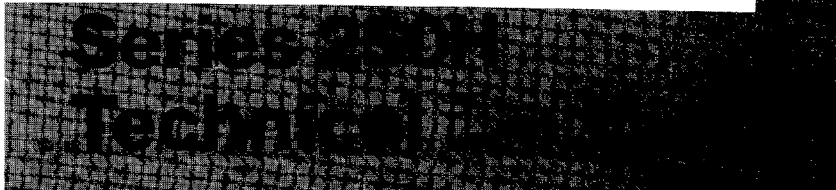
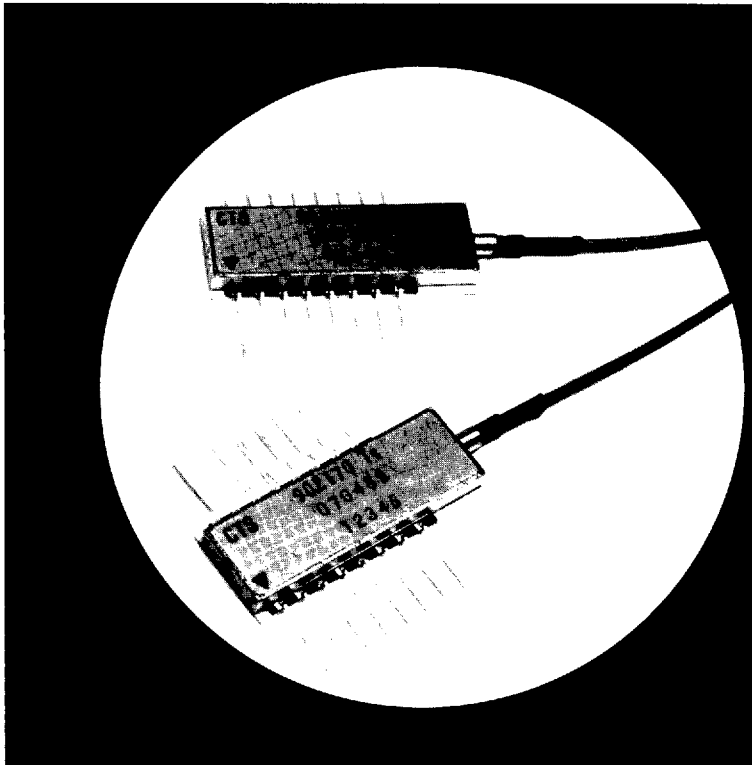


# CTS®



## 250H Military lightwave data link

- Hermetic, 0.12-inch high, gull-wing package
- Data rates: 32 Mbits/s to 250 Mbits/s
- Wide operating temperature range:  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- $1.3\ \mu\text{m}$  LED and PIN photodiode
- Link distance: up to 2 km
- Typical link budget: 19.5 dB at  $25^{\circ}\text{C}$
- Single  $-5.2\ \text{V}$  power supply
- 100K ECL compatibility
- High level of integration
- 100/140  $\mu\text{m}$  fiber pigtail
- Connector: Size 16 fiber-optic terminus (compatible with the MIL-C-38999 connector; optional connectors available)
- Link status flag
- Chatter-free output with no light input



### Applications

The 250H Data Link is recommended for use in on-board aircraft systems to transmit information from:

- Sensor to processor parallel data bus
- Radar sensors to a CPU within the fuselage
- CPU to display screen
- CPU to weaponry systems (including stores management).

### Other Uses

- Compressed video transmission
- High-bandwidth, token passing ring architectures (e.g., FDDI-type nodes)
- Tethered weapons/vehicles

- Remote antennae
- Secure point-to-point, long-distance data communications
- Other military/commercial avionics and harsh environment data link applications

### Benefits

- Low-profile package can be used to populate both sides of Standard Electronic Module circuit cards, format E
- Improved board manufacturing process through surface-mount technology
- 0.53-square-inch package minimizes mounting space
- Immediate delivery (prototypes four- to six-weeks)
- Technical product support

### Description

The 250H Lightwave Data Link is a military-quality  $1.3\ \mu\text{m}$  wave-length system designed for high-speed optical communications, 32 Mbits/s to 250 Mbits/s, nonreturn to zero (NRZ), at distances up to 2 km.

Characterized by an extremely wide operating temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ , the link is ideally suited for use in harsh environments, specifically military avionic applications. It is recommended for applications where high reliability and an extended service life are the critical concerns.

