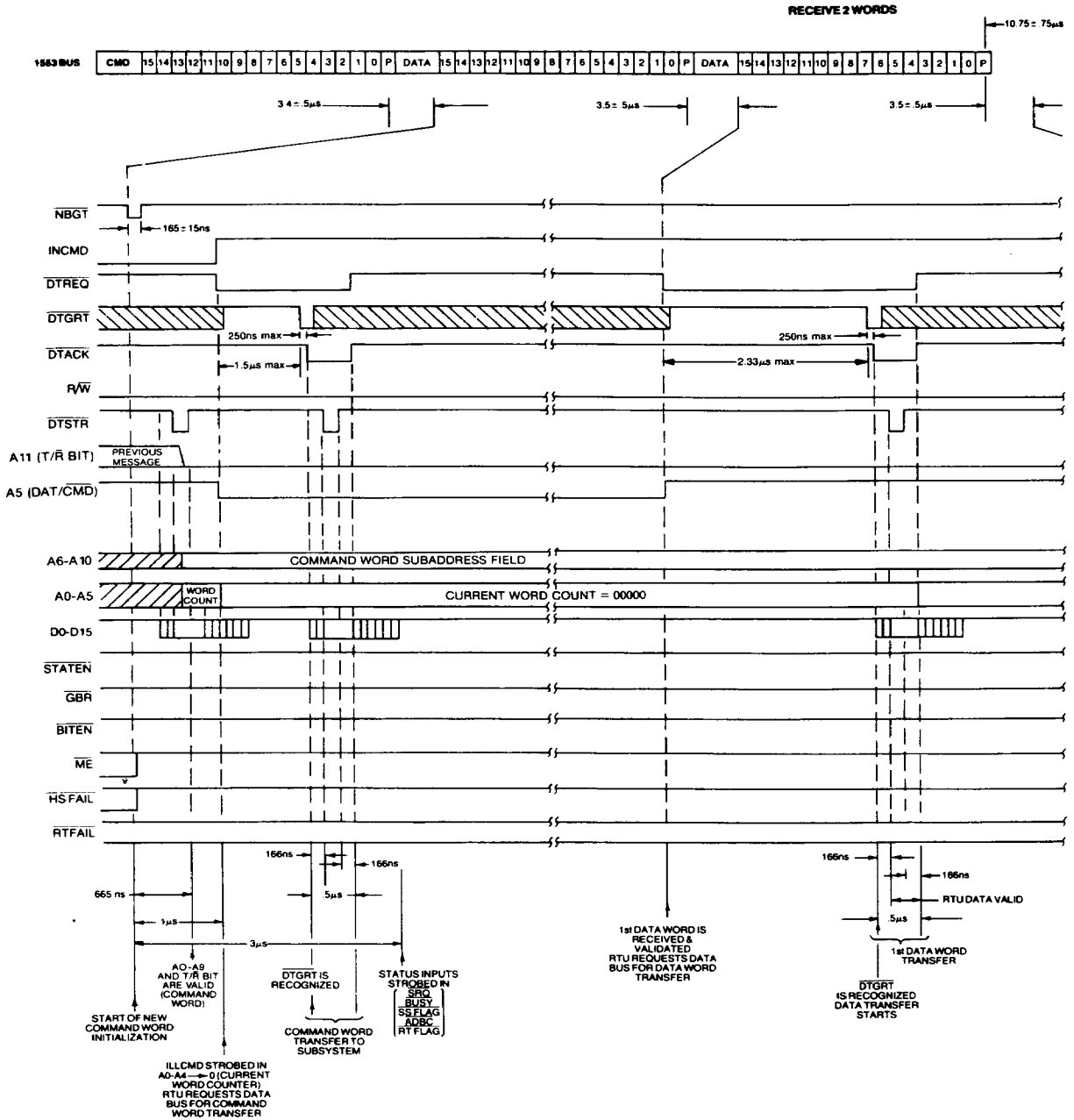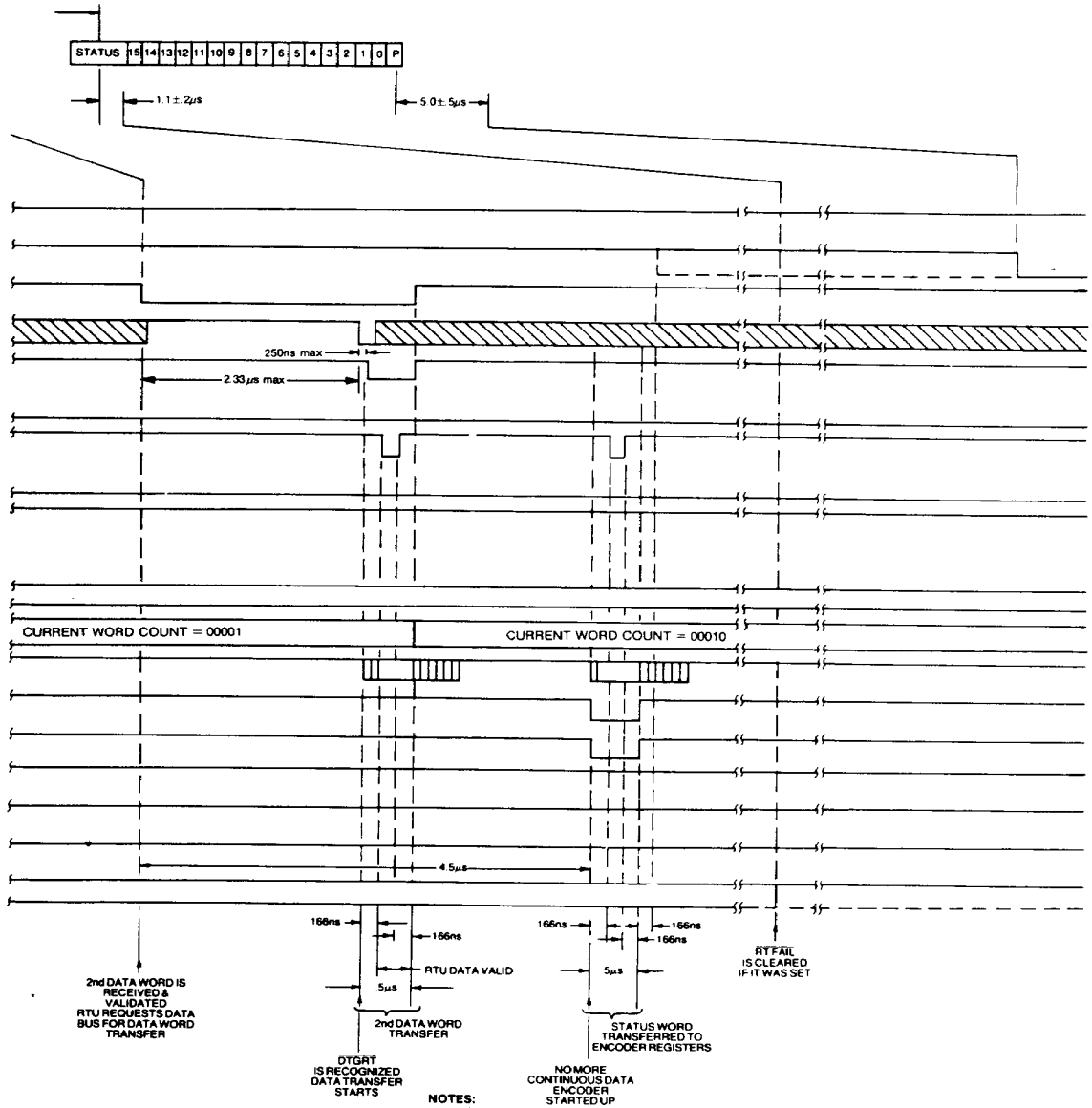
RECEIVE 2 WORDS

