



32- OR 96-CHANNEL DISCRETE-TO-DIGITAL INTERFACE "RXD3"

DESCRIPTION

The DD-03201 is a discrete-to-digital interface device. The inputs have been designed to handle 28 V/Gnd, 28 V/Open, and Open/Gnd signals. The device can also be configured as either a 32 triple-redundant or 96 non-redundant discrete input with either a microprocessor and/or ARINC 429 output. The device can be HIRF protected by adding capacitors to the input resistor network.

The device uses comparators in a triple-redundant configuration to take a consensus of the input state and raise a flag when there is no consensus. The device's microprocessor output is an addressable 8-bit or 16-bit tri-state port, which selects channel data, status, bounce, built-in-self-test (BIST) and major fault. All are compatible with TTL logic.

APPLICATIONS

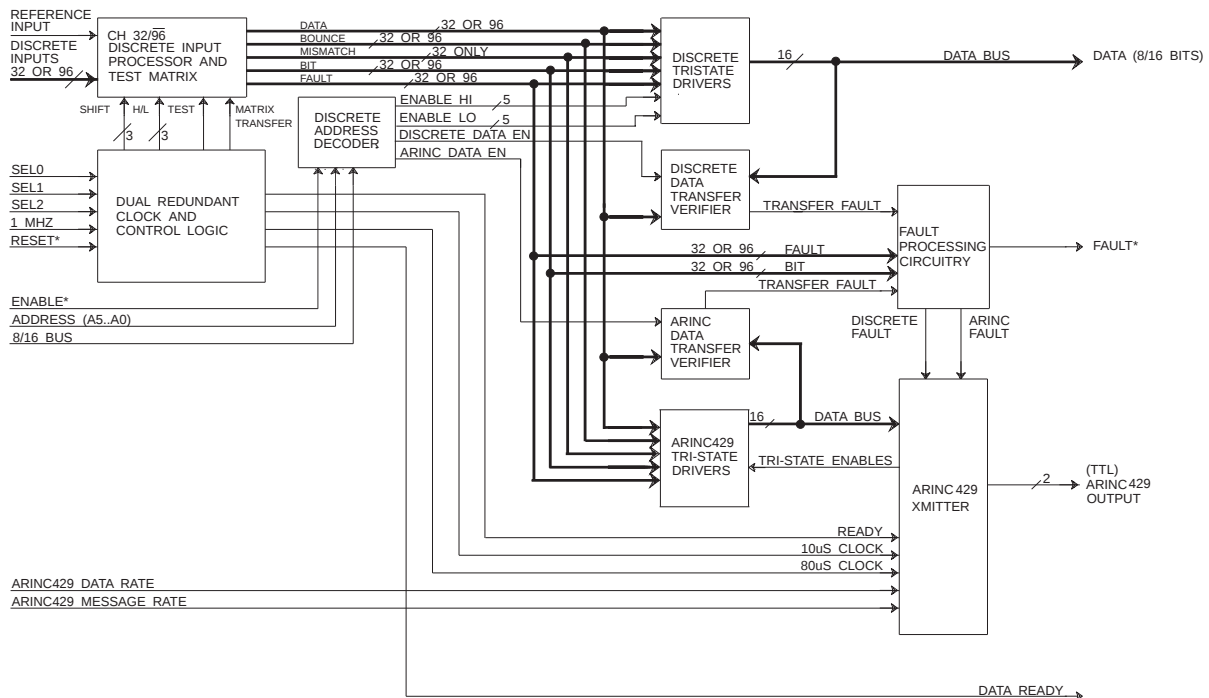
The design specifically addresses redundancy, built-in self-test autonomy, fault isolation and tolerance at the chip level.

In the 96-channel mode the device loses the capability of taking consensus of the input states as well as mismatch. These features are triple-redundant configuration specific. All other features are still available.

These features, along with high-reliability and low cost, enable the device to serve a variety of interface requirements in aerospace applications, including flight critical, essential and non-essential functions. The optional ARINC 429 output port is particularly well-suited to data concentrator requirements.

FEATURES

- **Universal Inputs -Configurable As 28 V/Gnd, 28 V/Open, 28 V/Open Input Resistor Usage**
- **Built-In Self-Test**
- **Soft Failure Reporting Deferred Maintenance Higher MTBUR**
- **Optional ARINC 429 Output Port**



Note: (*) Indicates active low.

FIGURE 1. DD -03201 BLOCK DIAGRAM

TABLE 1. DD-03201 SPECIFICATION				
PARAMETER	UNITS	MIN	TYP	MAX
ABSOLUTE MAXIMUM RATINGS				
Supply Voltages (V_{DD})	V	-0.3	5.0	7.0
Analog Inputs	V	-0.3		$V_{DD}+0.3$
Digital Inputs	V	-0.3		$V_{DD}+0.3$
OPERATING CONDITIONS				
Supply Voltages (V_{DD})	V	4.5		5.5
DIGITAL				
INPUTS/OUTPUTS				
Logic Compatibility	TTL			
Digital Inputs				
■ V_{IH}	V	2.0		
■ V_{IL}	V			0.8
Clock Inputs (See Note 1)	MHz	0.99	1.00	1.01
Digital Outputs				
■ V_{OH} ($I_{OH} = 4\text{ma}$)	V	2.4		
■ V_{OH} ($I_{OH} = -1\text{ma}$)	V	$V_{DD}-0.5$		
■ V_{OL} ($I_{OL} = 4\text{ma}$)	V			0.4
ANALOG INPUTS				
Analog Inputs				
■ Input currents:				
Input channels	μA	-0.1		0.1
Reference inputs	μA	-1.0		1.0
Self-test inputs	μA	-1.0		1.0
■ Input Offset Voltage:				
Input channel to corresponding reference input	mV	-15		15
■ Input Common Mode Range:				
Input channel and corresponding reference input	V	V_{SS}		V_{DD}
POWER SUPPLY REQUIREMENTS				
(Total V_{DD} , Analog & Digital)				
I_{DD} ($V_{DD} = +5\text{V}$ [Digital Outputs Unloaded])	mA		25	45
POWER DISSIPATION				
P_D	mw		125.0	250.0
THERMAL				
Operating Temperature				
■ Type 1	$^{\circ}\text{C}$	-40		85
■ Type 2	$^{\circ}\text{C}$	-55		125
■ Type 3	$^{\circ}\text{C}$	0		70
Storage Temp	$^{\circ}\text{C}$	-65		150
Lead Temperature				
(Localized, 1 sec. duration)	$^{\circ}\text{C}$			280
(Body, 2 sec. duration)	$^{\circ}\text{C}$			210
Junction Temperature				
θ_{jc}	$^{\circ}\text{C/W}$		5.0	
θ_{ca}	$^{\circ}\text{C/W}$		20.0	

TABLE 1. DD-03201 SPECIFICATION				
PARAMETER	UNITS	MIN	TYP	MAX
MTBF per MIL-Hbk 217 for airborne Inhabited Cargo at 64°C	96-Channel: 269,326 hrs. 32-Channel: 332,742 hrs.			
PHYSICAL CHARACTERISTICS				
Size	in. (mm)	1.1 x 1.1 28 x 28		
Weight	oz. (g)	1.0 26.0		

Note:

For the ARINC 429 option the bit rate is derived from the clock. Refer to ARINC 429 Bit Rate to avoid interference. ARINC 429-14 (January 4, 1993), paragraph 2.4, "Timing Related Elements" contains a "Commentary" section following subparagraph 2.1.4.2 ("Low Speed Operation") that cautions against using "precisely" 100 kilobits per second.

WHAT IS A DISCRETE?

Advisory Circular (FAA), Airworthiness Approval of Traffic Alert and Collision Avoidance Systems (TCAS II) and Mode S Transponders, AC20-131, defines a discrete as "a separate, complete and distinct signal." In many instances these signals are binary, on or off, 28 V-based signals; they are typically Open/Gnd, 28 V/Open, or 28 V/Gnd with very low bandwidth (DC to 200 Hz).

While on the surface the translation of these signals to TTL-levels compatible with digital avionics may seem simple, RTCA DO-160C power, lighting and high-intensity-radiated-fields (HIRF) are complicating factors. Add to that the desire to have a standardized, addressable, reliable interface and the challenge becomes apparent.

Today's systems address the interface with circuits tailored for each interface comprised of R-C input filters, divider networks, diode isolation and comparators. Multichannel interface to a processor requires additional logic and latches. The resulting circuit generally lacks any built-in test capability, consumes considerable pc-board real estate (up to one sq. in. per channel), and offers no chip-level redundancy.