Both the 902170 Transmitter and the 902171 Receiver are produced using identical, fully hermetic, 16-lead gull-wing packages. The pigtail consists of 100/140  $\mu\text{m}$

Technical Data Sheet 250H

hermetically sealed optical fiber with a size 16 fiber-optic terminus. The terminus is designed for use with the MIL-C-38999 connector. Other size 16 termini supporting MIL-C-28876 guidelines and ST® Connectors are also available.

For high reliability and maximum EMI/RFI protection, the metal/ceramic package should be used with a heat sink and mounted on a grounded portion of the printed circuit board.

**Transmitter**

The 902170 Transmitter operates from a -5.2 V power supply, and an InGaAsP LED provides a typical peak optical power of -9.5 dBm at +25°C. The LED driver is a microwave complementary bipolar IC (MCBIC) capable of a peak LED drive current of 125 mA. To minimize turn-on delay, the LED is biased by a small current in the off condition.

Along with the LED and driver circuitry, the only other components inside the package are two military-qualified ceramic capacitors and the optical subassembly.

The estimated mean time between failures (MTBF) at 85°C, calculated per MIL-HDBK-217D and using uninhabited aircraft conditions, is 877,000 hours.

**Receiver**

The 902171 Receiver operates from a -5.2 V power supply and, in conjunction with the transmitter, exhibits a typical dynamic range of 21 db at 25°C. The photodetector delivers an average power sensitivity of -32 dBm at a 10<sup>-9</sup> bit error rate (BER) at 250 Mbits/s.

For increased performance and design flexibility, two MCBIC chips are used in the receiver, one as a transimpedance preamplifier circuit and the other as a data quantizer and link status flag circuit. The data outputs are 100K ECL compatible.

The package also includes an InGaAs PIN photodetector, four military-qualified ceramic capacitors, and a discrete resistor.

**Link Status Flag**

Represented in the block diagram as a receiver output pin, the link status flag is a system monitor used to oversee the integrity of the optical communication channel. Like the data outputs, the link status flag outputs are 100K ECL compatible.

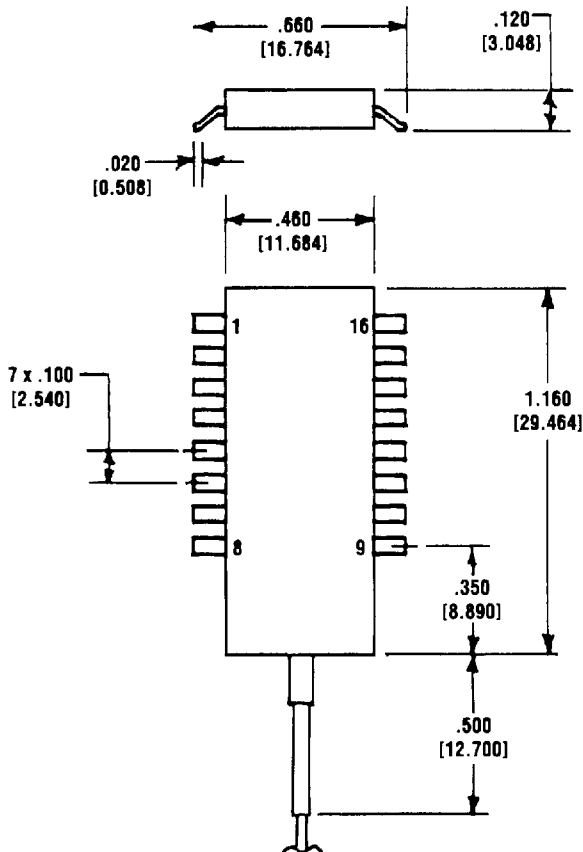
For the receiver, the estimated MTBF at 85°C, calculated per MIL-HDBK-217D and using uninhabited aircraft conditions, is greater than 1.9 million hours.

**Chatter-Free Output**

Under conditions of no light input, a chatter-free output is available (typical 0.4 μs between transitions). This results in a 2 dB sensitivity penalty.