VII-86

| STATUS | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | P |

1.1±.2μs

5.0±.5μs

250ns max

2.33μs max

CURRENT WORD COUNT = 00001

CURRENT WORD COUNT = 00010

4.5μs

166ns

166ns

166ns

166ns

166ns

166ns

RTU DATA VALID

5μs

RT FAIL
IS CLEARED
IF IT WAS SET

5μs

2nd DATA WORD IS
RECEIVED &
VALIDATED
RTU REQUESTS DATA
BUS FOR DATA WORD
TRANSFER

2nd DATA WORD
TRANSFER

STATUS WORD
TRANSFERRED TO
ENCODER REGISTERS

DTGRT
IS RECOGNIZED
DATA TRANSFER
STARTS

NO MORE
CONTINUOUS DATA
ENCODER
STARTED UP

NOTES:
1. LEGEND
    DON'T CARE
    DATA BUS IS UNDEFINED
    - - - REPRESENTS THE SEQUENCE OF EVENTS IF THE COMMAND WAS
        BROADCAST. NOTE, NO STATUS WOULD BE TRANSMITTED ON 1553 BUS.
2. ALL TIME REFERENCES ARE TYPICAL VALUES.
3. DATA BUS IS SHOWN WITH BUF ENA GROUNDED.
4. THE TIMING DIAGRAMS REPRESENT A DTGRT RESPONSE TIME OF 92μs FOR
    COMMAND TRANSFER AND 2.1μs FOR DATA. THE POSITION OF DTACK WILL
    VARY DEPENDING ON WHEN DTGRT IS GIVEN.
5. HSFAIL IS ASSERTED UPON EXCESS DTGRT RESPONSE TIME. GBR WILL BE SET
6. RTFAIL IS CLEARED UPON STATUS WORD TRANSMISSION. ONCE SET, FLAG
    WILL REMAIN SET FOR ENTIRE MESSAGE. INCMD FALLING EDGE CAN BE
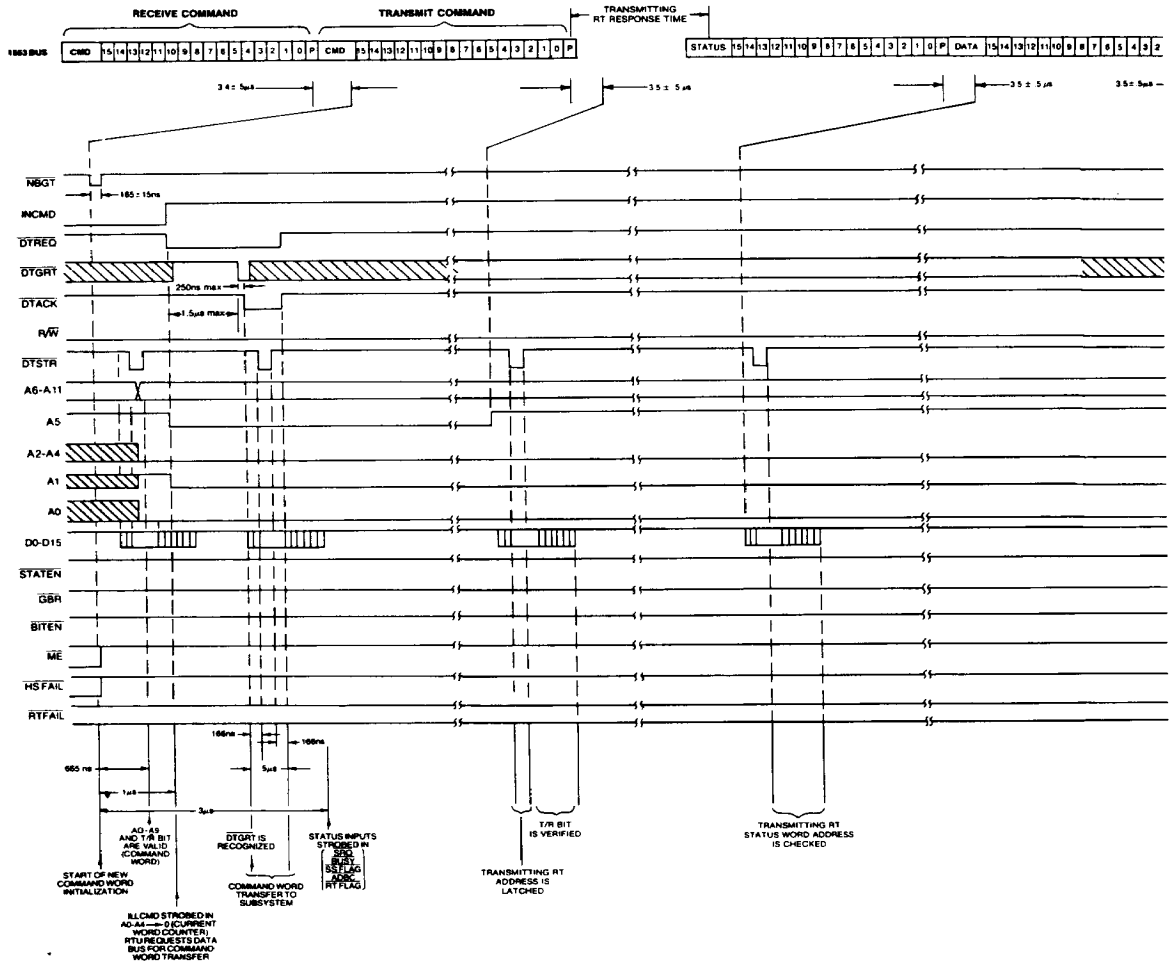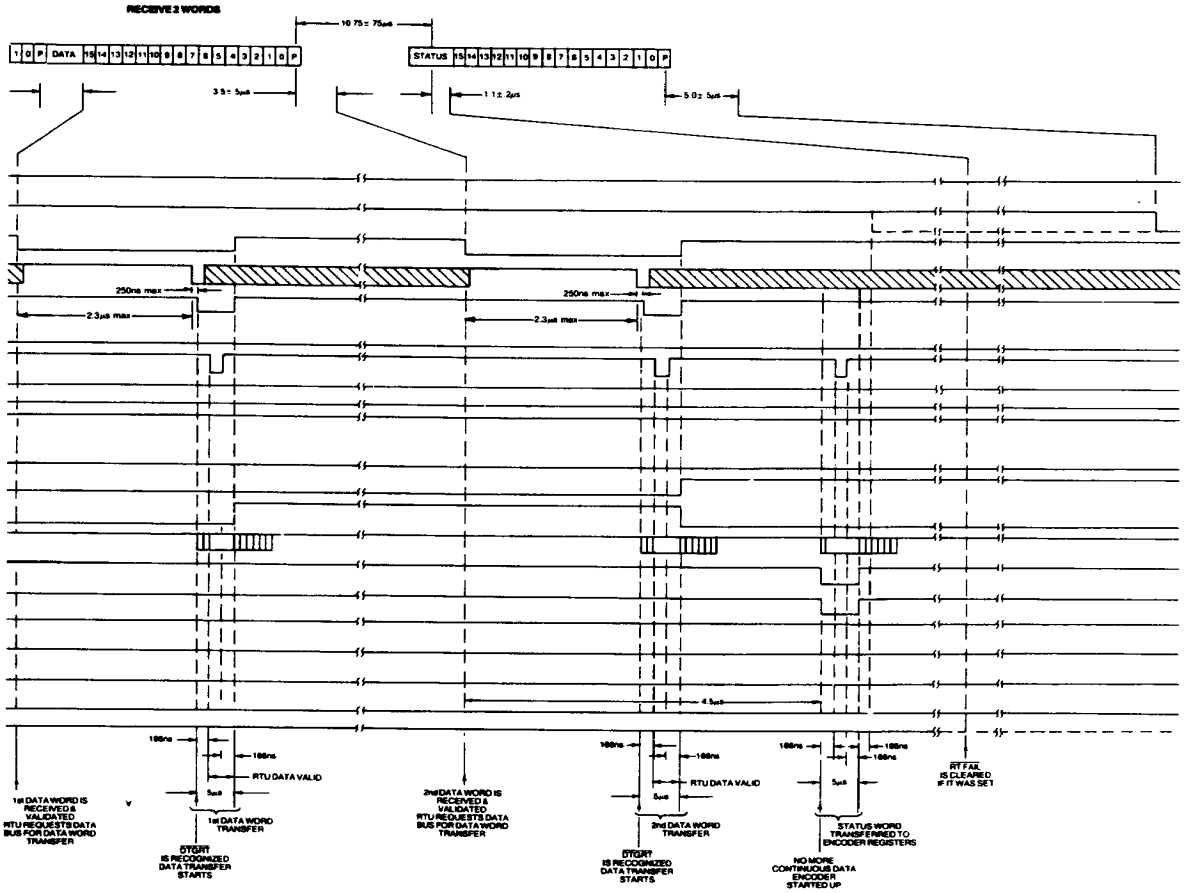   USED TO LATCH RTFAIL STATUS.
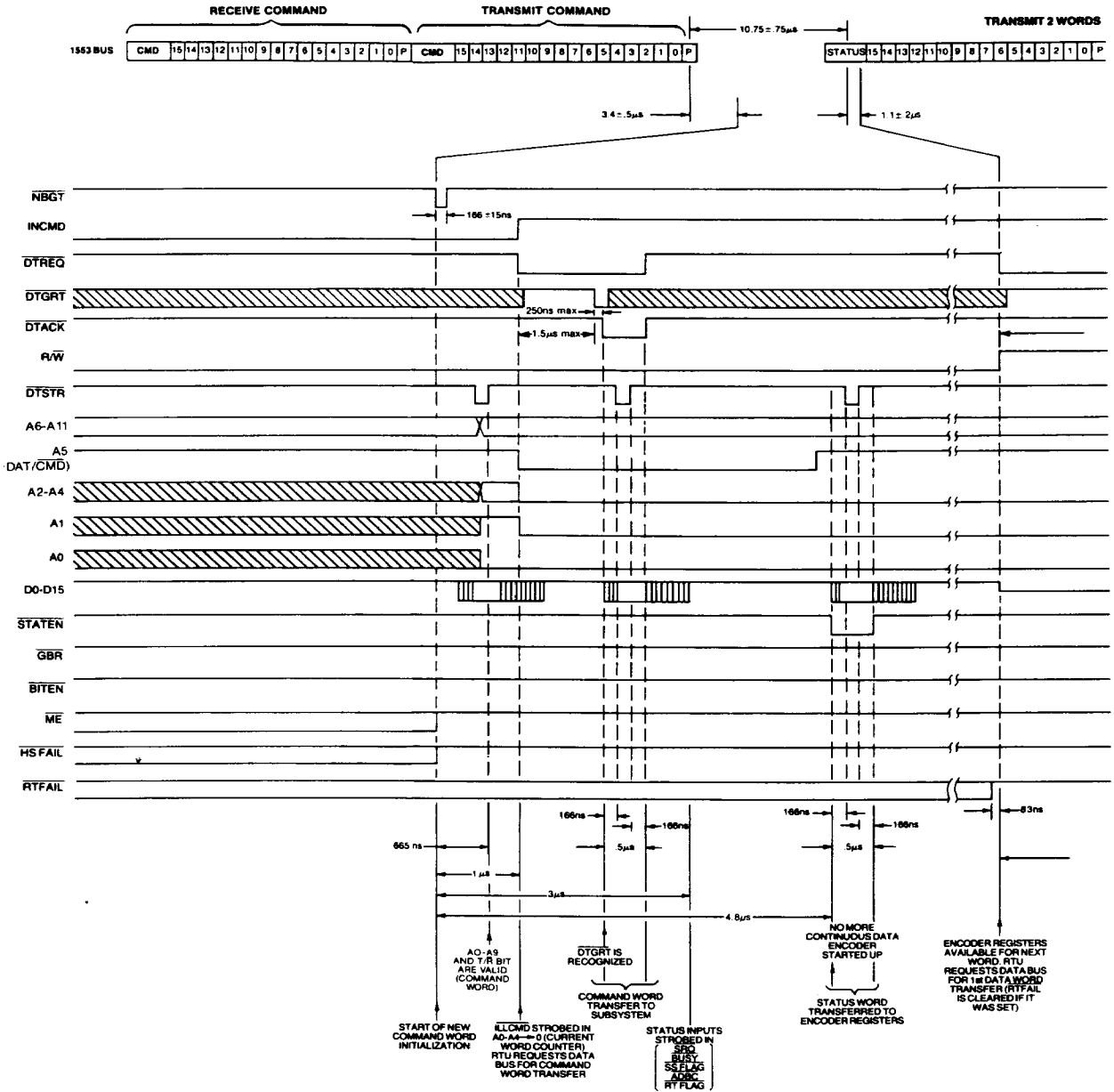
FIGURE 4. RECEIVE TIMING DIAGRAM