FUNCTIONAL INTEGRATION

Using the aggregated definition and functional requirements of industry, ILC Data Device Corporation has developed a programmable 32/96-channel discrete interface with inputs capable of handling 28 V/Open, Open/Gnd and 28 V/Gnd signals. When using the 32-channel mode, the design uses comparators in a triple-redundant configuration, so that each channel will take a consensus of the input state, and raise a flag when there is no consensus (consensus fails). The device's output is a selectable 8-bit or 16-bit tri-state port, which can be addressed for channel data, status, bounce, built-in-self-test and major fault information.

This design specifically addresses built-in self-test autonomy, fault isolation and tolerance; moreover, its functional integration

results in significant added reliability. A comparative look at MTBF calculated in accordance with MIL-HBK-217 for airborne inhabited cargo environments at 64°C indicates an order of magnitude improvement for an integrated approach vs. a similarly packaged discrete-component implementation. Moreover, the real estate is reduced from 32 square inches to 1.21 square inches for a 32-channel and from 64 square inches to 1.21 square inches for the 96-channel device.

Additional key features include:

FAULT ISOLATION: In 32-channel mode, triple-redundant comparators are physically located on three different edges of the custom chip so that an edge failure is not catastrophic.

FAULT TOLERANCE: In 32-channel mode, a single comparator failure is reported as a mismatch or BIT fault, but does not result in a hard-failure.

BOUNCE: Relays and switches, as mechanical devices, have a characteristic 'bounce' to their signal transition. It is desirable to mask this bounce by delaying the output digital transition accordingly. This sampling rate of the device can be varied to allow for debounce of relay/switch inputs. In addition, the triple sampling of a given comparator enables a consistent reading of otherwise asynchronous signals. Bounce is an addressable register that allows the user to detect bouncing or intermittent relays/switches.

REGISTERS: 8-bit or 16-bit selectable data or status is available via tri-state buffers for interface to any system processor.

OPTIONAL ARINC 429 PORT: A serial ARINC 429 output is available for data concentrator applications. This enables the transfer of data to other systems with a minimum of wiring and processor loading.

TEST PATTERNS: Internal Test Patterns can be selected to produce alternating '1's and '0's to verify that all address and data bits are operational. These outputs are always available, **regardless** of READY state. They must be addressed by the user (A5... A0) in accordance with TABLES 3 and 4.

DISSIMILAR PATHS: Errors are reported through registers and the optional ARINC 429 port as crosschecks.

DEFERRED MAINTENANCE: The error reporting scheme differentiates soft- and hard-failures to allow continued operation despite failures.

INTELLIGENCE: The device's built-in self-test, status reporting scheme and fault-tolerance/isolation significantly reduces application software requirements. FIGURE 1 illustrates the model DD-03201 functional block diagram.

MICROPROCESSOR INTERFACE

READ CYCLE TIMING

The DD-03201 is configured with either an 8-bit or a 16-bit microprocessor. FIGURE 2 illustrates this interface.

The read cycle(s) should be preceded by polling the device's READY bit which is located within the Status Register. The Status Register can be read at any time regardless of the state of the READY signal (pin 150) from the device.

If the READY bit is a logic "1" (this can be easily tested by a branch if negative statement) the address of the desired register, along with the negative true $\overline{\text{ENABLE}}$ signal, should be presented to the device. The additional data will be available within 100 nsec.

After the data is read the $\overline{\text{ENABLE}}$ line should be returned to a logic "1" level.

All of the data within the device is guaranteed to remain stable for at least 20 μsec after the high-to-low transition of the READY signal (See FIGURE 3).

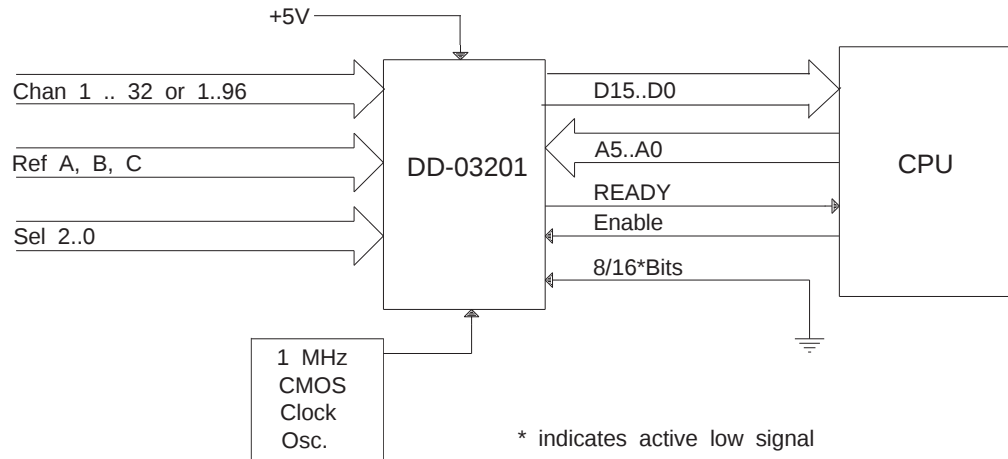
ANALOG INPUTS

FIGURE 4 illustrates the architecture of the analog input and front-end self-test circuits. Each group of 32-channels (A, B and C groups) are identically configured, with REF_A setting the threshold for the 'A' group of comparators, REF_B setting the threshold for the 'B' group, etc. During the self-test portion of each cycle, the comparator inputs are switched from the NORMAL to the TEST position, an alternating 1/0 (HI/LO) pattern is applied to each group of comparators and a functional test is performed. The test is then repeated with an alternating 0/1 (LO/HI) pattern.

INPUT CHANNELS: (Pins 4-19, 22-37, 44-59, 62-77, 81-96 and 99-114) Configured as three groups of 32-channels each; each group is associated with its own reference and self-test inputs. The device may be connected as 96-independent channels or 32-triple-redundant channels. Refer to FIGURE 5 and FIGURE 6 for a typical example of each configuration. For 32-channel operation, "Channel 1" drives the A1, B1 and C1 inputs, "Channel 2" drives the A2, B2 and C2 inputs, and so forth. The example in FIGURE 5 shows redundant input networks that provide isolation between ASIC input pins and protect the two working channel sections in the event of a short from an ASIC input pin to ground or V_{DD} on the the third section.

REFERENCE INPUTS: (Pins 39, 79 and 116) Each reference input sets the threshold voltage for the corresponding group of 32 comparators.

SELF-TEST INPUTS: (Pins 38, 40, 78, 80, 115 and 117) High and low self-test threshold settings. These settings should be set to at least 100 mV above (HI) and 100 mV below (LO) the reference (REF) input for the corresponding group of 32 comparators.



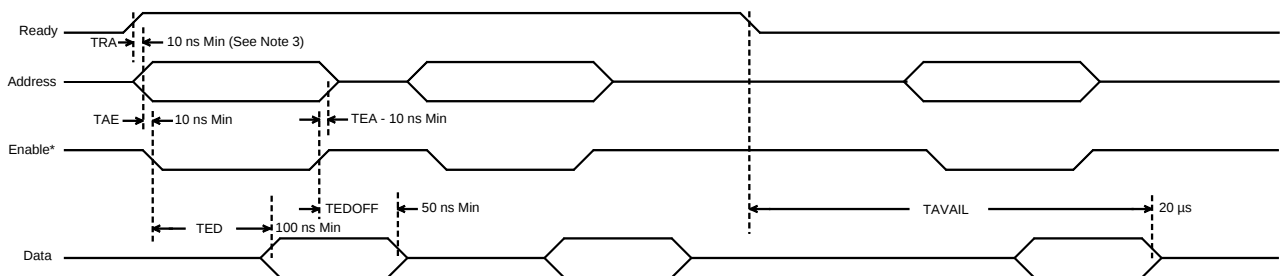
NOTE: 1) If 8/16* Bits pin is tied to +5 Volts, then the DD-03201 is configured for 8-Bit Mode.

The following must also be modified:

- D0 tied to D8
- D1 tied to D9
- D2 tied to D10
- D3 tied to D11
- D4 tied to D12
- D5 tied to D13
- D6 tied to D14
- D7 tied to D15

2) If the ARINC 429 option is not used, then pin 156 (429STRBI) MUST be grounded for the "bounce" circuit to operate properly.

