

## SENET

SENET is IGT's main I/O method for dealing with simple Input and Outputs. Most game designers take a straight forward process of Parallel I/O ports. Williams is known for its matrix of Row and Column outputs left over from their pinball days. IGT has SENET and NETPLEX. NETPLEX is a fairly straight Current Loop for smart devices on a serial I/O bus. Every device on NETPLEX has a microprocessor. SENET is for everything else.

SENET is a great idea in its concepts. We take most of the high failure circuits off the MPU board and put them on smaller assemblies outside the locked MPU so they can be changed easily. Simple circuits like lamps, switches, solenoids, meters and such have no microprocessors in them as bill acceptors and ticket printers do. SENET boards are flexible semi-smart circuits that act as an interface between the smart MPU and the simple circuit world of switches and lamps. By design you can have up to 16 devices on SENET. Each device can have 16 I/Os. So the maximum system can have 256 Inputs and 256 Outputs. All this change can be done without changing the MPU design. Each device is assigned an address. The MPU talks to each device by referencing this address and reading or writing information to it.

In between the CPU and the I/O world outside the MPU is the SENET Controller chip. This is an Application Specific Programmable Logic chip made specifically for IGT, and yes, they do come in different types. I don't think ones made for a video game, for example, will work in a reel game. The same basic design may be used, but there must be differences. I confess to never having made a study of it. SENET is a form of serial I/O. The signals are open-collector running from the +13 Volt supply, so our signals should be either ground or +13 Volt levels when idle. When the bus is active trying to measure the voltages may be meaningless. Trying to measure a changing signal with a meter yields weird voltages. Since malfunctions would also show up as weird voltages trying to measure voltages on an active system is futile. Before you try to make voltage measurements on the SENET bus kill SENET by either pulling the MPU out of the backplane then take voltage measurements. If that isn't possible due to a locked MPU, hold the Reset

button in while making the voltage measurements. This keeps the MPU in RESET and thus not making SENET active. Reset stops the SENET Controller from operating.

## SENET Signals

SENET is a Synchronous Serial Bus system. All operations are done one bit at a time, accompanied by a Clock Pulse. We only have a few signals to be concerned with.

SENET Ground

SENET Power (+13 V DC)

SENET Clock – Our synchronous clock pulse that must accompany all operations except Reset.

SENET Reset – Often labeled as SENET Enable. When active it resets the SENET bus. We would typically find this signal active between SENET operations or on Power-On Reset.

SENET Transmit Data A, and Transmit Data B – We have two outgoing paths from the SENET Controller on the MPU. Typically TxDA is used for lamps, solenoids, counters and such, while TxDB is used for 7-segment displays and Reel Back Light Control Boards.

SENET Receive Data – Only one used. This is data coming into the SENET Controller and MPU from switches and other inputs. This is only for the same channel as the TxDA side. I have never seen it used to read data in from a device that uses the TxDB side data. I guess that would be possible, but I don't think I have ever seen a SENET board that uses TxDB output and returns data on RxD.

SENET Strobe – Data is sent out from the MPU 8 or 16 bits at a time. 8 bits for sending an address. 16 bits for data. At the end of each operation the Strobe pulse ends the operation.

A typical SENET operation might start with the following steps:

First the SENET Controller selects the device it wants to talk to on the bus by sending out an address.

SENET Reset (to clear the bus).

8 SENET address bits, each accompanied by a Clock pulse. (Set the bit, clock pulse, set the next bit, clock pulse, set the next bit, clock pulse... most significant bit first.)

SENET Strobe

All devices get this information. When a device recognizes its address it gets ready to send and receive information.

The SENET controller then sends out 16 bits of information, one bit at a time. At the same time it is sending information it is reading information from the selected device too.

Set the output bit, clock pulse, read the input bit; set the next output bit, clock pulse, read the next input bit... until 16 bits have been transferred, most significant bit first.

SENET Strobe ends the cycle and the next operation can start.

Send the next address, read and write the data, end with Strobe.

Speed of the operation is unimportant. This is one advantage of using a synchronous system. Speed of our clock pulses can be as slow as manually setting inputs or as fast as the logic will allow. I have built manual test fixtures to operate a Door I/O board and I know this procedure is good.

- 1 – SEN GND
- 2 – SEN CLK
- 3 – SDATA ADR
- 4 – SDATA RxA
- 5 – SDATA TxA
- 6 – SDTAT TxB

7 – SEN STB  
 8 – SEN RST\  
 9 - +13 VDC  
 10 - +25 VDC  
 11 – BGND  
 12 – AGND  
 13 – (NC)  
 14 – (NC)

## What devices are on SENET?

751-183-00	Display, 3 Payline, Incandescent, Board Assembly
751-184-00	Display, 5 Payline, Incandescent, Board Assembly
751-239-00	PCB, 9-line, 2-digit per line display
751-283-00	Display, 7-Segment, 4-5 reel, w/tp interface, single row 7-seg displays
751-284-0x	7-segment display 3 reel, w/tp
751-426-00	Touch Panel denom assembly
751-426-10	Denom LED Board
754-276-01	Cabinet I/O
754-278-01	Multi I/O, B0 and B2 jumper, 10 pp switch, GK+
754-278-02	Multi I/O, Only B2 jumper, 6 player panel switch, Deluxe
763-006-00	PCB, touch panel denom
769-241-0x	Reel lamp controller, SENET, 3-reel
769-268-00	Reel Lamp Controller
769-270-00	SENET board for 9-line, 2-digit per line display (75123900)

## Troubleshooting hints and tips

Most problems can be resolved by just swapping out the boards, but sometimes you need a way of troubleshooting those problems that just aren't so obvious. Following are some troubleshooting hints that may seem useful.