FIGURE 5. RT TO RT (RECEIVE) TIMING DIAGRAM

NOTES:
1. LEGEND
   - DON'T CARE
   - DATA BUS IS UNDEFINED
   - - - - REPRESENTS THE SEQUENCE OF EVENTS IF THE COMMAND WAS BROADCAST. NOTE, NO STATUS WOULD BE TRANSMITTED ON 1553 BUS
2. ALL TIME REFERENCES ARE TYPICAL VALUES.
3. DATA BUS IS SHOWN WITH BUF ENA GROUNDED
4. THE TIMING DIAGRAMS REPRESENT A DTGRT RESPONSE TIME OF .92µs FOR COMMAND TRANSFER AND 2.1µs FOR DATA. THE MAXIMUM RESPONSE TIME FROM DTREQ TO DTGRT TO GUARANTEE A SUCCESSFUL TRANSFER IS 1.5µs FOR THE COMMAND TRANSFER AND 2.33µs FOR DATA TRANSFERS TO THE SUBSYSTEM. THE POSITION OF DTACK WILL VARY DEPENDING ON WHEN DTGRT IS GIVEN
5. RTFAIL IS CLEARED UPON STATUS WORD TRANSMISSION. ONCE SET, FLAG WILL REMAIN SET FOR ENTIRE MESSAGE. INCMD FALLING EDGE CAN BE USED TO LATCH RETFAIL STATUS.

RECEIVE COMMAND   TRANSMIT COMMAND   10.75 ± .75µs   TRANSMIT 2 WORDS

1553 BUS | CMD | 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 P | CMD | 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 P | STATUS | 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 P

3.4 ± .5µs

1.1 ± .2µs

NBGT

186 ±15ns

INCMD

DTREQ

DTGRT

250ns max

DTACK

1.5µs max

R/W

DTSTR

A6-A11

A5 (DAT/CMD)

A2-A4

A1

A0

D0-D15

STATEN

GBR

BITEN

ME

HS FAIL

RTFAIL

166ns   166ns   166ns   166ns   53ns

665 ns   .5µs   .5µs

1µs

3µs

4.8µs

NO MORE
CONTINUOUS DATA
ENCODER
STARTED UP

ENCODER REGISTERS
AVAILABLE FOR NEXT
WORD. RTU
REQUESTS DATA BUS
FOR 1st DATA WORD
TRANSFER (RTFAIL
IS CLEARED IF IT
WAS SET)

A0-A9
AND T/R BIT
ARE VALID
(COMMAND
WORD)

DTGRT IS
RECOGNIZED

COMMAND WORD
TRANSFER TO
SUBSYSTEM

STATUS WORD
TRANSFERRED TO
ENCODER REGISTERS

START OF NEW
COMMAND WORD
INITIALIZATION

ILLCMD STROBED IN
A0-A4 → 0 (CURRENT
WORD COUNTER)
RTU REQUESTS DATA
BUS FOR COMMAND
WORD TRANSFER

STATUS INPUTS
STROBED IN
SRQ
BUSY
SS FLAG
ADRC
RT FLAG

FIGURE 6. RT TO RT (TRANSMIT) TIMING DIAGRAM

NOTES:
1. LEGEND
   ▨▨▨ DON'T CARE
   ▥▥▥ DATA BUS IS UNDEFINED
2. ALL TIME REFERENCES ARE TYPICAL VALUES.
3. DATA BUS IS SHOWN WITH BUF ENA GROUNDED.
4. THE TIMING DIAGRAMS REPRESENT A DTGRT RESPONSE TIME OF 92µsec FOR COMMAND WORD TRANSFER AND 2.42µs FOR THE DATA WORDS. THE MAXIMUM RESPONSE TIME FROM DTREQ TO DTGRT TO GUARANTEE A SUCCESSFUL TRANSFER IS 1.5µs FOR THE COMMAND WORD AND 15.4µs FOR THE DATA TRANSFER FROM THE SUBSYSTEM. THE POSITION OF DTACK WILL VARY DEPENDING ON WHEN DTGRT IS GIVEN. THE MINIMUM TIME WILL BE 166ns FROM DTREQ.
5. RTFAIL IS CLEARED UPON STATUS WORD TRANSMISSION. ONCE SET, FLAG WILL REMAIN SET FOR ENTIRE MESSAGE. INCMD FALLING EDGE CAN BE USED TO LATCH RTFAIL STATUS.