FIGURE 2. DD-03201 TO CPU INTERFACE



- Note:
- 1) TRA = Time Ready Address
 - 2) TAE = Time Address Enable
 - 3) TEA = Time Enable to Address
 - 4) TED = Time Enable Data
 - 5) TEDOFF = Time Enable Off - Data Off
 - 6) TAVAIL = Time Ready* - Data Available
 - 7) (*) Indicates active low.
 - 8) The ready "on-time" = (sample rate - 440 μ s)
- Sample rate is programmable via SEL0 - SEL2 (See TABLE 2)

FIGURE 3. READ CYCLE TIMING

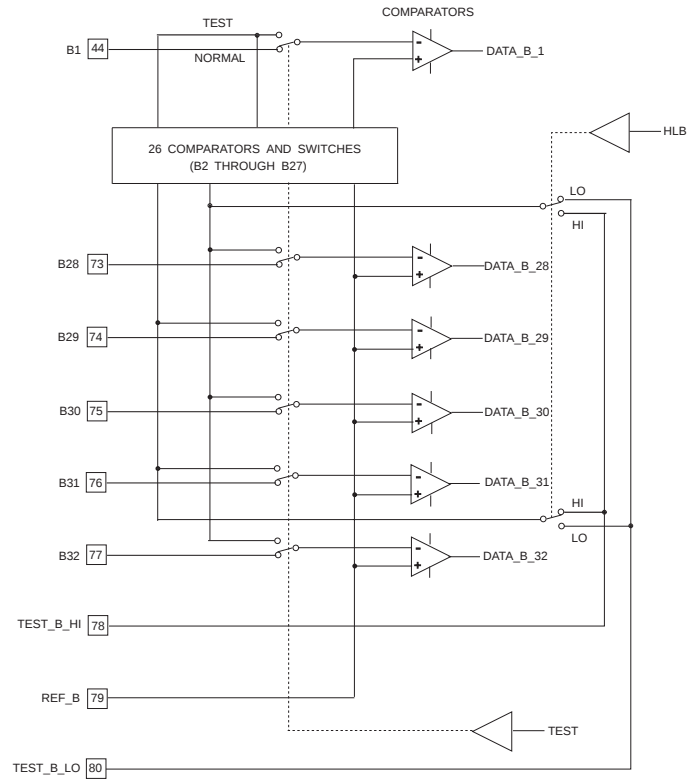


FIGURE 4. DD-03201 (ASIC) INPUT STRUCTURE

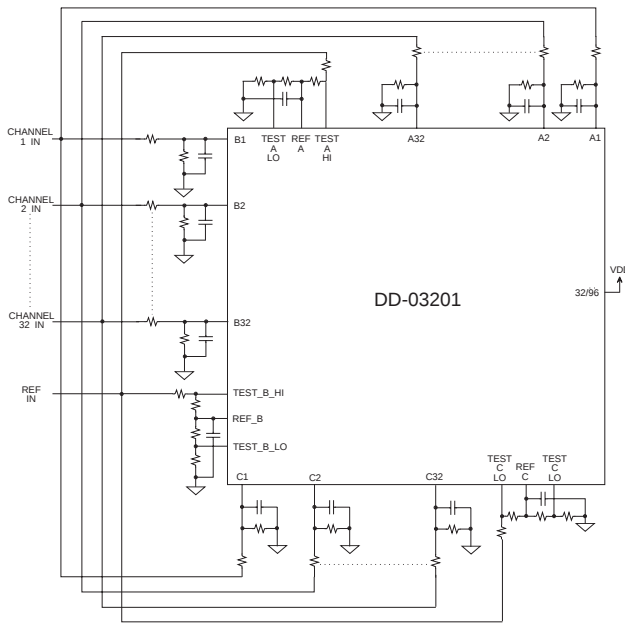


FIGURE 5. DD-03201 32-CHANNEL CONFIGURATION

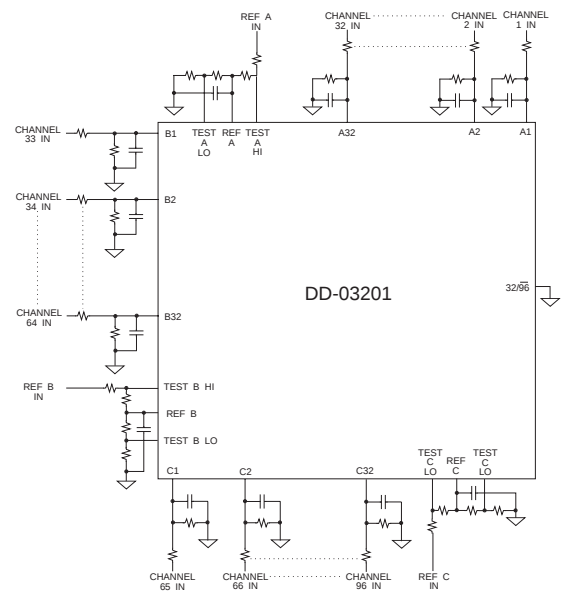


FIGURE 6. DD-03201 96-CHANNEL CONFIGURATION

DIGITAL INPUTS

DEBOUNCE (SEL2...SEL0): (Pins 1-3) The Input Discrete Sampling Rate (Debounce Time) is user-programmable via the three Select lines (SEL2...SEL0) in accordance with TABLE 2. The intent of this function is to mask the bounce of the input discrete appropriate to its characteristic performance. See **BOUNCE** on page 3.

TABLE 2. DISCRETE SAMPLING RATE	
SELECT (SEL 2 . . SEL 0)	SAMPLE RATE
000	5 msec
001	10 msec
010	20 msec
011	50 msec
100	100 msec
101	200 msec
110	500 msec
111	1000 msec

ENABLE: (Pin 149) The $\overline{\text{ENABLE}}$ line controls the tri-state drivers of the 8- or 16-bit Data Bus outputs. The tri-state Data Bus drivers are enabled when this signal is a logic “0”, and are tri-stated when this signal is a logic “1”. $\overline{\text{ENABLE}}$ is a read signal and should only be low during read cycles.

8 /16 BITS: (Pin 119) A logic “0” selects the 16-bit data bus output and logic “1” selects the 8-bit data bus output.

ADDRESS LINES (A5...A0): (Pins 143-148) The six address lines (A5...A0, where A0 is the LSB) provide for the selection of the

desired 8- or 16-bit data bus information in accordance with TABLE 5 and TABLE 6 (Word/Byte Modes).

CLKA and CLKB (1MHz CLK): (Pins 160 and 121) Dual redundant input clock paths are provided to the ASIC at two widely separated points to improve operational reliability. The 1 MHz clock should be connected to both CLKA and CLKB inputs (exact frequency and stability is important only to the serial bit rate of the ARINC 429 port, see NOTE 1, TABLE 1). Optional isolation resistors (200 ohms maximum) may be installed in series with each input to facilitate testing of the clock monitoring circuitry (see FIGURE 7). In the event of loss of CLKA (primary) input to ASIC, internal circuitry combined with external RC networks (see **A TIMER and B TIMER**) switches to the CLKB (secondary) source. Both clocks are continuously monitored for status and this information is available as separated bits in the Status Register.

A TIMER and B TIMER: (Pins 124 and 123) Clock monitoring and switching depends upon RC networks installed at these two pins (FIGURE 7). Each pin must have a 100 kΩ, 5% resistor to VDD and a 0.001 μF, 20% capacitor to ground.

FACTORY TEST INPUTS: (Pins 41, 42, 152 and 153) The $\overline{\text{TMUX}}$, $\overline{\text{TMODE}}$, $\overline{\text{FMUX}}$ and $\overline{\text{FMODE}}$ input signals are used for factory testing and should be tied to logic “1” for the device to operate properly.

