

DP83220 CDL™ Twisted Pair FDDI Transceiver Device

General Description

The Copper Data Link (CDL) Transceiver is an integrated circuit designed to interface directly with the National Semiconductor FDDI Chip Set or other FDDI PHY silicon, allowing low cost FDDI compatible data links over copper based media. The DP83220 Transceiver, with the proper compensation selected, will allow links of up to 100 meters over both Shielded Twisted Pair (STP) and Datagrade unshielded Twisted Pair (DTP). CDL surpasses a Bit Error Rate (BER) of $<1 \times 10^{-12}$ over both STP and DTP. The CDL is designed to meet the SDDI specification for FDDI transmission across Type 1 STP cable when used in conjunction with the appropriate transformer/filter module from Pulse Engineering.

Features

- Fully compatible with current FDDI PHY standard
- Fully compatible with the SDDI PMD specification
- Requires a single +5V supply
- Isolated TX and RX power supplies for minimum noise coupling
- Allows use of Type 1 STP and Category 5 DTP cables
- No Transmit Clock required
- Loopback feature for board diagnostics
- Link Detect input provided

Block Diagram

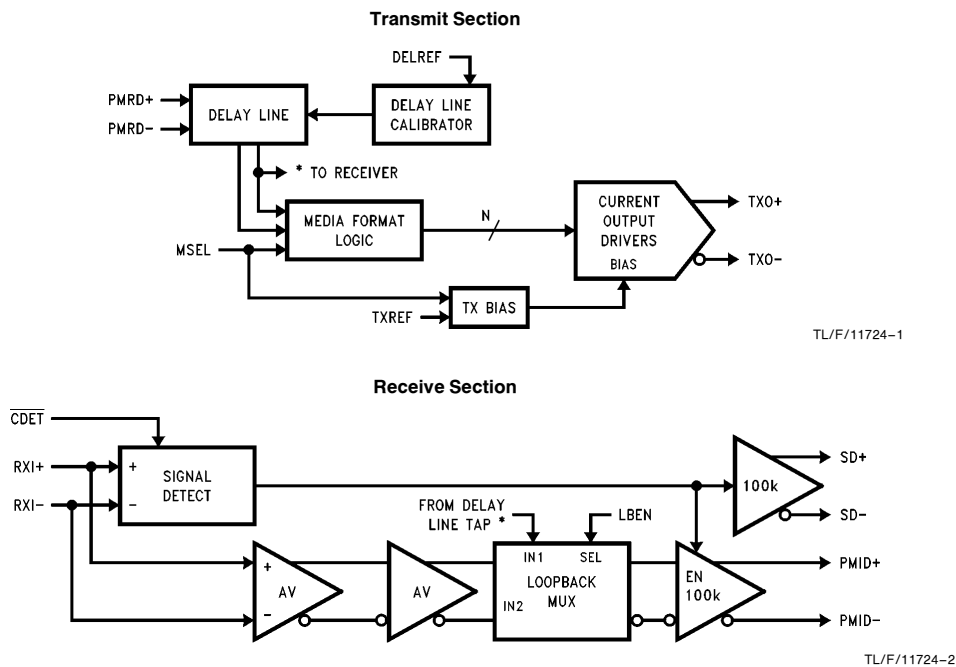


FIGURE 1. DP83220 Transceiver Block Diagram

CDL™, ODD™, CRD™ and PLAYER™ are trademarks of National Semiconductor Corporation.

1.0 Functional Description

The CDL Transceiver consists of nine major functional blocks as shown in *Figure 1*. The Transmit section includes the following: the Delay Line, the Delay Line Calibrator, the Media Format Logic, and the Current Output Driver circuitry with its bias circuitry. The Delay Line accepts the NRZI encoded data from the PMRD \pm pins and provides a short "memory" of the bit that preceded the bit currently being transmitted. The Delay Line Calibrator allows the use of an external resistor which governs the time calibration of the delay line. The Delay Line outputs the data via taps which are tied to the Media Format Logic. The encoding logic is dependent on the state of the Media Select pin. The encoded data is routed to the Current Output Driver, through the TXO \pm output pins and transformer coupled to the media.