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SYNCHRONIZE WITHOUT DATA WORD [00001]

message sequence = |SYNC| • |STATUS|

The hybrid will respond with status. If sent as a broadcast, the broadcast receive bit will be set and status response suppressed.

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address
No response - command ignored	No status response Set message error BIT hi word count	No status response Set message error BIT T/R mode error	No status response Set message error, BIT, T/R mode error Set brdcst recved

TRANSMIT STATUS WORD [00010]

message sequence = |Transmit Status| • |Status|

The status register is not cleared or loaded before it is transmitted and contains the resulting status from the previous command.

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address	Broadcast address
No response - command ignored	No status response Set message error BIT hi word count	No status response Set message error BIT T/R mode error	No status response Set message error BIT illegal mode code & T/R error Set brdcst recevd	No status response Set message error Set brdcst recved BIT illegal mode & T/R error set

INITIATE SELF-TEST [00011]

message sequence = |Self Test| • |Status|

The hybrid responds with a status word. If the command was broadcast, the broadcast received bit is set and status transmission is suppressed. Dynamic wrap-around self-test is initiated on the status word transmission and generates an RT fail flag if the test fails.

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address	Faulty test
No response command ignored	No status response Set message error BIT hi word count	No status response Set message error BIT T/R mode error	No status response Set message error BIT T/R error Set brdcst recevd	Set RT fail flag TF bit set automatically

TRANSMITTER SHUTDOWN [00100]

message sequence = |Shutdown| • |Status|

This command may only be used with dual redundant bus system. The hybrid responds with status, at the end of the status transmission, the hybrid inhibits any further transmission from the redundant channel. Once shutdown, the transmitter can only be reactivated by Override Transmitter Shutdown or Reset Remote Terminal commands.

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address
No response - command ignored	No status response Set message error BIT hi word count	No status response Set message error BIT T/R mode error	No status response Set message error, BIT, T/R mode error Set brdcst recved

OVERRIDE TRANSMITTER SHUTDOWN [00101]

message sequence = |Override Shutdown| • |Status|

This command may only be used with dual redundant bus systems. The hybrid will respond with status, at the end of the

status transmission, the hybrid reenables the transmitter of the redundant bus. If the command was broadcast, the broadcast received bit is set and status transmission is suppressed.

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address
No response - command ignored	No status response Set message error BIT hi word count	No status response Set message error BIT T/R mode error	No status response Set message error, BIT, T/R̄ mode error Set brdcst recved

INHIBIT TERMINAL FLAG BIT [00110]

message sequence = |Inhibit Terminal Flag| • |Status|

The hybrid will respond with status and inhibit any further internal or external setting of the terminal flag bit in the status register. Once the terminal flag has been inhibited, it can only be reactivated by an Override Inhibit Terminal Flag or Reset Remote Terminal command. If the command was broadcast, the broadcast received bit is set and status transmission is suppressed.

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address
No response - command ignored	No status response Set message error BIT hi word count	No status response Set message error BIT T/R mode error	No status response Set message error BIT T/R mode error Set brdcst recevd

OVERRIDE INHIBIT TERMINAL FLAG [00111]

message sequence = |Override Inhibit Terminal Flag| • |Status|

The hybrid responds with status and reactivates the terminal flag bit in the status register. If the command was broadcast, the broadcast received bit is set and status transmission is suppressed.

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address
No response - command ignored	No status response Set message error BIT hi word count	No status response Set message error BIT T/R mode error	No status response Set message error BIT T/R mode error Set brdcst recevd

RESET REMOTE TERMINAL [01000]

message sequence = |Reset Remote Terminal| • |Status|

The hybrid responds with status and internally resets. Transmitter shutdown, mode commands and inhibit terminal flag commands will be reset. If the command was broadcast, the broadcast received bit is set and the status word is suppressed.

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address
No response - command ignored	No status reponse Set message error BIT hi word count	No status response Set message error BIT T/R mode error	No status response Set message error BIT T/R mode error Set brdcst recevd

RESERVED MODE CODES [01001 - 01111]

message sequence = |Reserved Mode Codes| • |Status|

The hybrid responds with status. If the command is made illegal through an optional PROM, the message error bit is set and only the status word is transmitted.

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address
No response - command ignored	No status response Set message error BIT hi word count	No status response Set message error BIT illegal mode	No status response Set message error BIT illegal mode Set brdcst recevd

TRANSMIT VECTOR WORD [10000]

message sequence = | Xmit Vector Word | • | Status | | Vector Word |

The hybrid will transmit a status word followed by the vector word. The contents of the vector word (from the subsystem) are enabled onto DB0-DB15 with the DTREQ after the command transfer (same as a data word in a normal transmit command).

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address	Broadcast address
No response - command ignored	No status response Set message error BIT hi word count	No status response Set message error BIT T/R mode & lo word count	No status response Set message error BIT illegal mode code, T/R error & lo word count Set brdcst received	No status response Set message error Set brdcst recved BIT illegal mode

SYNCHRONIZE WITH DATA WORD [10001]

message sequence = | Synchronize | | Data Word | • | Status |

The data word received following the command word is transferred to the subsystem. The status register is then enabled and then transferred onto the data highway and transmitted. If the command was broadcast, the broadcast received bit is set and status transmission is suppressed.

