The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE RECOMMENDED PRACTICE

SAE ARP4258

Issued 1990-10-25

Submitted for recognition as an American National Standard

APPLICATION OF LOW SPEED AVIONIC SYSTEM DISCRETE SIGNAL INTERFACES

1. SCOPE:

The purpose of this Aerospace Recommended Practice (ARP) is to provide recommendations on the use of four types of discrete signal interfaces for unidirectional, low power, low frequency transmission of discrete information.

1.1 Technical Information:

This ARP provides technical and application information needed by the designers of aircraft electric systems and support equipment for the selection of discrete signal interface methods. It provides the definitions to permit comparisons of various electric discrete signal interface methods.

1.2 Field of Application:

For reliable unidirectional signaling system transmission of the status of electrical information, the selected method should provide enhanced performance against lightning or electromagnetic pulse induced transients and fault propagation suppression to assure adequate simple aircraft subsystems. Preferred types of functional and electromagnetic compatibility methods should be utilized as an essential safety of flight requirement.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this guide to the extent referenced herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

NATO STANAG 3909

BRITISH DEFENSE STANDARD 00-18 PART 4

MIL-C-83383
MIL-P-81653
MIL-R-28750
MIL-S-81619
MIL-S-85772

EIA(RS) 232
EIA(RS) 422 (NON-MULTIPLEXED)
EIA(RS) 423 (NON-MULTIPLEXED)
EIA(RS) 485 (NON-MULTIPLEXED)

SAE AIR4061
SAE ARP1587

2.2 Definitions:

BALANCED TRANSMISSION: A balanced transmission of discrete information takes place over two wires such that the common mode voltage ideally remains constant while the differential voltage takes two or more states to represent the discrete signal

BALANCED INTERCONNECTING CABLE: A two or more wire cable having impedance characteristics that provide similar impedance paths for each of two paired conductors

COMMON MODE VOLTAGE: The mean of the voltages measured between each signal conductor and a common 0 V reference point

DIFFERENTIAL VOLTAGE: The voltage difference seen between the two signal conductors in a balanced transmission system

DISCRETE SIGNAL: A signal that takes states to represent any single function or piece of information that has two or more states or values

DISCRETE SIGNAL INTERFACE INPUT: The input to the transmitter

DISCRETE SIGNAL INTERFACE OUTPUT: The output from the transmitter

D1: Diode

ELMC (Electrical Load Management Center Input): The input to the transmitter

2.2 (Continued):

OUTPUT: The output from the transmitter

PC: Power controller

Rx: Receiver

SCREENED GROUND: A wire or terminations provided with a means to adequately shield the inner conductor(s)

SSPC: Solid state power controller

SOLID STATE SWITCH: A nonmechanical switching device that changes output states upon electrical current/voltage or magnetic input

Tx: Transmitter

Zo: Lumped line load impedance

3. DISCUSSION:

3.1 Types of Discrete Signal Interfaces:

For purposes of this ARP, the types of signal interfaces considered are unidirectional in transmission mode, limited in power to the milliwatt range, and may be manifested in a variety of modes of which discrete input and output are the principle forms.

3.2 Practical Discrete Signal Interface Concepts:

The following are basic principles currently in use for the connection of sensors, switched on-off status indicators and numerous simple event state indicators. At least four discrete signal types have been considered:

a. Signaling interfaces for time-critical applications. See Figures 1 and 2.
b. Signaling interfaces for nontime critical applications. See Figure 7.
c. A switching interface for low power electrical loads. See Figure 3.
d. A switched impedance interface to designate multiple discrete interface states. See Figure 4. Normally the discrete interface may exhibit either a "0" or "1" logic state. However, a multilevel status may also be transmitted when the switched impedance method is employed to signal two or more states. The transmission medium should be configured to accommodate the discrete signal interface methods that are further specified in 4.2.1 and 4.2.2.

3.2.1 Discrete Input: The input to a discrete signal interface may be manifested in a variety of modes:

a. Off/on switch state where no electrical output is provided by the sensor device

b. Off/on switch state signaled by a change from a "0" to a "1" electrical signal state for either current or voltage. See Figure 6.

3.2.1 (Continued):

c. Level sensing device that provided an appropriate signal at "0" or "1" electrical output dependent on the functional requirements of the sensor/system. See Figure 5.

d. Impedance level switching means that provide an impedance change that is appropriate for the sensor output, but no electrical voltage or current is supplied as an output.

e. Impedance level switching that is coupled with an appropriate electrical power source such that a constant current source provides a voltage level coupled and proportional to the two or more switched impedance states. See Figure 4.

f. A direct-switched electrical low power source that may be used to directly drive lamps, relays, or other simple indicators; may or may not be part of an aircraft system or subsystem. See Figure 9.