The Receive section consists of the following: a differential input amplifier, Signal Detect circuitry, a Loopback Multiplexer, and differential 100K output drivers for data and Signal Detect. The Receive signal is input to the RXI \pm pins from the receive isolation transformer. The input signal is sensed by the Signal Detect circuit. The input signal also drives a differential input amplifier whose output is coupled to the Loopback Mux logic. The 'sel' input which is driven by LBEN controls which data stream, RXI \pm or Loopback data,

is routed to the differential 100K Output Driver. When in Loopback mode, the Signal Detect output driver is forced true. When receiving data from copper media, the signal detect circuit provides valid states to the Signal Detect output driver depending on the amplitude of the incoming signal and also allows the PMID \pm outputs to switch. Cable Detect is the final gating function for data reception. If no media is detected, the transceiver will generate a logic low Signal Detect which will inhibit data reception by the PHY.

1.1 SDDI OPERATION

The CDL allows full compatibility with the current SDDI specification. By allowing the MSEL pin to float, which forces the pin to V_{CC}/2 internally, the SDDI mode of operation is selected. The appropriate transmit voltage amplitude must also be set by selecting a value of 2.6 k Ω for the TXREF resistor.

Finally, it is important to note that the CDL must be used in conjunction with the Pulse Engineering 8.3 magnetics module in order to conform to the current SDDI specification. No special terminations are required in connecting the Pulse Engineering 8.3 module to the CDL. (Refer to the typical SDDI schematic, *Figure 9*.)

2.0 Pinout Summary

Signal	Pin No.	Description	Type
V _{CC}	13, 26	V _{CC}	Supply
GND	14, 22	GND	Supply
RXV _{CC}	4, 27	Receive V _{CC}	Supply
RXGND	3, 28	Receive GND	Supply
TXV _{CC}	5, 11	Transmit V _{CC}	Supply
TXGND	7, 10	Transmit GND	Supply
EXTV _{CC}	23	External V _{CC}	Supply
RXI \pm	2, 1	Receive Data Inputs	Current In
PMID \pm	25, 24	Physical Media Indicate Data	ECL Out
PMRD \pm	15, 16	Physical Media Request Data	ECL In
TXO \pm	9, 8	Transmit Data Outputs	Current Out
SD \pm	20, 21	Signal Detect Outputs	ECL Out
TXREF	6	Transmit Amplitude Reference	Current Out
DELREF	12	Delay Line Calibration Reference	Current Out
LBEN	19	Loopback Enable	CMOS In
MSEL	17	Media Select	3-Level Select
CDET	18	Cable Detect Bar	CMOS Schmitt Trigger In

3.0 Pin Definitions

V_{CC} (13,26): Positive power supply for the 100K ECL compatible circuitry. The Transceiver operates from a single +5 V_{DC} power supply.

GND (14,22): Return path for the 100K ECL compatible circuitry power supply.

RXV_{CC} (4,27): Positive power supply for the small signal receive circuitry. This power supply is intentionally separated from others to eliminate receive errors due to coupled supply noise.

RXGND (3,28): Return path for the receive power supply circuitry. This Power supply return is intentionally separated from others to eliminate receive errors due to coupled supply noise.

TXV_{CC} (5,11): Positive power supply required by the analog portion of the transmit circuitry. This power supply is intentionally separated from the others to prevent supply noise from coupling to the transmit outputs.

TXGND (7,10): Return path for the analog transmit power supply circuitry. This supply return is intentionally separated from others to prevent supply noise from being coupled to the transmit outputs.

EXTV_{CC} (23): Positive power supply for receiver output circuitry.

RXI \pm (2,1): Balanced differential line receiver inputs. Signals meeting the input threshold for a given media type are output through PMID \pm as differential ECL.