ERROR CONDITIONS

Invalid Command	Cmnd not followed by data word	Cmnd followed by too many data words	Command T/R bit set to one	Cmnd T/R bit set to one & brdcst address
No response - command ignored	No status response Set message error BIT lo word count	No status response Set message error BIT hi word count	No status response Set message error BIT hi word count & T/R error	No status response Set message error Set brdcst recved BIT hi word count & T/R mode error

TRANSMIT LAST COMMAND [10010]

message sequence = | Xmit Last Command | • | Status | | Last Command |

The status register is not cleared or loaded before transmission; it contains the status from the previous command. The data word transmitted contains the previous valid command (providing it was not another transmit last command).

ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address	Broadcast address
No response - command ignored	No status response Set message error BIT high word count	No status response Set message error BIT T/R mode & lo word count	No status response Set message error BIT illegal mode code & T/R error	No status response Set message error Set brdcst recved BIT illegal mode code

TRANSMIT BIT WORD [10011]

message sequence = | Transmit BIT Word | • | Status | | BIT word |

The hybrid responds with status followed by the BIT word. BITEN when active will allow the subsystem to latch the BIT word on the parallel data bus.

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PIN FUNCTION TABLE

PIN	FUNCTION	DESCRIPTION
1	A10	Latched output of the most significant bit (MSB) in the subaddress field of the command word.
2	A8	Latched output of the third most significant bit in the subaddress field of the command word.
3	A6	Latched output of the least significant bit (LSB) in the subaddress field of the command word.
4	DB1	Bi-directional parallel data bus Bit 1
5	DB3	Bi-directional parallel data bus Bit 3
6	DB5	Bi-directional parallel data bus Bit 5
7	DB7	Bi-directional parallel data bus Bit 7
8	DB9	Bi-directional parallel data bus Bit 9
9	DB11	Bi-directional parallel data bus Bit 11
10	DB13	Bi-directional parallel data bus Bit 13
11	DB15	Bi-directional parallel data bus Bit 15 (MSB)
12	BRO ENA	Broadcast enable – when HIGH, this input allows recognition of an RT address of all ones in the command word as a broadcast message. When LOW, it prevents response to RT address 31 unless it was the assigned terminal address.
13	ADDRE	Input of the MSB of the assigned terminal address.
14	ADDRC	Input of the 3rd MSB of the assigned terminal address.
15	ADDRA	Input of the LSB of the assigned terminal address.
16	RTADERR	Output signal used to inform subsystem of an address parity error. If LOW, indicates parity error and the RT will not respond to any command address to a single terminal. It will respond to broadcast commands if BRO ENA is HIGH.
17	TXDATA B	LOW output to the primary side of the coupling transformer that connects to the B channel of the 1553 Bus.
18	+15VB	+15 volt input power supply connection for the B channel transceiver.
19	GND B	Power supply return connection for the B channel transceiver.
20	RXDATA B	Input from the HIGH side of the primary side of the coupling transformer that connects to the B channel of the 1553 Bus.
21	A3	Multiplexed address line output. When INCMD is LOW or A6 thru A10 are all zeroes or all ones (Mode Command), it represents the latched output of the 2nd MSB in the word count field of the command word. When INCMD is HIGH and A6 thru A10 are not all zeroes or all ones, it represents the 2ns MSB of the current word counter.
22	A1	Multiplexed address line output. When INCMD is LOW or A6 thru A10 are all zeroes or all ones (Mode Command), it represents the latched output of the 2nd LSB in the word count field of the command word. When INCMD is HIGH and A6 thru A10 are not all zeroes or all ones, it represents the 2nd LSB of the current word counter.

PIN FUNCTION TABLE

PIN	FUNCTION	DESCRIPTION
23	DTGRT	Data transfer grant – active LOW input signal from the subsystem that informs the RT, when DTREQ is asserted, to start the transfer. Once transfer is started, DTGRT can be removed.
24	INCMD	In Command – HIGH level output signal used to inform the subsystem that the RT is presently servicing a command.
25	HSFAIL	Handshake Fail – output signal that goes LOW and stays LOW whenever the subsystem fails to supply DTGRT in time to do a successful transfer. Cleared by the next NBGT.
26	DTSTR	A LOW level output pulse (166ns) present in the middle of every data word transfer over the parallel data bus. Used to latch or strobe the data into memory, FIFOs, registers, etc. Recommend using the rising edge to clock data in.
27	(DAT/CMD) A5	Address line output that is LOW whenever the command word is being transferred to the subsystem over the parallel data bus, and is HIGH whenever data words are being transferred.
28	RTFAIL	Remote Terminal Failure – latched active LOW output signal to the subsystem to flag detection of a remote terminal continuous self-test failure. Cleared by the start of the next message transmission (status word) and set if problem is again detected.
29	DTREQ	Data Transfer Request – active LOW output signal to the subsystem indicating that the RT has data for or needs data from the subsystem and requests a data transfer over the parallel data bus. Will stay LOW until transfer is completed or transfer timeout has occurred.
30	ADBC	Accept Dynamic Bus Control – active LOW input signal from subsystem used to set the Dynamic Bus Control Acceptance bit in the status register if the command word was a valid, legal mode command for dynamic bus control.
31	TEST 2	Factory test point – DO NOT USE.
32	A11 (T/R)	Latched output of the T/R bit in the command word.
33	ILLCMD	Illegal Command – Active LOW input signal from the subsystem, strobed in on the rising edge of INCMD. Used to define the command word as illegal and to set the message error bit in the status register.
34	SRQ	Subsystem Service Request – Input from the subsystem used to control the Service Request Bit in the status register. If LOW when the status word is updated, the Service Request Bit will be set; if HIGH, it will be cleared.
35	BITEN	Built-in-Test Word Enable – LOW level output pulse (.5μsec), present when the built-in-test word is enabled on the parallel data bus.
36	RXDATA A	Input from the LOW side of the primary side of the coupling transformer that connects to the A Channel of the 1553 Bus.
37	+5VA	+5 volt input power supply connection for the A channel transceiver.