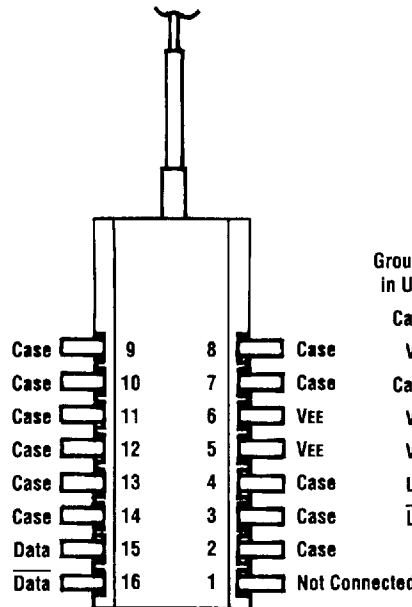
**Outline Drawing**

Dimensions are in inches and [millimeters].  
Weight: transmitter/receiver pair = 10 grams.

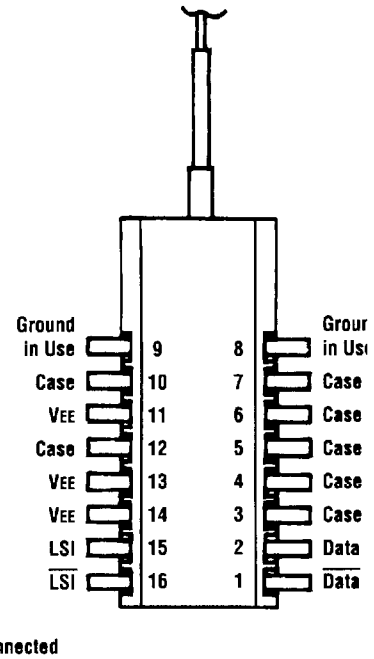


**Pin Diagrams**

902170 Transmitter



902171 Receiver



**Electrical Characteristics 250H Transmitter\***

Parameter	Symbol	Min	-55°C	+25°C	+85°C	+125°C	Max	Unit
Input Voltage—Low	V <sub>IL</sub>	-1.810	—	—	—	—	-1.475	V
Input Voltage—High	V <sub>IH</sub>	-1.165	—	—	—	—	-0.880	V
Average Optical Power†	P <sub>O</sub> (AVG)	-17	-10.9	-12.5	-13.7	-14.5	-6.0	dBm
Duty Cycle Distortion‡	DCD	—	0.45	0.45	0.5	0.6	0.7	ns
Extinction Ratio	EXT	10	13	14	15	16	—	dB
Output Rise Time§	t <sub>r</sub>	—	0.95	1.0	1.1	1.2	1.8	ns
Output Fall Time§	t <sub>f</sub>	—	0.95	1.0	1.1	1.2	1.8	ns
Optical Wavelength	λ	1245	1295	1320	1340	1352	1380	nm
Spectral Width	Δλ	—	120	145	177	190	215	nm
Power Supply Current	I <sub>CC</sub>	—	217	225	224	223	265	mA
Data Rate	BR	0	—	—	—	—	250	Mbits/s

\* Typical values from -55°C to +125°C measured at 200 mb/s.

† Power at the end of a 1-meter, 100/140 μm GI, NA = 0.29 fiber pigtail.

‡ Measured with a 1010 . . . pattern.

§ Measured between the 20% and 80% points.

**Maximum Ratings 250H Transmitter**

Parameter	Min	Max	Unit
Storage Temperature	-65	+150	°C
Lead Soldering Temp./Time*	—	240/10	°C/s
Supply Voltage	-6.0	—	V
Input Voltage	V <sub>EE</sub>	V <sub>CC</sub> + 0.5	V
Differential Input Voltage	—	2.0	V

\* Leads only; not the entire package.

**Electrical Characteristics 250H Receiver\***

Parameter	Symbol	Min	-55°C	+25°C	+85°C	+125°C	Max	Unit
Output Voltage—Low	V <sub>OL</sub>	-1.860	—	—	—	—	-1.500	V
Output Voltage—High	V <sub>OH</sub>	-1.085	—	—	—	—	-0.820	V
Power Supply Current	I <sub>EE</sub>	75	115	120	117	115	130	mA
Optical Sensitivity†	P <sub>IN</sub>	—	-33	-33.5	-34.1	-34.5	-29	dBm
Eye Width	EW	1.4	4.1	4.1	4.1	4.1	—	ns
Saturation Power‡	P <sub>sat</sub>	-17	-10	-11	-12.5	-14	-8	dBm
Output Rise Time§	t <sub>r</sub>	—	1.3	1.3	1.3	1.3	1.7	ns
Output Fall Time§	t <sub>f</sub>	—	1.5	1.5	1.4	1.4	1.7	ns
Optical Wavelength	λ	1245	—	—	—	—	1380	nm
Data Rate	BR	32	—	—	—	—	250	Mbits/s

\* Typical values from -55°C to +125°C measured at 200 mb/s.

