

Special Features of the SN65HVS88x Family of Digital Input Serializers

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ABSTRACT

The SN65HVS880 and SN65HVS882 provide additional performance features not mentioned in the product data sheets. These features include an extended negative-input voltage range, representing a sensor switch off-condition, and the capability of a 5V back-supply in case the 24-V field supply collapses.

Negative Input Voltage Range

While the data sheet specifies the range of field input voltage between 0V and 30V for the HVS880 and 0V to 35V for the HVS882, it is possible to extend the lower limit to -5 V , provided that input resistors, R_{IN} , are switched in series with the field inputs IP 0:7 as demonstrated in [Figure 1](#).

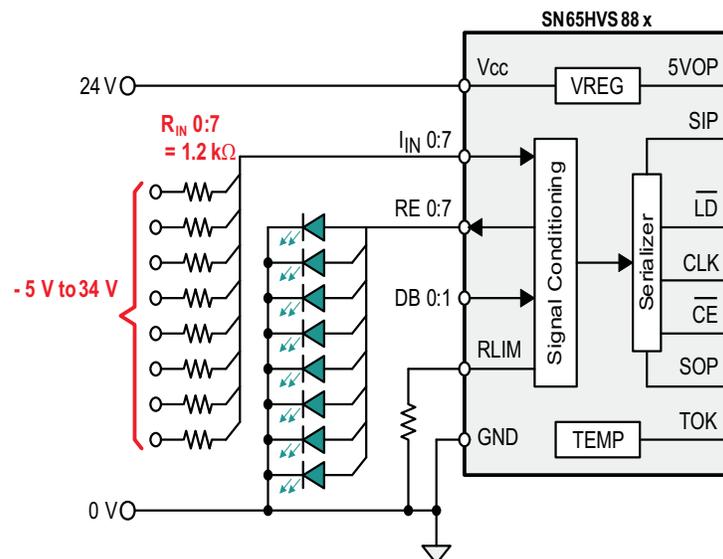


Figure 1. Applying Negative Input Voltages Requires the Insertion of Series Input Resistors

For positive input voltages, each one of the inputs sinks current whose maximum value is determined by an internal current limiter. In the case of negative input voltages however, an input starts sourcing current and the only current limiting provided is through the input resistors R_{IN} . To assure that the total power consumption stays within the thermal capacity of the device, the recommended minimum resistor value for R_{IN} is $1.2\text{ k}\Omega$.

[Figure 2](#) shows the V - I characteristic for an input with $R_{IN} = 1.2\text{ k}\Omega$ represented by the red slope in the third quadrant.

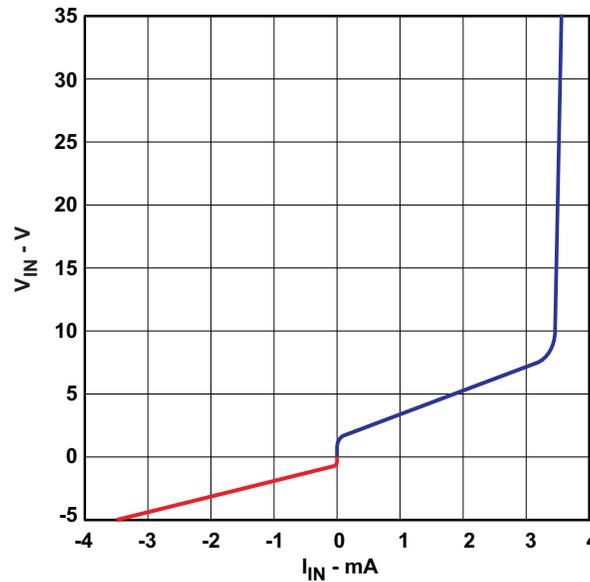


Figure 2. V-I Input Characteristic for $R_{IN} = 1.2k\Omega$

Back-Supply

Some rare applications require back-supply in the event of a field supply collapse. To ensure continuous operation it is possible to apply a 5V supply to the regulator output (5VOP) of the HVS88x device. Care must be taken to ensure that the V24 input is floating before applying the back supply, so as to avoid the internal regulator from being driven from both input and output sides. Figure 3 suggests a simple back-supply circuit with field supply detection.