3.2.2 Discrete Output: The discrete output signal interface is defined as follows to match various interfaces for conveying information. These are generally of lower frequency than 100 kHz and can closely match the electrical standards defined by EIA(RS) 232, EIA(RS) 422, EIA(RS) 423, and EIA(RS) 485.

a. Critical timing signaling that necessitates relatively high speed (100 kHz or less frequencies) transmissions utilizes balanced transmission techniques to reduce electromagnetic interference and limit susceptibility. (For example EIA(RS) 422.) See Figure 1.

b. Noncritical timing signaling utilizes single-ended transmission where simplicity and flexibility are the most important factors. This mode provides information and simply changes the status from a voltage "0" to "1". This provides a voltage of approximately 6 to 15 V at an "on" state where the current may be as high as 10 to 15 mA. See Figure 7 and Figure 8.

c. Low power switching is used where both information and power must be supplied, but is constrained by the need to protect the power source and aircraft cable. Conventional switching from a dc bus is used to power lamps or relays, but limited to 2 A nominal. See Figure 3.

d. Impedance switching utilizes a constant 10 mA current supply so that the discrete signal interface produces two or more voltage signal states. Thus, multiple states beyond the "0" and "1" are permissible if suitable detection means are implemented to detect these voltage levels and further process the information for bus communication. See Figure 4.

4. RECOMMENDATIONS:

Standardized discrete signal interfaces should be utilized wherever possible consistent with the variations identified by this ARP.

BALANCED DIGITAL INTERFACE CIRCUIT

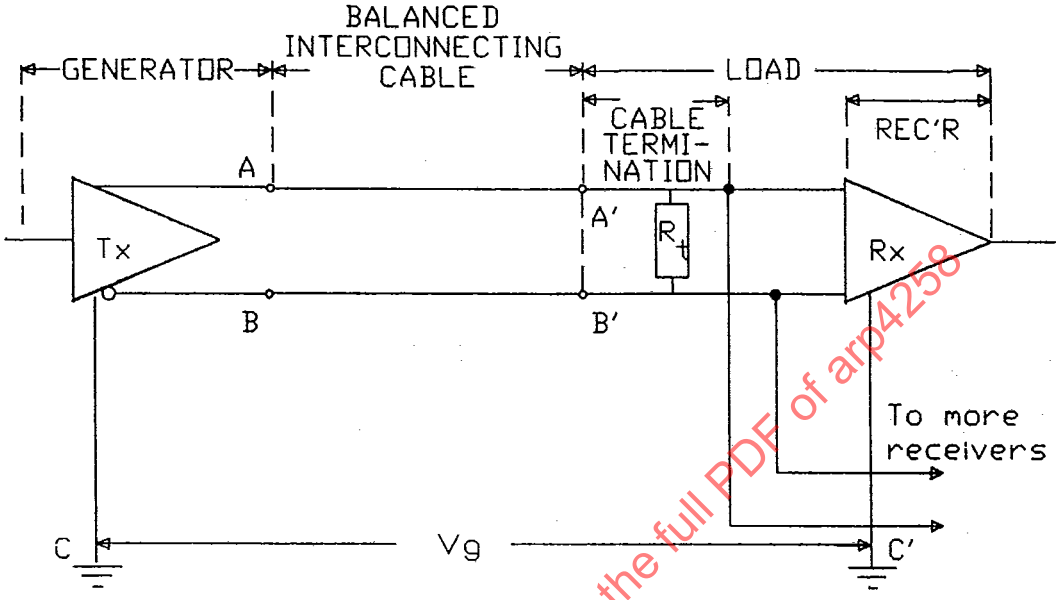


FIGURE 1

DISCRETE SIGNAL INTERFACE
TWISTED PAIR, SCREENED GRD.