PMID \pm (25,24): 100K ECL compatible differential outputs used as the source of the receive data for the DP83231 Clock Recover Device (CRD™).

PMRD \pm (15,16): Differential 100K compatible 4B5B NRZI transmit data inputs originating from the DP83251/55 Physical Layer Device (PLAYER™).

TXO \pm (9,8): Differential current driver outputs precompensated for twisted pair cable.

SD \pm (20,21): Differential 100K ECL compatible Signal Detect outputs indicating that a valid signal is present at the RXI \pm inputs.

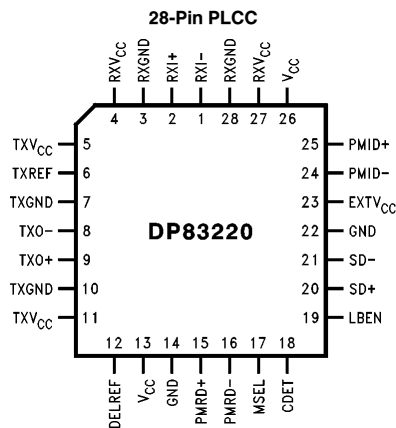
DELREF (12): A resistor is connected between this pin and GND. The value of this resistor controls the current into the delay line calibrator which, in turn controls the delay time of the delay line.

TXREF (6): A resistor is connected between this pin and TXGND. The value of this resistor controls the signal amplitude of the TXO \pm data which drives the twisted pair.

LBEN (19): TTL compatible CMOS Loopback Enable input pin selects the internal loopback path which effectively routes the PMRD \pm data to the PMID \pm differential outputs.

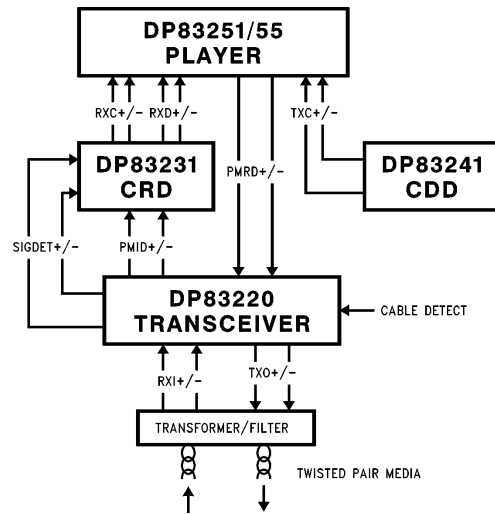
MSEL (17): The Media Select input controls the compensation and output current required to drive to 100 meters of either STP or DTP media. This is a tri-level control pin. When forced to a low voltage, STP compensation is selected. Forcing a high voltage level will select the DTP compensation mode. Forcing a median voltage allows the device to operate in the transparent mode by deasserting pre-emphasis.

CDET (18): The Cable Detect input is provided to support the option of external Cable Detection circuitry. With CDET low, the CDL transceiver functions normally. When CDET is high, the signal detect output is forced low which inhibits data reception by the PHY. The exception is in the case of Loop Back, where Signal Detect is forced high regardless.



TL/F/11724-3

Order Number DP83220V
See NS Package Number V28A
FIGURE 2. Pin Configuration



TL/F/11724-4

FIGURE 3. System Connection Diagram

4.0 Electrical Characteristics

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V _{CC}	Logic Power	Referenced to GND	-0.5		6.0	V
RXV _{CC}	Received Power	Referenced to RXGND	-0.5		6.0	V
TXV _{CC}	Transmit Power	Referenced to TXGND	-0.5		6.0	V
EXTV _{CC}	ECL Output Power	Referenced to GND	-0.5		6.0	V
I _{ECL}	DC Output Current (High)				-50	mA
ESD				TBD		
T _{storage}	Storage Temperature		-65		+150	°C