† Expressed as average power and at 10<sup>-6</sup> BER.

‡ Includes jitter and duty cycle distortion; measured with a PRW and -18 dBm peak power input; includes effect of test instrumentation.

§ Measured between the 20% and 80% points.

**Maximum Ratings 250H Receiver**

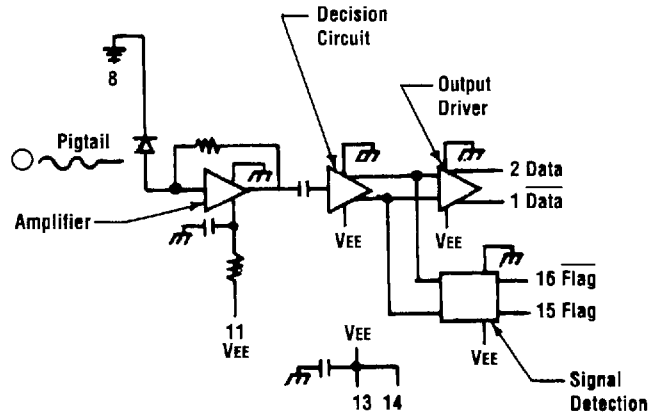
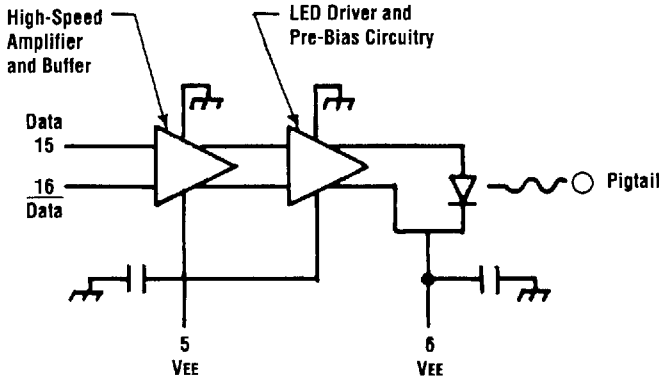
Parameter	Min	Max	Unit
Storage Temperature	-65	+150	°C
Lead Soldering Temp./Time*	—	240/10	°C/s
Supply Voltage	-6.0	—	V
Output Current†	—	50	mA

\* Leads only; not the entire package.

† From data and data outputs of the receiver.