RESET: (Pin 43) The $\overline{\text{RESET}}$ signal is used to reset the device during factory testing. It must be connected to an external RC network (100 kΩ, 5% resistor to VDD and a 0.01μf, 20% capacitor to ground) to provide a Power-on-Reset for the device. If there is some reason to reset the device from external circuitry this pin can be momentarily pulled to logic “0” through an open collector device. **Do not hard wire this pin to +5V or ground.**

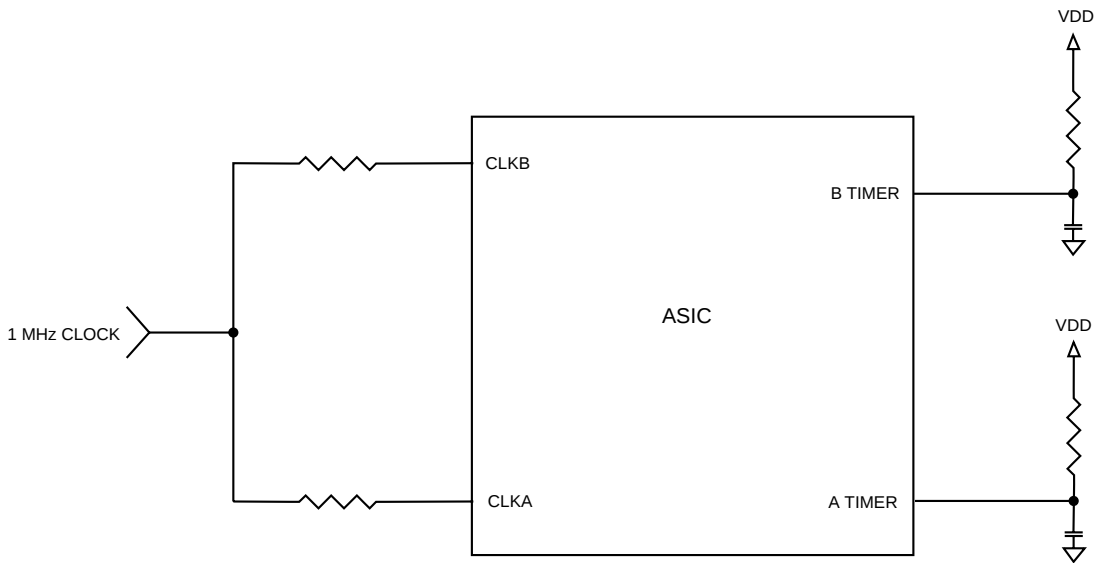


FIGURE 7. DD-03201 CLOCK INPUTS AND TIMERS

TABLE 3. 32-CHANNEL WORD MODE (16-BIT BUS)	
ADDRESS (A5...A0)	DATA (D7...D0)
00 000X	BOUNCE CH 16..CH_01
00 001X	BOUNCE CH 32..CH 17
00 010X	MISMATCH CH_16..CH_01
00 011X	MISMATCH CH_32..CH 17
00 100X	BIT CH_16..CH_01
00 101X	BIT CH 32 CH_17
00 110X	FAULT CH_1 6 CH 01
00 111X	FAULT CH_32 CH 17
01 000X	DATA CH 1 6 CH_01
01 001X	DATA CH 32 CH_17
01 010X	TEST PATTERN 0's and 1's
01 011X	STATUS REGISTER
01 100X	FACTORY TEST WORD 1
01 101X	FACTORY TEST WORD 2
01 110X	FACTORY TEST WORD 3
01 111X	FACTORY TEST WORD 4
10 000X	NOT USED
10 001X	NOT USED
10 010X	NOT USED
10 011X	NOT USED
10 100X	NOT USED
10 101X	TEST PATTERN 1's and 0's
10 110X	NOT USED
10 111X	:
11 111X	NOT USED

NOTES FOR TABLES 3 AND 4.

Note 1: A true BOUNCE bit indicates that the input signal of the associated channel changed in an alternating fashion, i.e., OFF-ON-OFF or ON-OFF-ON in three successive samples at the selected sampled rate.

Note 2: A MISMATCH bit that is true indicates that one of the triple-redundant inputs of the associated channel did not agree with the other two for three consecutive samples of the input i.e., there was a lack of consensus for the three inputs. A MISMATCH indication is a SOFT FAULT condition indicating that there is a problem with the channel but the associated output data can be believed because of the internal voting taking place.

Note 3: A BIT indication for any channel signifies that the associated channel has failed the Built-In-Test sequence which is performed prior to every input sample taken. These signals are reset at the start of each Built-In-Test sequence, and will be set if any of the tests in the sequence fail. A BIT indication is a HARD FAULT condition indicating that the Built-in-Test has failed one or more of the voltage tests.

Note 4: A FAULT bit that is true indicates that the associated channel has a major problem and the associated data should not be believed. A FAULT is a HARD FAULT condition.

Note 5: A DATA bit indicates the triple-redundant vote or unanimous consensus of the input discrete state for the associated channel over the last two data samples taken.

Note 6: The two available TEST PATTERNS contain an alternating string of 1's and 0's, and 0's and 1's, which can be used to verify that all of the data bits are operational, i.e., there are no stuck bits. The two test patterns have been located at addresses of alternating address bits so that the address decoder bits are tested at the same time.

TABLE 4. 32-CHANNEL BYTE MODE (8-BIT BUS)	
ADDRESS (A5...A0)	DATA (D7...D0)
00 0000	BOUNCE CH_08 CH_01
00 0001	BOUNCE CH_1 6 CH_09
00 0010	BOUNCE CH_24 CH_17
00 0011	BOUNCE CH 32 CH 25
00 0100	MISMATCH CH_08 CH_01
00 0101	MISMATCH CH_1 6 CH_09
00 0110	MISMATCH CH_24 CH_17
00 0111	MISMATCH CH_32 CH_25
00 1000	BIT CH_08 CH_01
00 1001	BIT CH_16 CH 09
00 1010	BIT CH_24 CH_17
00 1011	BIT CH_32 CH_25
00 1100	FAULT CH_08 CH_01
00 1101	FAULT CH_1 6 CH_09
00 1110	FAULT CH_24 CH_17
00 1111	FAULT CH_32 CH_25
01 0000	DATA CH_08 CH_01
01 0001	DATA CH_16 CH_09
01 0010	DATA CH_24 CH_17
01 0011	DATA CH_32 CH_25
01 0100	TEST PATTERN 0's and 1's
01 0100	TEST PATTERN 0's and 1's
01 0110	STATUS REGISTER LO
01 0111	STATUS REGISTER HI
01 1000	FACTORY TEST WORD 1 LO
01 1001	FACTORY TEST WORD 1 HI
01 1010	FACTORY TEST WORD 2 LO
01 1011	FACTORY TEST WORD 2 HI
01 1100	FACTORY TEST WORD 3 LO
01 1101	FACTORY TEST WORD 3 HI
01 1110	FACTORY TEST WORD 4 LO
01 1111	FACTORY TEST WORD 4 HI
10 0000	NOT USED
10 0001	NOT USED
10 0010	NOT USED
10 0011	NOT USED
10 0100	NOT USED
10 0101	NOT USED
10 0110	NOT USED
10 0111	NOT USED
10 1000	NOT USED
10 1001	NOT USED
10 1010	TEST PATTERN 1's and 0's
10 1011	TEST PATTERN 1's and 0's
10 1100	NOT USED
10 1101	:
11 1111	NOT USED

See Notes at left.

TABLE 5. 96-CHANNEL WORD MODE (16-BIT BUS)	
ADDRESS (A5...A0)	DATA (D7...D0)
00 000X	BOUNCE CH_16..CH_01
00 001X	BOUNCE CH_32..CH_17
00 010X	BOUNCE CH_48..CH_33
00 011X	BOUNCE CH_64..CH_49
00 100X	BOUNCE CH_80..CH_65
00 101X	BOUNCE CH_96..CH_81
00 110X	FAULT CH_16..CH_01
00 111X	FAULT CH_32..CH_17
01 000X	FAULT CH_48..CH_33
01 001X	FAULT CH_64..CH_49
01 010X	TEST PATTERN 0's and 1's
01 011X	FAULT CH_80..CH_65
01 100X	FAULT CH_96..CH_81
01 101X	DATA CH_16..CH_01
01 110X	DATA CH_32..CH_17
01 111X	DATA CH_48..CH_33
10 000X	DATA CH_64..CH_49
10 001X	DATA CH_80..CH_65
10 010X	DATA CH_96..CH_81
10 011X	NOT USED
10 100X	STATUS REGISTER
10 101X	TEST PATTERN 1's and 0's
10 110X	FACTORY TEST WORD 1
10 111X	FACTORY TEST WORD 2
11 000X	FACTORY TEST WORD 3
11 001X	FACTORY TEST WORD 4
11 010X	NOT USED
11 011X	:
11 111X	NOT USED

Notes for TABLES 5 and 6:

Note 1: A true BOUNCE bit indicates that the input signal of the associated channel changed in an alternating fashion i.e. OFF-ON-OFF or ON-OFF-ON in three consecutive samples at the selected sample rate.

Note 2: A FAULT bit that is true indicates that the associated channel has a major problem and the associated data should not be believed. A FAULT indication is a HARD FAULT condition.