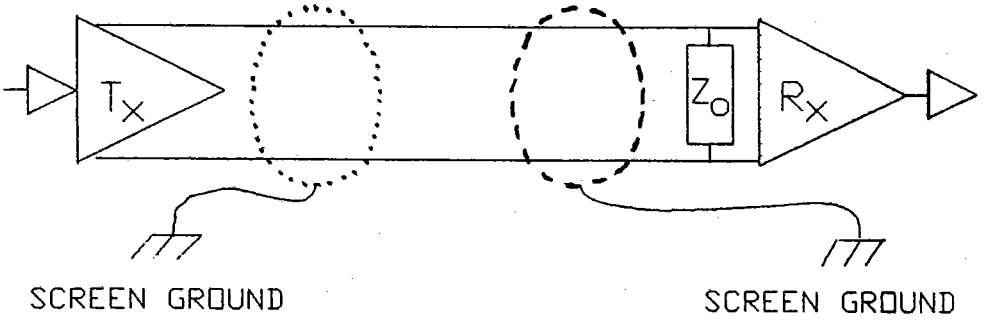


FIGURE 2

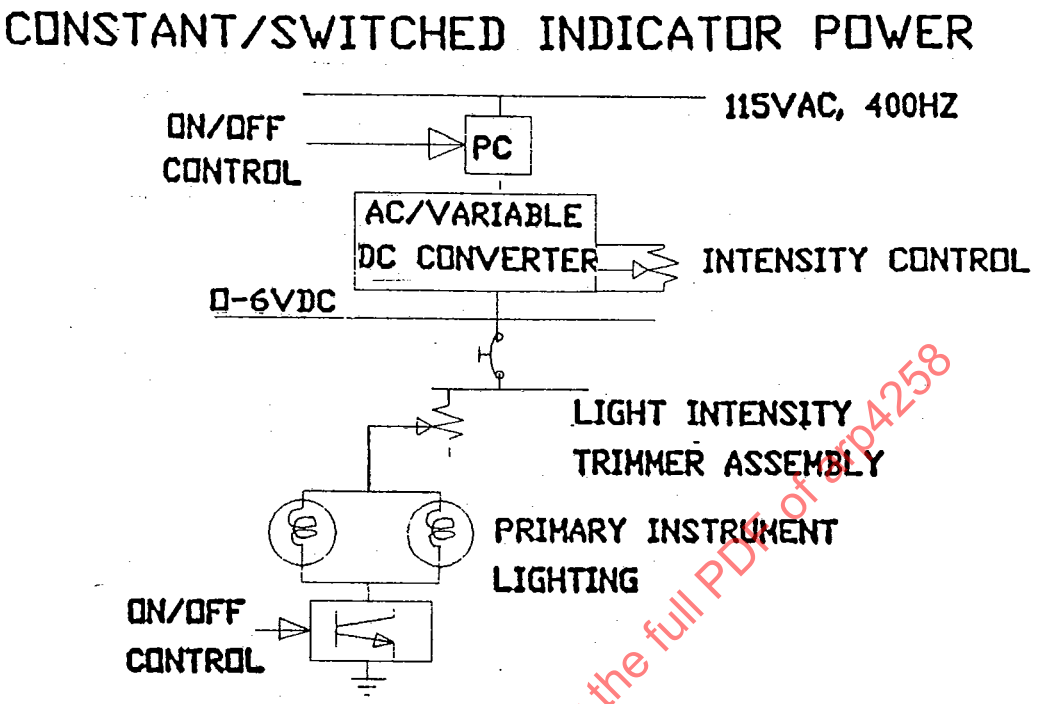


FIGURE 3

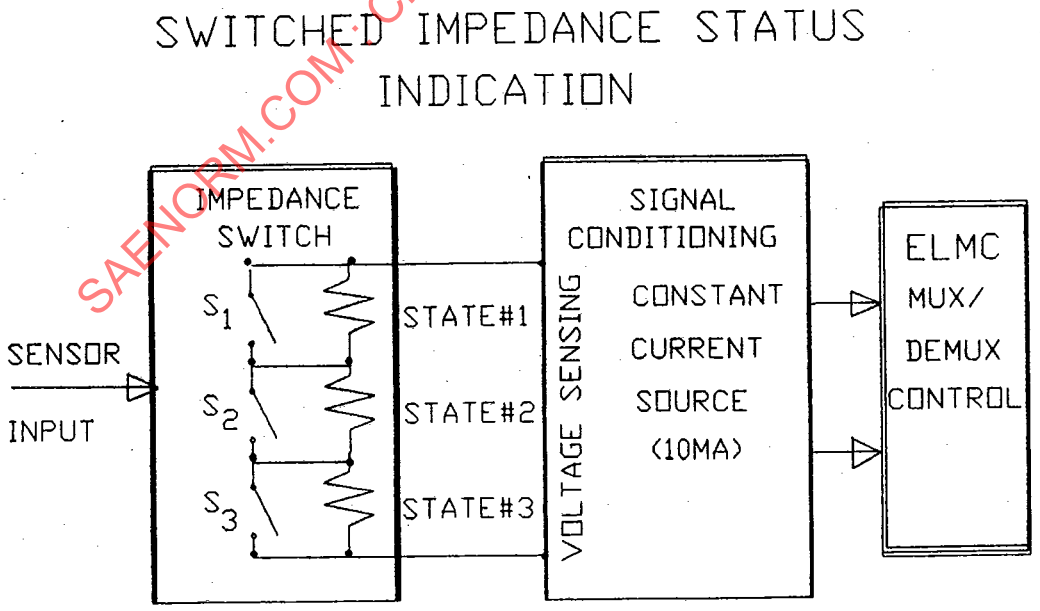
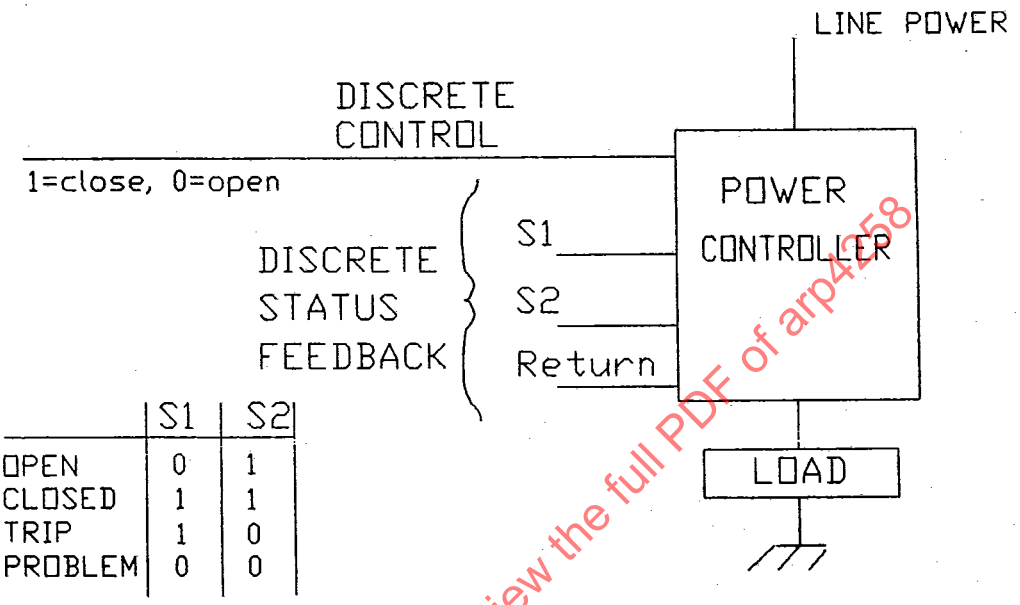


FIGURE 4