**Transmitter Block Diagram**

**Receiver Block Diagram**



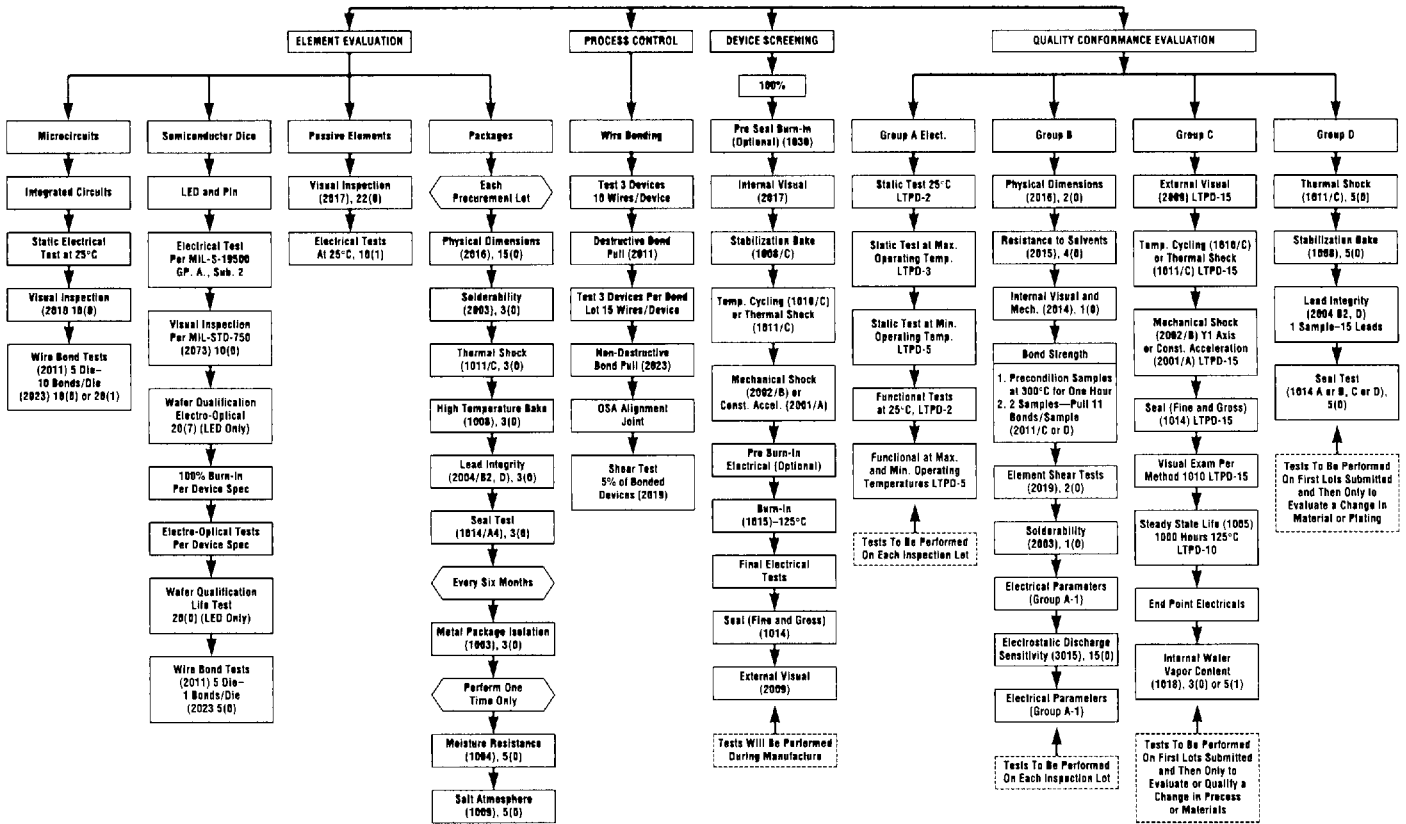
**Quality Process**

The 250H Military Data Link is manufactured on a dedicated

production line. The quality process in effect on the production line meets the intent of MIL-I-45208.

Screening and test procedures are identified in the following process flow chart.

**Screening and Quality Conformance Test Procedures for 250H Military Fiber Optic Transmitters and Receivers\***



\* The first number in parentheses refers to a test method or procedure of MIL-STD-883C. The second number, where applicable, denotes the test sample size followed by the allowable failures in parentheses.

## Printed-Wiring Board Layout

As with any sensitive or high-speed electronic component, to obtain optimum performance from the fiber optic transceiver, careful attention must be given to the printed-wiring board. The routing of sensitive input traces relative to other components and signal lines must be considered in great detail. Data lines must be of controlled impedance and properly terminated to minimize reflections that might degrade performance. Power-supply pins must be protected from noisy operating conditions by proper filtering.

### Printed-Wiring Board

As a minimum, a double-sided printed wiring board having a large ground plane on the component side should be utilized. In applications where a large number of other devices are included on the circuit card, a multilayer circuit board is preferred. This allows for the separation of power and ground connections, and provides isolation for sensitive traces from high level signals that might couple to the sensitive inputs. In either case, the ideal approach is to have the ground plane as close to the transceiver as possible and to cover as much of the printed wiring board as possible.

### Layout Considerations

A fiber-optic receiver employs a very high-gain, wide-bandwidth, transimpedance amplifier. The amplifier detects and amplifies signal levels that are only nano-amperes in amplitude. Any unwanted signals that couple into the receiver circuitry cause a decrease in the receiver's sensitivity and can also degrade the performance of the receiver's signal-detect indicators.

To minimize the coupling of unwanted noise into the receiver, route transmitter-input traces and other traces carrying high-level signals as far away as possible from the receiver pins. If wide separation of the receiver pins from other high-level signal lines is not possible, the receiver pins and traces connected to them should be shielded by placing a ground trace between the receiver's pins and connecting traces and other high-level signal paths.