Note 3: A DATA bit indicates the input discrete state for the associated channel over two out of the last three samples taken.

Note 4: The two available TEST PATTERNS contain an alternating string of '1's and '0's and '0's and '1's, which can be used to verify that all of the data bits are operational, i.e., there are no stuck bits. The two test patterns have been located at addresses of alternating address bits so that the address decoder bits are tested at the same time.

TABLE 6. 96-CHANNEL BYTE MODE (8-BIT BUS)	
ADDRESS (A5...A0)	DATA (D7...D0)
00 0000	BOUNCE CH_08..CH_01
00 0001	BOUNCE CH_16..CH_09
00 0010	BOUNCE CH_24..CH_17
00 0011	BOUNCE CH_32..CH_25
00 0100	BOUNCE CH_40..CH_33
00 0101	BOUNCE_48 CH_41
00 0110	BOUNCE_56..CH_49
00 0111	BOUNCE_64 CH_57
00 1000	BOUNCE 73..CH_65
00 1001	BOUNCE 80 CH_74
00 1010	BOUNCE 88..CH_81
00 1011	BOUNCE 96 CH_89
00 110.0	FAULT CH_08..CH_01
00 1101	FAULT CH_16 CH_09
00 1110	FAULT CH_24..CH_17
00 1111	FAULT CH_32..CH_25
01 0000	FAULT CH_40..CH_33
01 0001	FAULT CH_48..CH_41
01 0010	FAULT CH_56..CH_49
01 0011	FAULT CH_64..CH_57
01 0100	TEST PATTERN 0's and 1's
01 0101	TEST PATTERN 0's and 1's
01 0110	FAULT CH_73..CH_65
01 0111	FAULT CH_80..CH_74
01 1000	FAULT CH_88..CH_81
01 1001	FAULT CH_96..CH_89
01 1010	DATA CH_08..CH_01
01 1011	DATA CH_16..CH_09
01 1100	DATA CH_24..CH_17
01 1101	DATA CH_32..CH_25
01 1110	DATA CH_40..CH_33
01 1111	DATA CH_48..CH_41
10 0000	DATA CH_56..CH_49
10 0001	DATA CH_64..CH_57
10 0010	DATA CH_72..CH_65
10 0011	DATA CH_80..CH_73
10 0100	DATA CH_88..CH_81
00 1010	DATA CH_96..CH_89
10 0110	NOT USED
10 0111	NOT USED
10 1000	STATUS REGISTER LO
10 1001	STATUS REGISTER HI
10 1010	TEST PATTERN 1's and 0's
10 1011	TEST PATTERN 1's and 0's
10 1100	TEST WORD 1 LO
10 1101	TEST WORD 1 HI
10 1110	TEST WORD 2 LO

See Notes at left.

OUTPUTS

DATA (D15...D0): (Pins 125-140) 8-bit byte or 16-bit byte word information is available on the Data Bus depending on the logic state of the BUS Select line as described above. In the Byte mode the upper and lower Bytes are enabled separately so that bit 0 can be hard wired to bit 8, bit 1 to bit 9 etc., thereby providing an 8-bit data bus.

It is important that the 8-bit mode be selected if these data bits are wired together, otherwise corrupted data will result. The available data can be found under ADDRESS LINES (A5...A0).

FAULT: (Pin 151) The FAULT flag was designed to serve as an interrupt to the microprocessor when a HARD or SOFT error has been detected within the device (See BIT and FAULT notes in TABLE 4). If this signal is asserted (logic "0") the Status Register should be read to determine the nature of the fault. Thereafter more detailed information can be found in the associated addressable registers. The Fault Flag will remain at a logic "0" for as long as the fault condition persists. FIGURE 8 and FIGURE 9 illustrate the fault logic tree for the 32-channel and the 96-channel respectively.

Note: Depending on the exact nature of the fault, the Fault Flag may return to logic "0" during the Built-In-Test interval (when the READY signal is at logic "0") if there is a persistent fault condition.

Fault Conditions:

FAULT is logic "0" for any of the following fault conditions. The reason for the fault can be obtained from the status register which is accessible **regardless** of READY state. TABLE 7 shows the contents of the status register.

A definition of each bit is as follows:

BIT FAULT: A logic "1" for this bit indicates that one of the channels has failed the Built-In-Test sequence. The offending channel(s) can be determined by reading the associated BIT data words.

DISCRETE FAULT: A logic "1" for this bit indicates that one of the channels detected a HARD failure during the Built-In-Test sequence, or that the discrete input data word did not transfer to the data bus output properly when it was read. If a HARD fault was detected the offending channel can be determined by reading the associated FAULT data registers. If it was generated by a transfer error the DISCRETE TRANSFER FAULT bit in this status register will be set to logic "1".

ARINC FAULT: A logic "1" for this bit indicates that one of the channels detected a HARD failure during Built-In-Test sequence, or that the discrete input word did not transfer to the ARINC transmitter section properly.

If a HARD fault was detected the offending channel can be determined by reading the associated FAULT data registers. If it was generated by a transfer error then no FAULT bits will be set to logic "1".†

ARINC READY: A logic "0" for this bit indicates that an ARINC transmission is currently in progress. A logic "1" indicates that no ARINC transmission is in progress.†

CLOCK_A FAULT: A logic "1" for this bit indicates that the primary 1 MHz clock is currently defective and that the device is running off the secondary 1 MHz clock. †

CLOCK_B FAULT: A logic "1" for this bit indicates that the secondary 1 MHz clock is currently defective and cannot be used as a backup.

NO CLOCK: A logic "1" for this bit indicates that there is no 1 MHz clock being supplied to the device (or that both have failed).

DISCRETE TRANSFER FAULT: A logic "1" for this bit indicates that the discrete data word(s) did not transfer properly during the associated microprocessor read cycle, i.e., the word present on the data bus did not agree with internal data. The most likely cause of this type of fault condition is a collision on the data bus during the read cycle.

Note: This condition is only monitored for the discrete data words, not for all of the available data.

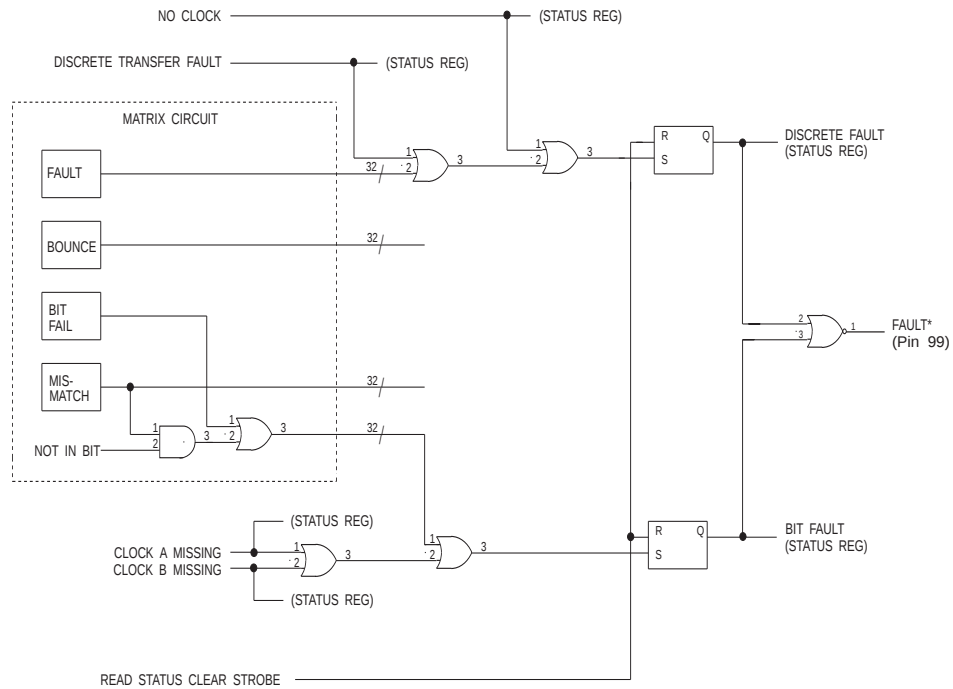
READY: (Pin 150) A logic "1" for this bit indicates that all of the available data is stable and can be read. A logic "0" indicates that the device is in Built-In-Test mode, or taking a sample of discrete input data lines.