4.1 RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V _{CC}	Supply Voltage		4.5	5.0	5.5	V
T _A	Operating Temperature		0	25	70	°C
P _D	Power Dissipation			600		mW

4.2 DC ELECTRICAL CHARACTERISTICS T_A = 25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V _{IHt}	TTL High Level Input		2.0			V
V _{ILt}	TTL Low Level Input				0.8	V
V _{IHschmitt}	Schmitt High Level Input		3.7			V
V _{ILschmitt}	Schmitt Low Level Input				1.5	V
V _{IHmsel}	MSEL High Level Input		3.7			V
V _{ILmsel}	MSEL Low Level Input				1.5	V
V _{IMmsel}	MSEL Middle Level Input			V _{CC} /2		V
V _{IHe}	ECL High Level Input		V _{CC} - 1165		V _{CC} - 870	mV
V _{ILe}	ECL Low Level Input		V _{CC} - 1830		V _{CC} - 1475	mV
V _{OHe}	ECL High Level Output	Refer to Figure 4	V _{CC} - 1035		V _{CC} - 870	mV
V _{OLe}	ECL Low Level Output	Refer to Figure 4	V _{CC} - 1830		V _{CC} - 1605	mV
I _{CC1}		Refer to Figure 4		90		mA
I _{CCt}	Total Supply Current	Refer to Figure 4		145		mA
I _{TXO1}	Transmit Current 1	Transmit Current / 100Ω Z _O			20	mA
I _{TXO2}	Transmit Current 2	Transmit Current / 150Ω Z _O			15	mA
SD _{THon}	Sig Det Turn-On Threshold	Refer to Figure 5, Note 1	60			mV
SD _{THoff}	Sig Det Turn-Off Threshold	Refer to Figure 5, Note 1			15	mV

4.3 AC ELECTRICAL CHARACTERISTICS T_A = 25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t _{TXr/f}	TX Driver Rise and Fall	Into 25Ω in Parallel with 50 pF		1.6		ns
t _{TXr/f}	TX Driver Rise and Fall	Into 37.5Ω in Parallel with 50 pF		2.5		ns
t _{TXpd}	TX Propagation Delay	From PMRD ± to TXO ±		6		ns
t _{RXpd}	RX Propagation Delay	From RXI ± to PMID ±		10		ns
T _{TXskew}	TX Driver Skew			0		ps

Note 1: Subject to change.