“Meter disconnected”

This is one of the first checks the IGT game makes when it comes up. If SENET is dead the error reported might indicate “Meter Disconnected” but the problem is really best described as “SENET is not working at all”. In this case you can swap out all the boards with known good boards.

### Making continuity checks of SENET

With game power off you should be able to make continuity checks from the 14-pin MiniFit connectors on the end of the boards. All these are connected together.

- Pin 1 – Ground (SENET Ground)
- Pin 2 – SEN CLK, SENET Clock
- Pin 3 – SEN ADR, SENET Address
- Pin 4 – SEN RxD, SENET Receive Data
- Pin 5 – SEN TxDA, SENET Transmit Data, A channel
- Pin 6 – SEN TxDB, SENET Transmit Data, B channel
- Pin 7 – SEN STB, SENET Strobe Pulse
- Pin 8 – SEN RST, SENET Reset line
- Pin 9 – +13 V DC
- Pin 10 – +25 V DC
- Pin 11 – Ground (for the 25 Volt line)
- Pin 12 – Ground (for the 13 Volt line)
- Pin 13 – (not used usually)
- Pin 14 – (not used usually)

The square solder pad on the board can identify pin 1 of the connector. Following down that side to pin 7. Pin 8 starts back beside pin 1 and proceeds down the other side.

### Making voltage checks of SENET

Turn power off. Pull the MPU board out a bit. Return power on. The SENET is powered from the backplane. Pins 2 through 8 should be high, roughly +13 Volts. Pin 9 should be +13 Volt Power (typically +12.5 to +13 V). Pin 10 should be +25 Volt Power (typically +24 to +26 Volts). Pins 1, 11 and 12 should be ground.

If you find an odd voltage turn off power and pull the SENET boards one at a time, then restoring power until you find the one that is pulling that line down. Worth noting is that the RxD line may only go up to +5 VDC if the MPU is still connected in the circuit or may not go positive at all if the MPU is not in the circuit.

### Using the game to test boards

Not all circuits are used on all the boards. On Game King Plus games there is a second Door I/O board (75427802, or just “802”) that only controls the added buttons of the “Plus” games. These are the five “Play x Lines” buttons on the top row of the Player Panel. So using a game to test a board may not be a good idea. Another reason not to use a game to test a board is the possibility that a damaged board may have caused damage to the game. Putting the questionable board into a good game could down the good game too. It is better to replace the board with a known good one and test the boards on a test fixture or a game that is not in play.

### Which boards control what?

On S2000 the Door I/O is typically a 75427801, or referred to as an “801” board. This board controls most of the player panel switches and lamps and coin-in circuits. The Cabinet I/O, 75427601, or just “601”, board controls circuits in the lower cabinet area. On TITO games this board might only control the “Meter Disconnected” circuit and Tower Lamps. Not all the functions may be in use. On Game Kings the Main Door I/O board may be an “801” or “802” board depending on the model of the game. Game King Plus designs add a second Door I/O that must be an “802” board.

### What is the difference between an “801” and an “802”?

Both of these boards are almost identical in schematic. The main difference is the part of the circuit that sets the addressing for that board. On the “801” board you will find jumpers “B0” and “B2” on the board itself. Look for R13 to R16 on the bottom of the board. On “802” designs the addressing is done in the cabling by putting in jumpers “B0” through “B3” lines. The board is designed to use a DIP switch to set addressing also. Four LEDs on the board indicate what address the

board is currently set for.

Use of the “802” boards may differ between model types, so take the preceding statement with a bit of consideration in any specific game. Generally speaking general statements are only generally true.

Yes, you can take the jumpers off of the “801” and have it function as an “802” but this would be confusing for those who follow you. The board would no longer function as an “801” in an S2000.

On the motherboard

You have three connectors dedicated to SENET on the motherboard. One labeled for “Door I/O”. One labeled for “Cabinet I/O”. The other is SENET going to other areas, such as the top box on games that have features to control up there. These are all wired together. A problem on one can effect all others.

What normally fails?

Two areas fail most of the time. When SENET boards are “Hot Swapped” the chip that dies most often is the 40106 (or 4106) which is the first inverter on the SENET signals on the board. Otherwise it is an output transistor that is on the outputs. These are a dual N-MOSFET. One side melting often takes out the other side as well.

Input signals are fairly well protected by a resistor network, but I have seen them fail in rare instances. Since the circuit is a good design I can only suspect that static electricity was to blame, but that is like blaming it on the devil. I don’t think I could ever prove it to anybody.

Other board failures I have seen are do to “mis-adventure” and are not a failure of the SENET board itself. One side of the player panel switches in connected to ground. One side of the player panel lamps is connected to +13 Volts. If a loose wire is found and reconnected wrong there is a possibility of creating a short between +13 V and Ground. Since this power runs through the SENET Bus the weakest link in the system is what blows. One possibility is the Door I/O board. If you replace a Door I/O board that has heavy damage look for a reason before replacing the board. Check for overheated wires on the Player’s Panel and burned

contacts on the SENET connectors.

### Problems on the motherboard

The “Mis-adventure” problem mentioned in the previous paragraph often plays havoc with the motherboard and MPU board. Traces burn out. Continuity checks between the SENET sockets will usually find this damage.

### Problems on the MPU board.

There are only three ICs on the MPU that are concerned with SENET. The SENET controller itself, which is on a socket. Consult your schematic for which one this is on your model. The SENET controller runs on +5 Volts DC and the SENET bus runs on +13 V DC, so we have to have a Voltage Level Converter in between these two circuits. This is typically a “4504” inverter. In between the 4504 and the bus is another buffer. This is usually a “74C240”. The 74C240 takes damage often, also. The damage seldom gets back as far as the 4504 or SENET Controller, but it can happen. When troubleshooting this area check for damage on all three chips.

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