The signal should be polled directly by reading the status word prior to performing any read cycles. The internal data is guaranteed to be stable for 20 µsec after the logic "1" to logic "0" transition (READY to NOT READY) of this signal. Therefore, it should not be necessary to repoll the signal after the read.

TABLE 7. STATUS REGISTER WORD BIT MAP	
BIT	SIGNAL
00	BIT FAULT
01	DISCRETE FAULT
02	ARINC FAULT
03	ARINC READY
04	CLOCK_A FAULT
05	CLOCK_B FAULT
06	NO CLOCK
07	DISCRETE TRANSFER FAULT
08	LOGIC LOW (HIGH BYTE)
09	LOGIC LOW
10	LOGIC LOW
11	LOGIC LOW
12	LOGIC LOW
13	LOGIC LOW
14	LOGIC LOW
15	READY

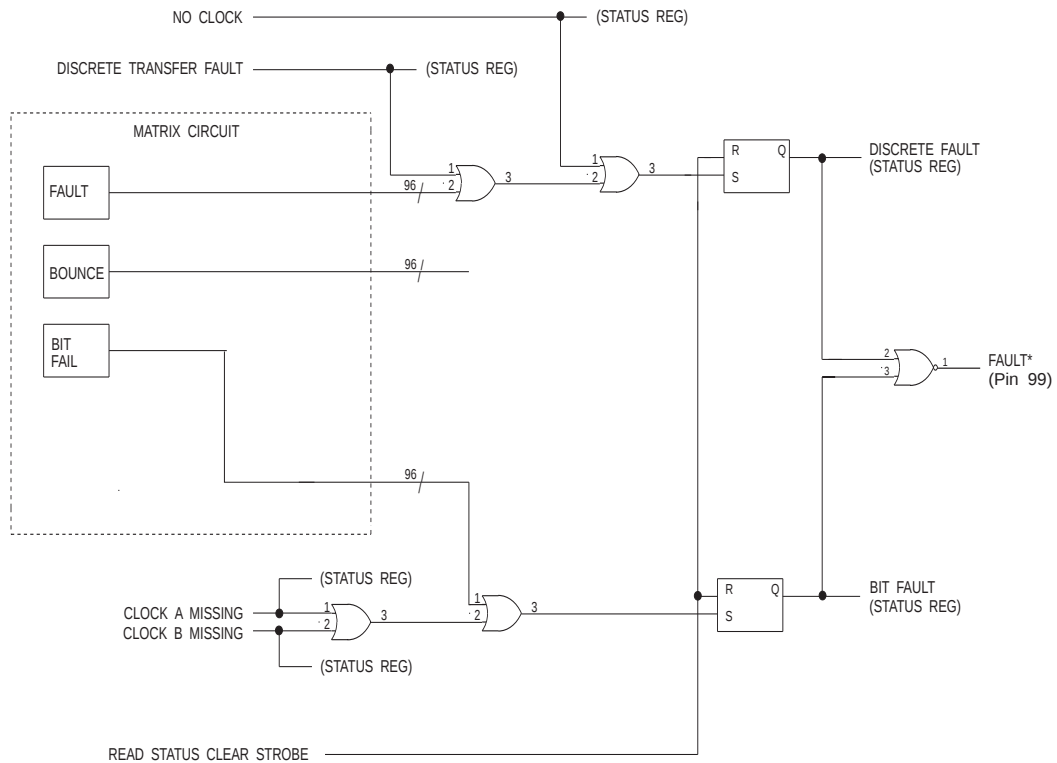
Note: All bits available regardless of ready-state.

† This signal is only meaningful for the ARINC 429 device option.



Note: (*) indicates active low.

FIGURE 8. 32-CHANNEL FAULT LOGIC TREE



Note: (*) indicates active low.

FIGURE 9. 96-CHANNEL FAULT LOGIC TREE

ARINC 429 PORT (OPTIONAL)

DD-03201XX-XX4 indicates the inclusion of the ARINC 429 data output. This option enables the transmission of discrete data via serial ARINC 429 (CMOS levels) output lines. The following features and pins apply:

ARINC 429 DATA RATE (429DRATE): (Pin 159) A logic “1” (or a no-connect) for this input selects the ARINC 429 Low Speed data rate of 12.5 kHz. A logic “0” selects the High Speed data rate of 100 kHz.†

ARINC 429 MESSAGE RATE (429MRATE): (Pin 158) The message rate of the ARINC output is selectable at either a fixed 100 msec rate or at the selected sampling rate of the input discretes. A logic “1” selects the input sampling rate as the message rate, and a logic “0” selects the fixed 100 msec message rate.

Note: If the Low-Speed ARINC 429 bit rate is selected (12.5k bps) an entire ARINC message will take about 35 msec to complete. Therefore, input discrete sampling rates of 5 msec, 10 msec, and 20 msec cannot be utilized or the ARINC message will be truncated unless the fixed 100 msec message rate is selected.

429 STROBE IN (429STRBI): (Pin 156) This pin is utilized in the special case where the device is being used as a remote ARINC 429 serial port and is not connected to a local microprocessor. When the device is being used in this specific configuration the associated 429 Strobe Out should be connected to this pin. In other cases this pin **must** be grounded.

Related Information: Because the BOUNCE data is momentary, it is latched within the device. This information is normally reset by a READ to the associated BOUNCE data words. In the instance where there is no microprocessor, and therefore no READS to the BOUNCE data, this connection provides a mechanism to reset the source of the BOUNCE information (just after it is transferred to the ARINC transmitter section) at the start of each ARINC message.†

429 STROBE OUT (429STRBO): (Pin 157) This signal is used in conjunction with the “429 Strobe In” described in the preceding paragraph. It is a 500 nsec positive pulse which occurs at the start of each 429 message. For further information concerning the use of this signal see 429 STROBE IN (429STRBI).†

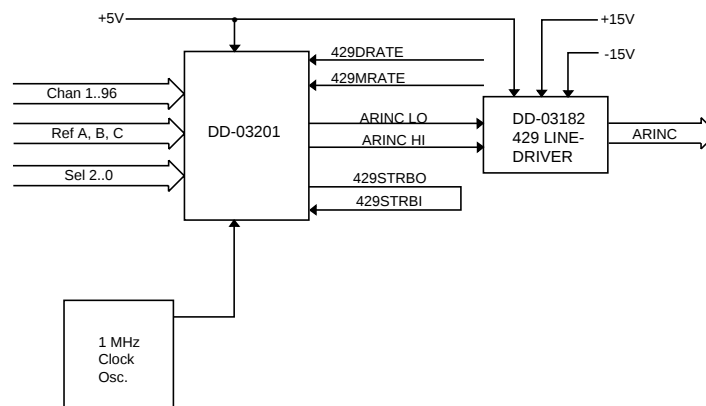
ARINC_LO AND ARINC_HI: (Pin 154 and 155) These two signals comprise the ARINC 429 serial output transmission. Both are TTL compatible signals where the ARINC_LO signal contains the logic “0” serial transmission and the ARINC_HI signal contains the logic “1” serial transmission. These two signals must be connected to a differential ARINC 429 transmission signal. FIGURE 10 illustrates this interface.

The content and word order of the ARINC 429 transmission is shown in TABLE 8 (32-Channel) and TABLE 9 (96-Channel).†

As noted, these features are only guaranteed and tested if the ARINC 429 option is selected. In addition, the clock frequency (1 MHz) must be selected carefully so as not to interfere with other avionic communications as detailed in ARINC 429. The ARINC 429 option bit rate is derived from the (1 MHz) clock. Refer to ARINC 429 Bit Rate to avoid interference. ARINC 429-14 (January 4, 1993), paragraph 2.4 “Timing Related Elements” contains a “COMMENTARY” section following subparagraph 2.1.4.2 (“Low Speed Operation”) that cautions against using “precisely” 100 kilobits per second.

OPTIONAL 429 LINE DRIVER

If you choose the 429 option for the DD-03201, you can use a line driver chip to transmit the data on the serial data bus. DDC has such a device, the DD-03182 which will support ARINC 429, 571, and 575 bus standards. See FIGURE 10 for connection diagram.



NOTE: 1) 429 MRATE and DRATE can either be tied to gnd or +5V (Refer to Page 11)

2) If the ARINC 429 option is not used, then pin 153 (429STRBI) MUST be grounded for the “bounce” circuit to operate properly.

FIGURE 10. DD-03201 TO ARINC 429 INTERFACE

† This signal is only significant for the ARINC 429 device option.