4.0 Electrical Characteristics (Continued)

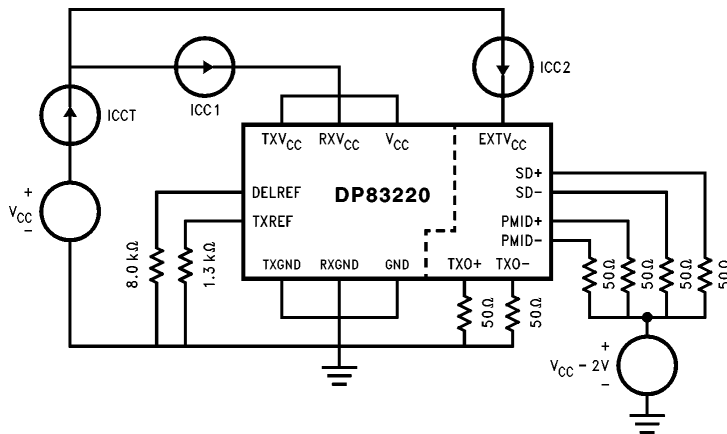


FIGURE 4. I_{CC} Diagram

TL/F/11724-5

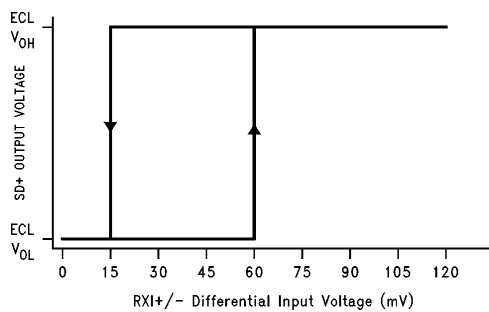


FIGURE 5. Signal Detect Threshold

TL/F/11724-6

4.0 Electrical Characteristics (Continued)

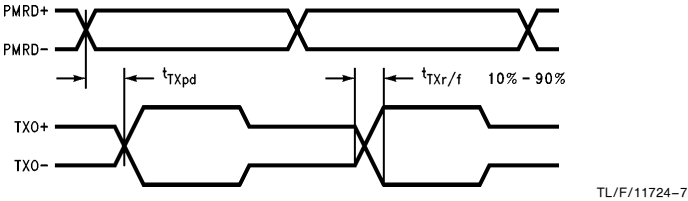


FIGURE 6. Transmit Timing

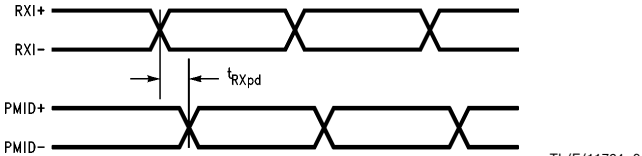


FIGURE 7. Receive Timing

4.0 Electrical Characteristics (Continued)

4.3 TRANSMIT DATA AND CURRENT DRIVER OUTPUT

TXD _n	TXD _{n-1}	I _{TXO+}	I _{TXO-}
0	0	(I ₁) I _{max}	(I ₂) I _{max}
0	1	(I ₁ + I ₂) I _{max}	0
1	0	0	(I ₁ + I ₂) I _{max}
1	1	(I ₂) I _{max}	(I ₁) I _{max}

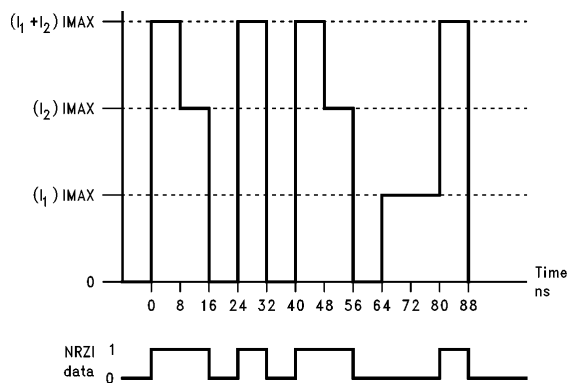


FIGURE 8. Typical Pre-Emphasized Current Waveform, I_{TXO+}

TABLE I. Media Select

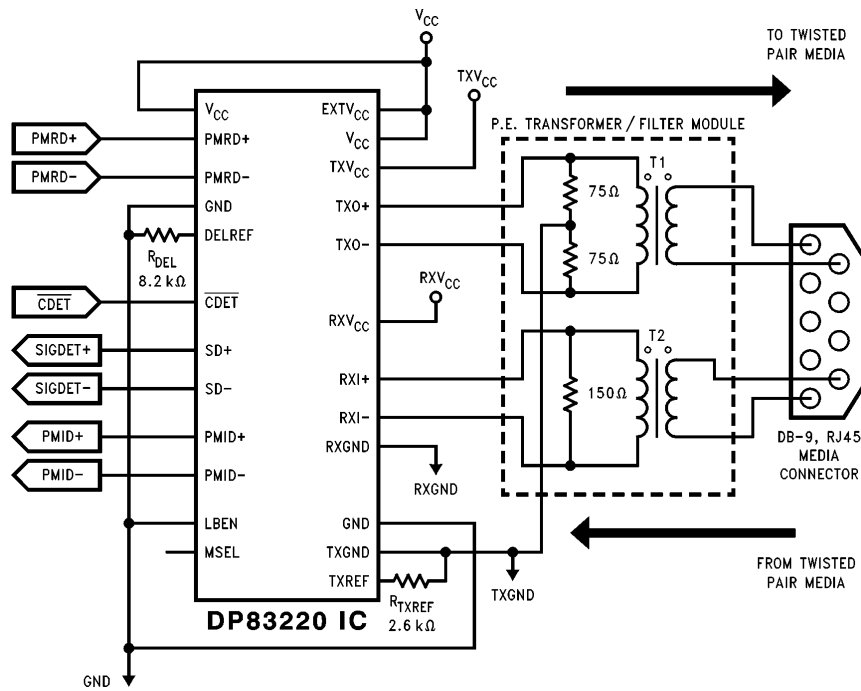
Mode	MSEL
STP	<1.5V
DTP	>3.7V
SDDI	Float