SSPC/REMOTE POWER CONTROLLER DISCRETE SIGNAL INTERFACE



	S1	S2
OPEN	0	1
CLOSED	1	1
TRIP	1	0
PROBLEM	0	0

FIGURE 5

SOLID STATE DSI SWITCH TO TERMINAL

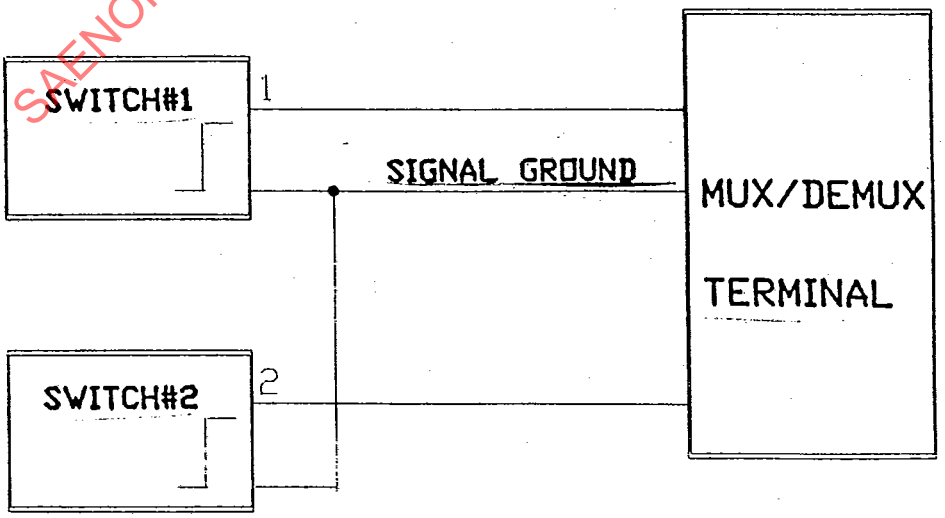


FIGURE 6