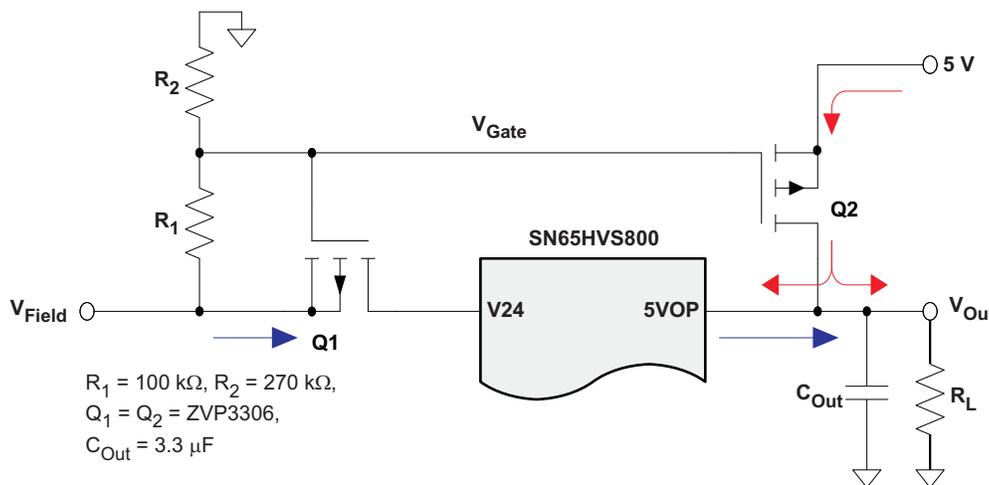


Figure 3. Back-Supply Circuit

The circuit basically senses the loss of the field supply via the transistor Q_1 and the voltage divider R_1 – R_2 and applies an external 5V supply via Q_2 to the regulator output. The blue arrows indicate the current flow during normal operation, the red arrows the flow during back-supply.

Choosing two matched P-channel MOSFETs and making the voltage divider nonsymmetrical ensures that the switch-off threshold of Q_1 is reached before the switch-on threshold of Q_2 and vice versa. Also, the resistor values selected ensure that for a maximum field supply of $V_{Field} = 30\text{V}$, the V_{GS} of Q_2 stays well below its specified maximum of $\pm 20\text{V}$.

Figure 4 shows the timing diagram for the loss and the recurrence of V_{Field} .

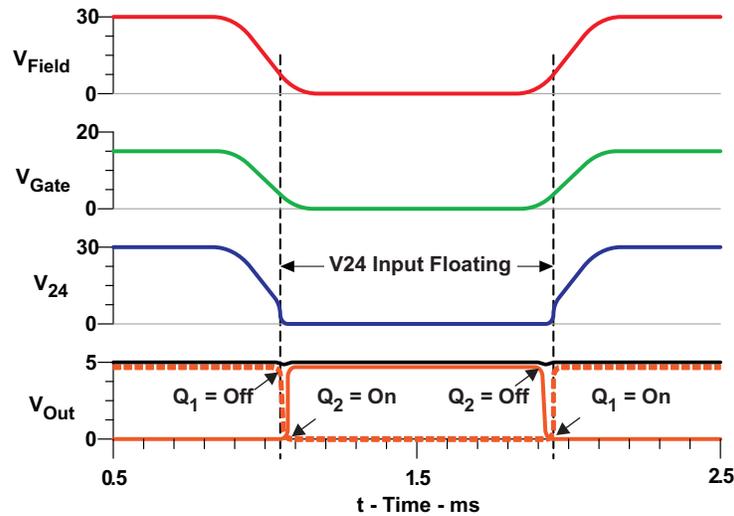


Figure 4. Back-Supply Timing

During collapse of the field supply, the V_{Gate} voltage of Q_1 and Q_2 tracks V_{Field} . When the V_{Gate} drops below the gate-source threshold voltage of Q_1 , Q_1 becomes high impedance, thus disconnecting the V_{24} input from the field supply. With falling V_{Gate} , V_{GS} of Q_2 increases. When it exceeds the MOSFET's on-threshold voltage, Q_2 conducts and provides the external 5V supply to $5V_{OP}$.

When V_{Field} returns, the gate-source thresholds of Q_1 and Q_2 are passed in reverse sequence. This ensures that the 5V supply is disconnected from V_{Out} prior to the application of V_{Field} .

Note that the orange colored curves in [Figure 4](#) present the individual V_{Out} responses of Q_1 and Q_2 . Applying a bulk capacitor of $C_{Out} \geq 3.3\mu F$ smooths the output voltage to a stable 5V level.

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