TABLE II. Data Paths and Signal Detect

LBEN	$\overline{\text{CDET}}$	Data @ PMID \pm	SD \pm
0	1	RXI \pm	0
0	0	RXI \pm	1
1	1	PMRD \pm	1
1	0	PMRD \pm	1

Note: This table assumes that minimum signal's levels required by Signal Detect have been met.

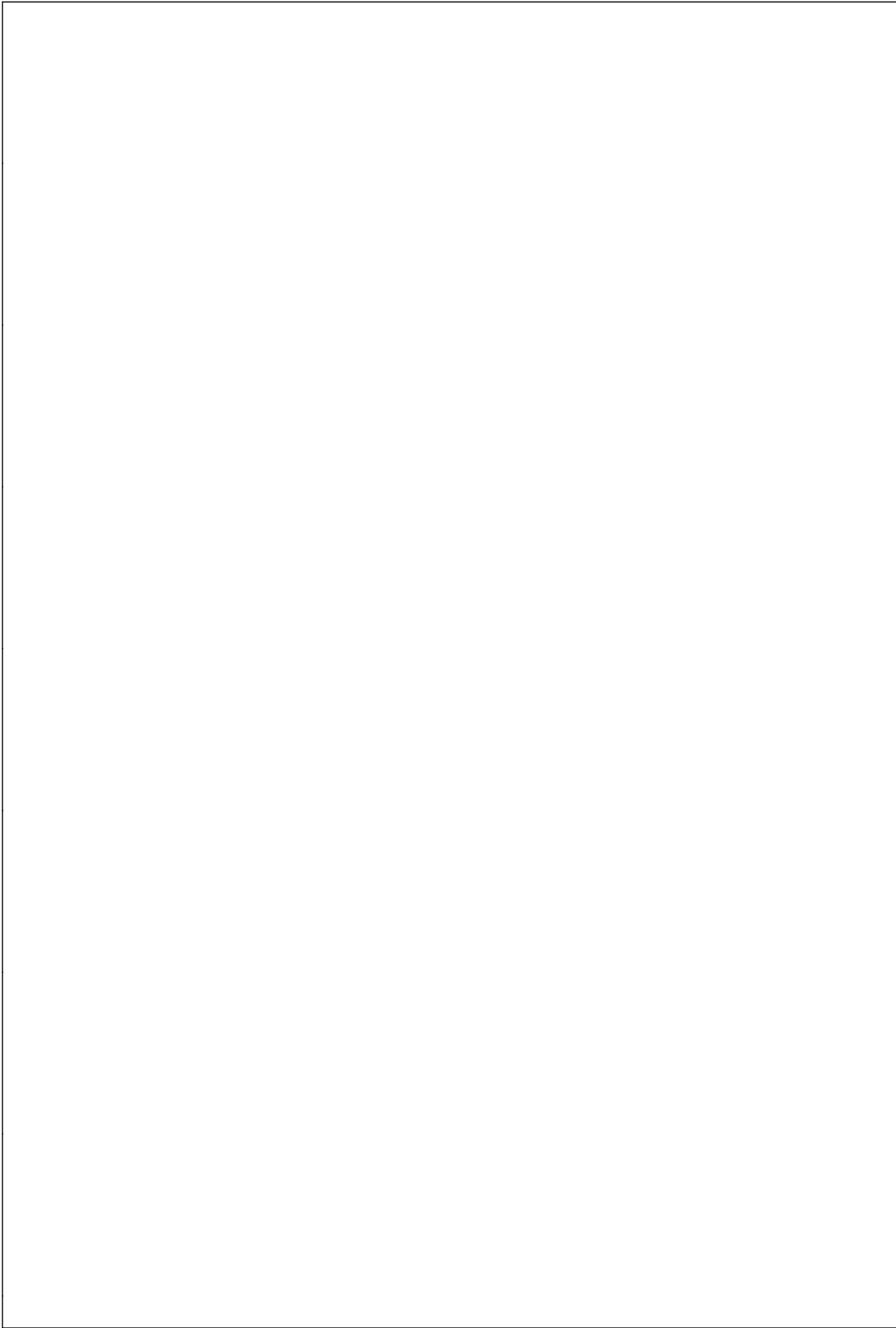
4.0 Electrical Characteristics (Continued)