TABLE 8. 32-CHANNEL ARINC BIT DESCRIPTION

	P A R	SSM			16 BIT DATA																LSB		F	C	SDI			LABEL REVERSED OCTAL										
																												L S B										
ARNC 429 BTS	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1						
TRIPLE BOUNCE 16..1	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	0	0	0	0	0	0	0	001					
TRIPLE BOUNCE 32..17	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	1	0	0	0	0	0	0	002					
MISMATCH 16..1	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	1	0	0	0	0	0	0	003					
MISMATCH 32..17	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	0	1	0	0	0	0	0	004					
BIT 16..1	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	0	1	0	0	0	0	0	005					
BIT 32..17	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	1	1	0	0	0	0	0	006					
TRIPLE FAULT 16..1	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	1	1	0	0	0	0	0	007					
TRIPLE FAULT 32..17	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	0	0	1	0	0	0	0	010					
TRIPLE DATA 16..1	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	0	0	1	0	0	0	0	011					
TRIPLE DATA 32..17	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	1	0	1	0	0	0	0	012					
TEST 5'S	P	1	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	E	F	C	G	H	1	1	0	1	0	0	0	0	013					
TEST A'S	P	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	E	F	C	G	H	0	0	1	1	0	0	0	0	014					

Notes:

AB = 00, if there are no major faults.

AB = 11, if major faults exist (data is bad).

C = 0, when 429 data rate is 100 kbps; C = 1 when data rate is 12.5 kbps.

D = Data bit.

F = 1, if the discrete interface output has any major faults (429 data may still be good).

P = ARINC 429 parity bit

E = 1, if there is a bit fault.

GH = The value of these two locations will track channel 1 and 2, or can be hard-wired (via channel 1 and 2) to determine which RXD3 the 429 word came from.

The 12 words are transmitted in order shown from top to bottom.

TABLE 9. 96-CHANNEL ARINC BIT DESCRIPTION

	P A R	SSM			M S B	16 BIT DATA																L S B		F	C	SDI	LABEL REVERSED OCTAL										
																											L S B									M S B	
ARINC 429 BTS	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1					
FAULT 16..1	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	0	0	0	0	0	0	0	001			
FAULT 32..17	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	1	0	0	0	0	0	0	002			
FAULT 48..33	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	1	0	0	0	0	0	0	003			
FAULT 64..49	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	0	1	0	0	0	0	0	004			
FAULT 80..65	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	0	1	0	0	0	0	0	005			
FAULT 96..81	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	1	1	0	0	0	0	0	006			
BOUNCE 16..1	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	1	1	0	0	0	0	0	007			
BOUNCE 32..17	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	0	0	1	0	0	0	0	010			
BOUNCE 48..33	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	0	0	1	0	0	0	0	011			
BOUNCE 64..49	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	1	0	1	0	0	0	0	012			
TEST 5'S	P	1	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	E	F	C	G	H	1	1	0	1	0	0	0	0	013		
TEST A'S	P	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	E	F	C	G	H	0	0	1	1	0	0	0	0	014		
BOUNCE 80..65	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	0	1	1	0	0	0	0	015			
BOUNCE 96..81	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	1	1	1	0	0	0	0	016			
DATA 16..1	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	1	1	1	0	0	0	0	017			
DATA 32..17	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	0	0	0	1	0	0	0	020			
DATA 48..33	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	0	0	0	1	0	0	0	021			
DATA 64..49	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	1	0	0	1	0	0	0	022			
DATA 80..65	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	1	1	0	0	1	0	0	0	023			
DATA 96..81	P	A	B	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	E	F	C	G	H	0	0	1	0	1	0	0	0	024			

Notes:

AB = 00, if there are no major faults.

AB = 11, if major faults exist (data is bad).

C = 0, when 429 data rate is 100 kbps; C = 1 when data rate is 12.5 kbps.

D = Data bit.

F = 1, if the discrete interface output has any major faults (429 data may still be good).

P = ARINC 429 parity bit

E = 1, if there is a bit fault.

GH = The value of these two locations will track channel 1 and 2, or can be hard-wired (via channel 1 and 2) to determine which RXD3 the 429 word came from.

The 20 words are transmitted in order shown from top to bottom.

TABLE 10. DD-03201 PIN FUNCTIONS					
PIN NUMBER	FUNCTION	PIN NUMBER	FUNCTION	PIN NUMBER	FUNCTION
1	SEL0	55	CH44	109	CH70
2	SEL1	56	CH45	110	CH69
3	SEL2	57	CH46	111	CH68
4	CH1	58	CH47	112	CH67
5	CH2	59	CH48	113	CH66
6	CH3	60	V _{DD} B (Note 4, 8)	114	CH65
7	CH4	61	V _{SS} 2 (Note 6, 9)	115	TEST C HI (Note 1)
8	CH5	62	CH49	116	REF C (Note 1)
9	CH6	63	CH50	117	TEST C LO (Note 1)
10	CH7	64	CH51	118	V _{DD} (Note 5, 8)
11	CH8	65	CH52	119	BITS 8/16*
12	CH9	66	CH53	120	CH32/96*
13	CH10	67	CH54	121	CLKB (1MHZ CLK)**
14	CH11	68	CH55	122	V _{SS} (Note 7, 9)
15	CH12	69	CH56	123	B TIMER (Note 2)
16	CH13	70	CH57	124	A TIMER (Note 2)
17	CH14	71	CH58	125	D15
18	CH15	72	CH59	126	D14
19	CH16	73	CH60	127	D13
20	V _{DD} A (Note 4, 8)	74	CH61	128	D12
21	V _{SS} 1 (Note 6, 9)	75	CH62	129	D11
22	CH17	76	CH63	130	D10
23	CH18	77	CH64	131	D9
24	CH19	78	TEST B HI (Note 1)	132	D8
25	CH20	79	REF B (Note 1)	133	D7
26	CH21	80	TEST B LO (Note 1)	134	D6
27	CH22	81	CH96	135	D5
28	CH23	82	CH95	136	D4
29	CH24	83	CH94	137	D3
30	CH25	84	CH93	138	D2
31	CH26	85	CH92	139	D1
32	CH27	86	CH91	140	D0
33	CH28	87	CH90	141	V _{SS} DIG (Note 7, 9)
34	CH29	88	CH89	142	V _{DD} DIG (Note 5, 8)
35	CH30	89	CH88	143	ADDR5
36	CH31	90	CH87	144	ADDR4
37	CH32	91	CH86	145	ADDR3
38	TEST A HI (Note 1)	92	CH85	146	ADDR2
39	REF A (Note 1)	93	CH84	147	ADDR1
40	TEST A LO (Note 1)	94	CH83	148	ADDR0
41	TMODE*	95	CH82	149	ENABLE*
42	TMUX*	96	CH81	150	READY
43	RESET*	97	V _{DD} C (Note 4, 8)	151	FAULT*
44	CH33	98	V _{SS} 3 (Note 6, 9)	152	FMUX*
45	CH34	99	CH80	153	FMODE*
46	CH35	100	CH79	154	ARINC LO
47	CH36	101	CH78	155	ARINC HI
48	CH37	102	CH77	156	429STRBI
49	CH38	103	CH76	157	429STRBO
50	CH39	104	CH75	158	429MRATE
51	CH40	105	CH74	159	429DRATE
52	CH41	106	CH73	160	CLKA (1MHZ CLK)**
53	CH42	107	CH72		
54	CH43	108	CH71		

Notes:

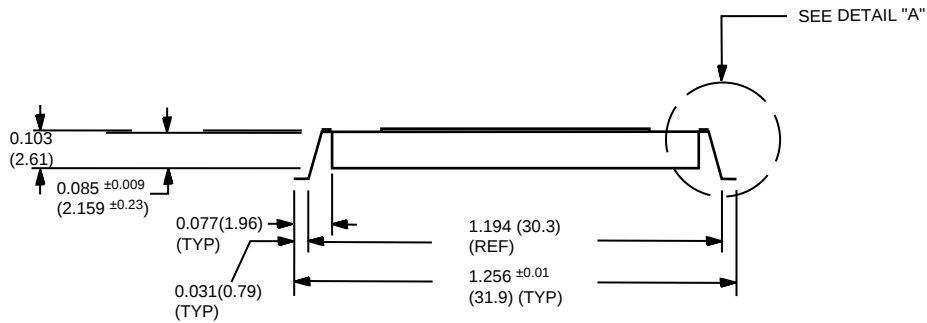
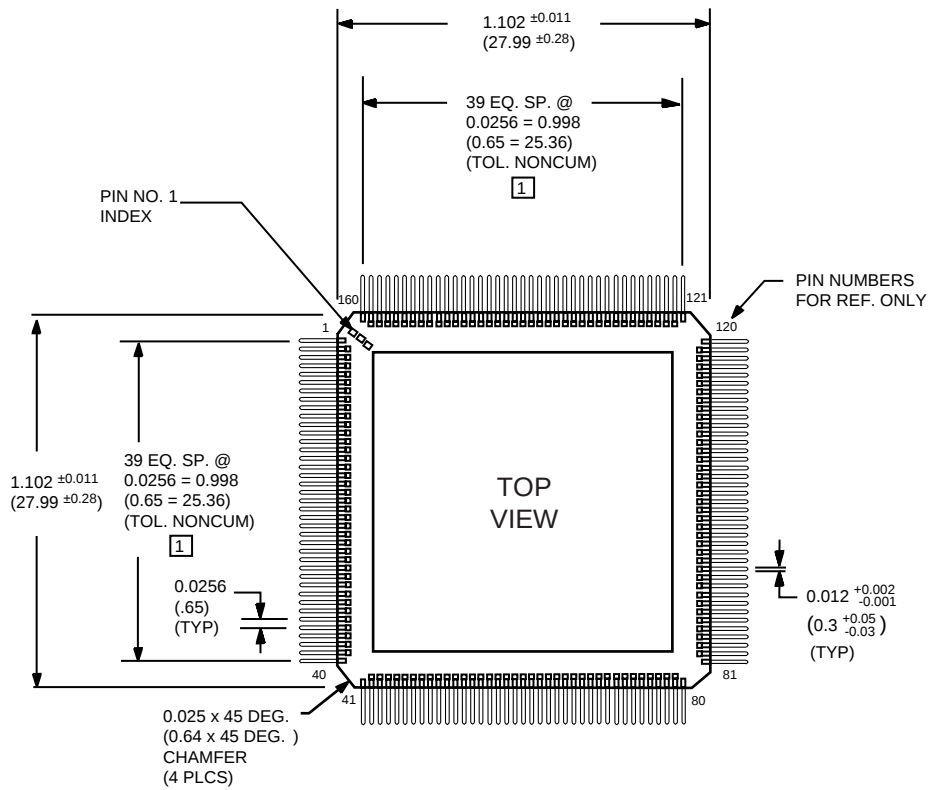
1. Refer to Analog Inputs section and FIGURES 4, 5 and 6.
2. Refer to A Timer and B Timer section and FIGURE 7.
3. (*) Indicates an active low signal.
4. Analog V_{DD} input.
5. Digital V_{DD} input.
6. Analog Gnd.

7. Digital Gnd.

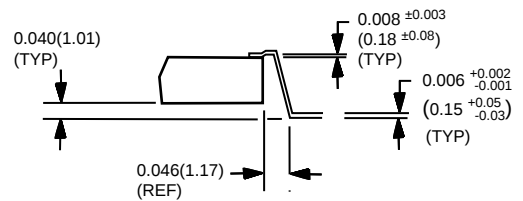
8. Analog V_{DD} and Digital V_{DD} inputs must be tied to the same local supply potential.

9. Analog GND and Digital GND inputs must be tied to the same local ground potential.

10.(**) Refer to CLKA and CLKB section and FIGURE 7.



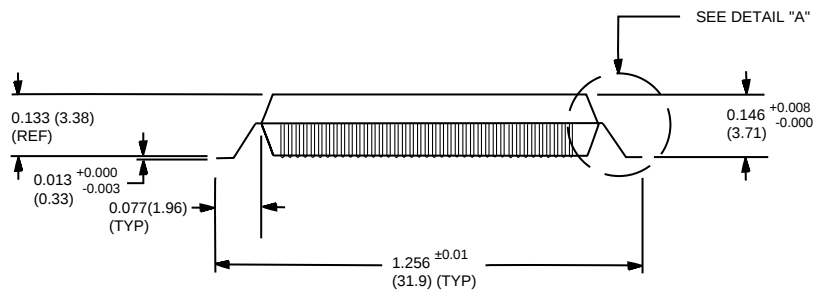
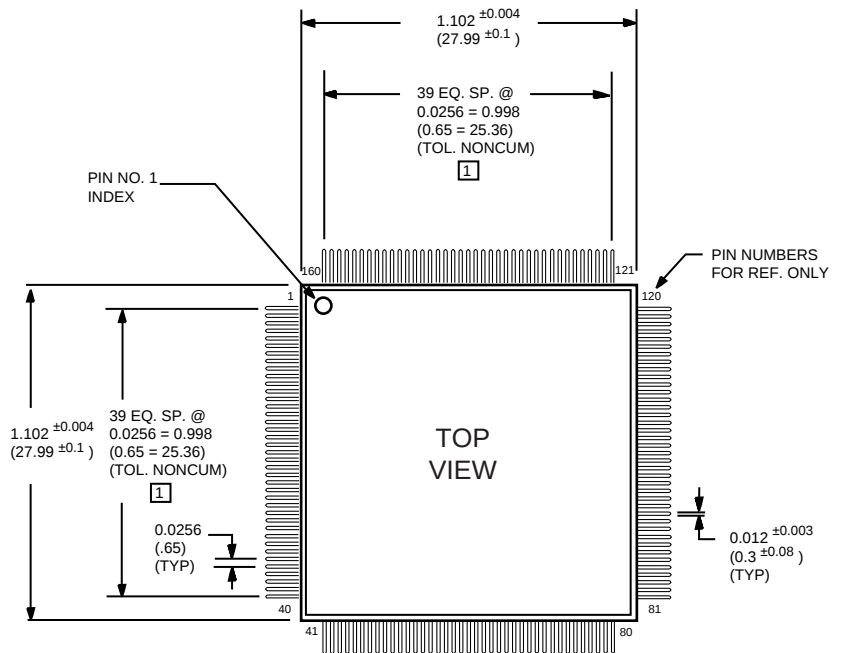
DETAIL "A" NTS



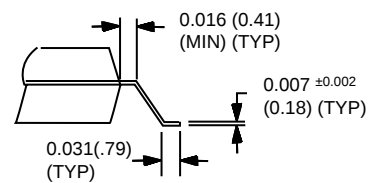
Notes:

- 1 LEAD CLUSTER TO BE CENTRALIZED ABOUT CASE CENTERLINE WITHIN ± 0.010 (± 0.25).
2. DIMENSIONS IN INCHES (MILLIMETERS).

FIGURE 11. DD-03201 MECHANICAL OUTLINE (CERAMIC PACKAGE)



DETAIL "A"
NTS



- Notes:
1. LEAD CLUSTER TO BE CENTRALIZED ABOUT CASE CENTERLINE WITHIN ± 0.010 (± 0.25).
 2. DIMENSIONS IN INCHES (MILLIMETERS).

FIGURE 12. DD-03201 MECHANICAL OUTLINE (PLASTIC PACKAGE)

ORDERING INFORMATION

DD-03201FC-110

ARINC Port Option:

- 0 = Without ARINC 429 Output
- 4 = With ARINC 429 Output

Screening:

- 0 = Standard DDC Procedures

Temperature Range:

- 1 = -55°C to + 125°C (Ceramic Only)
- 2 = -40°C to + 85°C

ASIC Package Type:

- P = Plastic
- C = Ceramic

Package Style:

- F = Surface Mount

OPTIONAL HARDWARE

DD-03182XX-XXXX – ARINC 429 Line Driver

T = Tape and Reel (GP and VP only)

Options:

- 0 = With resistors and fuses
- 1 = With resistors, no fuses*

Screening:

- 0 = Standard DDC Procedures
- 2 = Burn-in (ceramic only)

Temperature Range:

- 1 = -55 to +125°C (ceramic only)
- 2 = -40 to +85°C
- 9 = -55 to +85°C (GP package only)

Package Style/Type:

- DC = 16-pin ceramic DIP
- GP = 16-pin plastic SOIC
- PP = 28-pin plastic PLCC
- VP = 14-Pin plastic SOIC

*VP version only.

OTHER APPLICABLE DOCUMENTS

RTCA/DO-160C: Environmental Conditions and Test Procedures for Airborne Equipment.

The information in this data sheet is believed to be accurate; however, no responsibility is assumed by Data Device Corporation for its use, and no license or rights are granted by implication or otherwise in connection therewith.
Specifications are subject to change without notice.



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