PIN FUNCTION TABLE

PIN	FUNCTION	DESCRIPTION
38	−15VA	−15 volt input power supply connection for the A Channel transceiver.
39	TXDATA A	HIGH output to the primary side of the coupling transformer that connects to the A channel of the 1553 Bus.
40	NBGT	New Bus Grant − LOW level output pulse (166 ns) used to indicate the start of a new protocol sequence in response to the command word just received.
41	A9	Latched output of the 2nd MSB in the subaddress field of the command word.
42	A7	Latched output of the 2nd LSB in the subaddress field of the command word.
43	DB0	Bidirectional parallel data bus Bit 0 (LSB)
44	DB2	Bidirectional parallel data bus Bit 2
45	DB4	Bidirectional parallel data bus Bit 4
46	DB6	Bidirectional parallel data bus Bit 6
47	DB8	Bidirectional parallel data bus Bit 8
48	DB10	Bidirectional parallel data bus Bit 10
49	DB12	Bidirectional parallel data bus Bit 12
50	DB14	Bidirectional parallel data bus Bit 14
51	+5V	+5 Volt input power supply connection for RTU digital logic section.
52	GND	Power supply return for RTU digital logic section.
53	ADDRD	Input of the 2nd MSB of the assigned terminal address.
54	ADDRB	Input of the 2nd LSB of the assigned terminal address.
55	ADDRP	Input of Address Parity Bit. The combination of assigned terminal address and ADDRP must be odd parity for the RT to work.
56	TXDATA B	HIGH, output to the primary side of the coupling transformer that connects to the B Channel of the 1553 Bus.
57	−15VB	−15 volt input power supply connection for the B channel transceiver.
58	+5VB	+5 volt input power supply connection for the B channel transceiver.
59	RXDATA B	Input from the LOW side of the primary side of the primary side of the coupling transformer that connects to the B Channel of the 1553 Bus.
60	A2	Multiplexed address line output. When INCMD is LOW or A6 thru A10 are all zeroes or all ones (Mode Command),it represents the latched output of the 3rd MSB in the word count field of the command word. When INCMD is HIGH and A6 thru A10 are not all zeroes or all ones, it represents the 3rd MSB of the current word counter.
61	A0	Multiplexed address line output. When INCMD is LOW or A6 thru A10 are all zeroes or all ones (Mode Command), it represents the latched output of the LSB in the word count field of the command word. When INCMD is HIGH and A6 thru A10 are not all zeroes or all ones, it represents the LSB of the current word counter.
62	DTACK	Data Transfer Acknowledge − active LOW output signal during data transfers to or from the subsystem indicating the RTU has received the DTGRT in response to DTREQ and is presently doing the transfer. Can be connected directly to pin 67 (BUF ENA) for control of tri-state data buffers; and to tri-state address buffer control lines, if they are used.

PIN FUNCTION TABLE

PIN	FUNCTION	DESCRIPTION
63	A4	Multiplexed address line output. When INCMD is LOW or A6 thru A10 are all zeroes or all ones (Mode Command), it represents the latched output of the MSB in the word count field of the command word. When INCMD is HIGH and A6 thru A10 are not all zeroes or all ones, it represents the MSB of the current word counter.
64	R/W̄	Read/Write − output signal that controls the direction of the internal data bus buffers. Normally, the signal is LOW and the buffers drive the data bus. When data is needed from the subsystem, it goes HIGH to turn the buffers around and the RT now appears as an input The signal is HIGH only when DTREQ is active (LOW).
65	GBR	Good Block Received − LOW level output pulse (.5μsec) used to flag the subsystem that a valid, legal, non-mode receive command with the correct number of data words has been received without a message error and successfully transferred to the subsystem.
66	12MHz IN	12MHz Clock Input − input for the master clock used to run RTU circuits.
67	BUF ENA	Buffer Enable − input used to enable or tri-state the internal data bus buffers when they are driving the bus. When LOW, the data bus buffers are enabled. Could be connected to DTACK (Pin 62) if RT is sharing the same data bus as the subsystem.
68	RESET	Input resets entire RT when LOW.
69	RTFLAG	Remote Terminal Flag − input signal used to control the terminal flag bit in the status register. If LOW when the status word is updated, the terminal flag bit would be set; if HIGH, it would be cleared. Normally connected to RTFAIL (Pin 28).
70	TEST 1	Factory test point − DO NOT USE.
71	BUSY	Subsystem Busy − input from the subsystem used to control the busy bit in the status register. If LOW when the status word is updated, the busy bit will be set; if HIGH, it will be cleared. If the busy bit is set in the status register, no data will be requested from the subsystem in response to a transmit command. On receive commands, data will still be transferred to subsystem.
72	SSFLAG	Subsystem Flag − input from the subsystem used to control the subsystem flag bit in the status register. If LOW when the status word is updated, the subsystem flag will be set; if HIGH, it will be cleared.
73	ME	Message Error − output signal that goes LOW and stays LOW whenever there is a format or word error with the received message over the 1553 Data Bus. Cleared by the next NBGT.
74	RXDATA A	Input from the HIGH side of the primary side of the coupling transformer that connects to the A channel of the 1553 Bus.
75	GNDA	Power supply return connection for the A Channel transceiver.
76	+15VA	+15 volt input power supply connection for the A channel transceiver.
77	TXDATA A	LOW output to the primary side of the coupling transformer that connects to the A channel of the 1553 Bus.
78	STATEN	Status Word Enable − LOW level active output signal present when the status word is enabled on the parallel data bus.

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ERROR CONDITIONS

Invalid Command	Command followed by data word	T/R bit set to zero	Zero T/R bit & broadcast address	Broadcast address
No response - command ignored	No status response Set message error	No status response Set message error BIT T/R mode error & lo word count	No status response Set message error BIT illegal mode code, T/R error & lo word count	No status response Set message error Set brdcst recved BIT illegal mode

SELECTED TRANSMITTER SHUTDOWN [10100]

message sequence = | Transmitter Shutdown | | Data | * | Status |

The data word received is transferred to the subsystem and then the status word is transmitted. If the command was broadcast, the broadcast received bit is set and status transmission is suppressed. Intended for RTs with more than dual redundant channels.