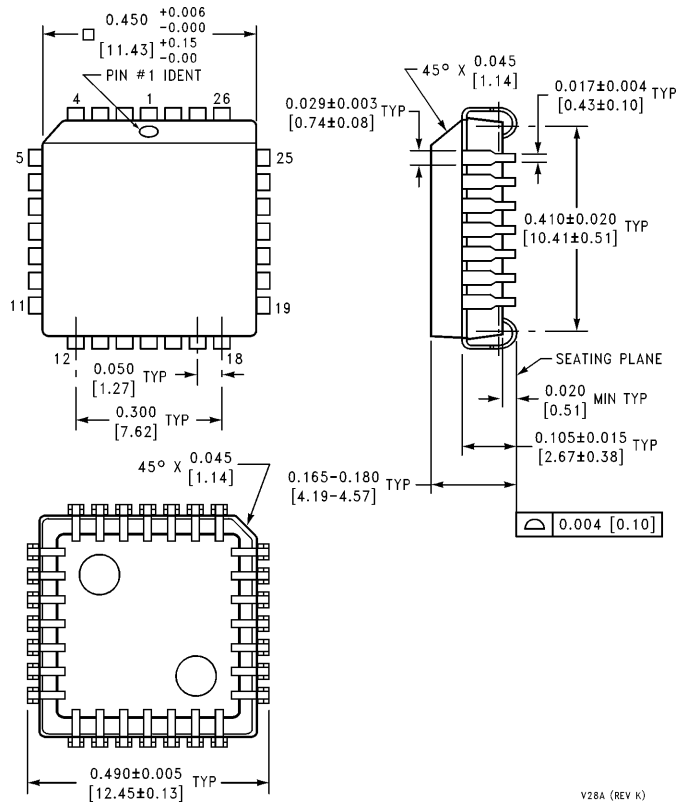
TL/F/11724-10

Refer to the Pulse Engineering datasheet for detailed information on the 8.3 SDDI magnetics module.

FIGURE 9. Typical Schematic for SDDI Application



Physical Dimensions inches (millimeters)



V28A (REV K)

28-Pin Plastic Leaded Chip Carrier (V)
Order Number DP83220V
NS Package Number V28A

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



National Semiconductor Corporation
 1111 West Bardin Road
 Arlington, TX 76017
 Tel: 1(800) 272-9959
 Fax: 1(800) 737-7018

National Semiconductor Europe
 Fax: (+49) 0-180-530 85 86
 Email: cnjwge@tevm2.nsc.com
 Deutsch Tel: (+49) 0-180-530 85 85
 English Tel: (+49) 0-180-532 78 32
 Français Tel: (+49) 0-180-532 93 58
 Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
 19th Floor, Straight Block,
 Ocean Centre, 5 Canton Rd.
 Tsimshatsui, Kowloon
 Hong Kong
 Tel: (852) 2737-1600
 Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
 Tel: 81-043-299-2309
 Fax: 81-043-299-2408

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.