### Power Supply Filtering

Noise that couples into the transceiver through the power-supply pins can also degrade device performance. High quality 0.1  $\mu\text{F}$  capacitors, rated for RF applications, should be placed as close as physically possible to the VCC pins.

In some instances, especially on double-sided circuit boards in noisy environments, it may be necessary to provide separate filtering for the VPD bias pin on the receiver. Do this by placing a separate 0.1  $\mu\text{F}$  capacitor from pin 2 to ground, and connecting pin 2 to VCC through a separate ferrite bead.

### Data Lines

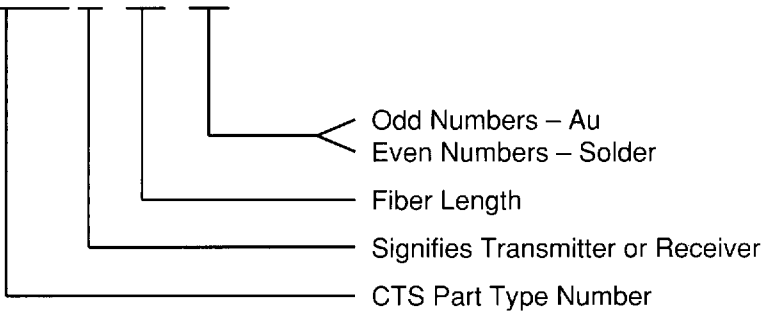
The signals on the data lines typically have rise and fall times on the order of 1 ns to 2 ns. If the data lines are not properly handled, the fast transitions cause EMI problems as well as electrical reflections and excessive ringing, which degrade the performance of the transceiver. When laying out the traces for the data lines, follow high-speed ECL design guidelines as described in the Motorola MECL System Design Handbook.

- All high-speed output lines must use controlled-impedance traces and have the termination impedance match the trace impedance. Controlled-impedance interruptions must be avoided (i.e., 90° bends, etc.), and paired lines (i.e., DATA and  $\overline{\text{DATA}}$ ) should be of equal length.
- Each output line should be terminated at the end of the line and must have a bypass capacitor on the voltage side of the resistor for each termination resistor.
- Data and signal-detect output lines should be as short and straight as possible and should be isolated from noise sources (and each other) to prevent noise from feeding back into the receiver.

# Ordering Information

ORDER PART NUMBER		LEAD FINISH	FIBER LENGTH (INCHES)	CONNECTOR				
TRANSMITTER	RECEIVER			MFG.	MFG. P/N	CONTACT TYPE	USED IN CONNECTOR BODY STYLE	CONTACT SPEC.
902170T-18-01 902170T-18-02	902171R-18-01 902171R-18-02	Au Solder	18.00 ± 2.00	AT&T	MIL-ST P2050A-C-140	Bayonet	N/A	MIL-C-83522/E1-02
902170T-18-03 902170T-18-04	902171R-18-03 902171R-18-04	Au Solder	18.00 ± 2.00	Bendix	CF-198036-017	Pin	MIL-C-38999 Series III Size 16	MIL-T-29504/4
902170T-18-05 902170T-18-06	902171R-18-05 902171R-18-06	Au Solder	18.00 ± 2.00	Bendix	CF-198060-017	Socket		MIL-T-29504/5
902170T-5.6-07 902170T-5.6-08	902171R-5.6-07 902171R-5.6-08	Au Solder	5.630 ± .500	Hughes	4568331-056-1H	Socket	MIL-C-28876, MIL-C-83526 Size 16	MIL-T-29504/2
902170T-4.8-09 902170T-4.8-10	902171R-4.8-09 902171R-4.8-10	Au Solder	4.790 ± .500	Hughes	4568331-056-1H	Socket		MIL-T-29504/2
902170T-8.0-11 902170T-8.0-12	902171R-8.0-11 902171R-8.0-12	Au Solder	8.00 - 10.80	AT&T	MIL-ST P2050A-C-140	Bayonet	N/A	MIL-C-83522/E1-02

AAAAAB-CC-XX



## Order From:

CTS CORPORATION, MICROELECTRONICS/1201 Cumberland Avenue/West Lafayette, Indiana 47906/  
 (317) 463-2565/FAX: (317) 497-5399

le