ERROR CONDITIONS

Invalid Command	Cmnd not followed by data word	Cmnd followed by too many data words	Cmnd T/R bit set to one	Cmnd T/R bit to one & broadcast address
No response - command ignored	No status response Set message error BIT lo word count & illegal mode	No status response Set message error BIT hi word count & illegal mode	No status response Set message error BIT illegal mode & hi word count	No status response Set message error Set brdcst recved BIT illegal mode & hi word count

OVERRIDE SELECTED TRANSMITTER SHUTDOWN [10101]

message sequence = | Override Shutdown | | Data | * | Status |

The data word received after the command word is transferred to the subsystem. If the command was broadcast, the broadcast received bit is set and status transmission is suppressed.

ERROR CONDITIONS

Invalid Command	Cmnd not followed by data word	Cmnd followed by too many data words	Cmnd T/R bit set to one	Cmnd T/R set to one & broadcast address
No response - command ignored	No status response Set message error BIT lo word count & illegal mode	No status response Set message error BIT hi word count & illegal mode	No status response Set message error BIT illegal mode & hi word count	No status response Set message error Set brdcst recved BIT illegal mode, hi word count & T/R mode

RESERVED MODE CODES [10110 - 11111]

message sequence = | Reserved Mode Code (T/R=1) | * | Status |

| Reserved Mode Code (T/R=0) | * | Status |

The hybrid responds with status. If the command was broadcast, the broadcast received bit is set and status transmission is suppressed.

ERROR CONDITIONS

	T/R=1			T/R=0	
Invalid Command	Command followed by data word	Invalid Command	Cmnd not followd by contiguous data word	Cmnd followed by too many data words
No response - command ignored	No status response Set message error BIT hi word count & illegal mode	No response - command ignored	No status response Set message error BIT illegal mode & lo word count	No status response Set message error BIT hi word count & illegal mode

Command Word Illegalizing

Any command, including mode codes, can be illegalized. When an illegalized command or mode code is received, the RTU will set the message error bit of the status register and transmit the status word. Data received with an illegal command will be passed on to the subsystem, and data to be transmitted will not be requested from the subsystem, only the status word with the message error bit set will be transmitted.

FACTORY TEST

The BUS-65112 is capable of performing two internal tests.

TEST 1, PIN 70. A logic low on this pin will cause the last word of the next message to be repeated continuously until the built in Watch Dog Timeout circuit disables the transmitter. The transmitter will be re-enabled upon receipt of the next valid command to the BUS-65112 on that channel.

TEST 2, PIN 31. This pin indicates the result of the loop test comparison test. It is performed for every word transmitted to the 1553 bus.

(1 = Pass. 0 = Fail) The result is reset upon transmission of the next word over the bus.

BUS-65117 FLATPACK PIN FUNCTIONS

PIN	FUNCTION	PIN	FUNCTION
1	NC	42	NC
2	A10	43	NBGT
3	A9	44	STATEN
4	A8	45	TXDATA OUT A
5	A7	46	TXDATA OUT A
6	A6	47	−15V A
7	DB0	48	+15V A
8	DB1	49	+5V A
9	DB2	50	GND A
10	DB3	51	RXDATA IN A
11	DB4	52	RXDATA IN A
12	DB5	53	BITEN
13	DB6	54	ME
14	DB7	55	SRQ
15	DB8	56	SSFLAG
16	DB9	57	ILLCMD
17	DB10	58	BUSY
18	DB11	59	A11
19	DB12	60	TEST 1
20	DB13	61	TEST 2
21	DB14	62	RT FLAG
22	DB15	63	ABDC
23	+5V	64	RESET
24	BRO ENA	65	DTREQ
25	GROUND	66	BUF ENA
26	ADDRE	67	RTFAIL
27	ADDRD	68	12 MHz IN
28	ADDRC	69	A5
29	ADDRB	70	GBR
30	ADDRA	71	DTSTR
31	ADDRP	72	R/W
32	RTADERR	73	HSFAIL
33	TXDATA OUT B	74	A4
34	TXDATA OUT B	75	INCMD
35	−15VB	76	DTACK
36	+15VB	77	DTGRT
37	+5VB	78	A0
38	GND B	79	A1
39	RXDATA IN B	80	A2
40	RXDATA IN B	81	A3
41	NC	82	NC
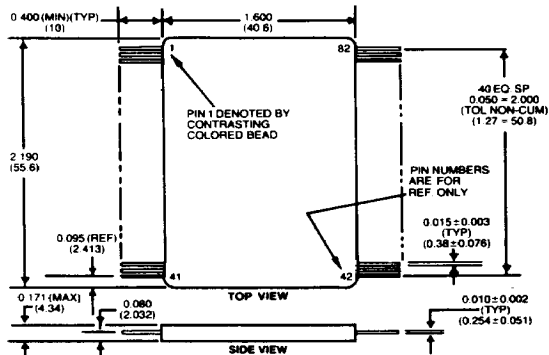
Note: Dimensions are in inches (millimeters).

FIGURE 7. BUS-65117 MECHANICAL OUTLINE (FLATPACK)
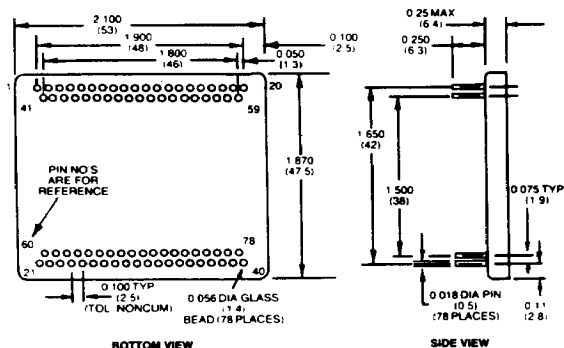
Note: Dimensions are in inches (millimeters).

FIGURE 8. BUS-65112 MECHANICAL OUTLINE (DDIP)

ORDERING INFORMATION

BUS-65112 – 883B

Reliability Grade:

883B = Fully compliant with MIL-STD-883.

B = Screened to MIL-STD-883 but without QCI testing.

Blank = 0° to 70°C operation

Power Supply and Packaging

2 = ±15VDC, DDIP
3 = ±12VDC, DDIP
7 = ±15VDC, Flatpack
8 = ±12VDC, Flatpack