# 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.

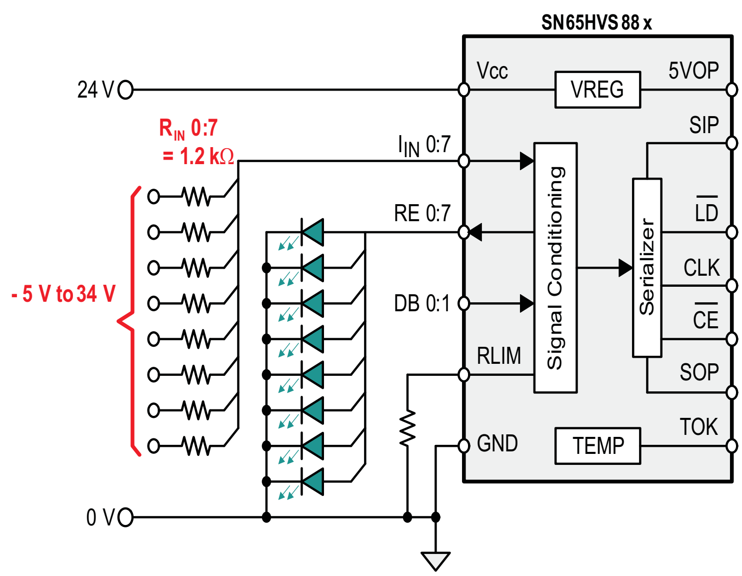


**Figure 1. Applying Negative Input Voltages Requires the Insertion of Series Input Resistors**

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 kΩ.

Figure 2 shows the V–I characteristic for an input with $R_{IN}$ = 1.2kΩ represented by the red slope in the third quadrant.

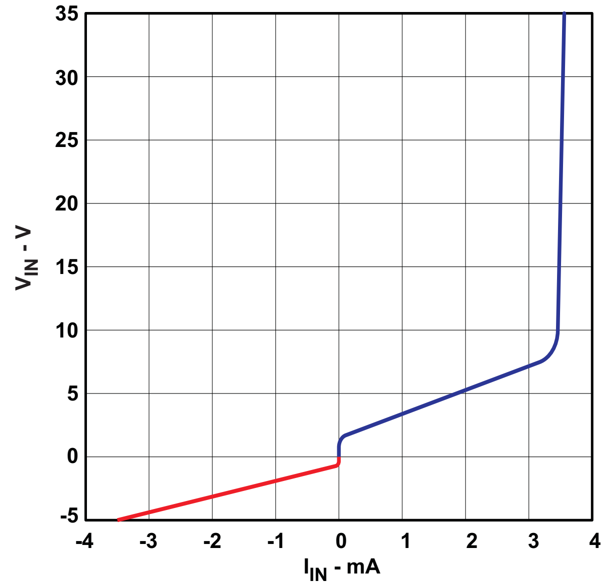


**Figure 2. V–I Input Characteristic for $R_{IN}$ = 1.2kΩ**

## 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.

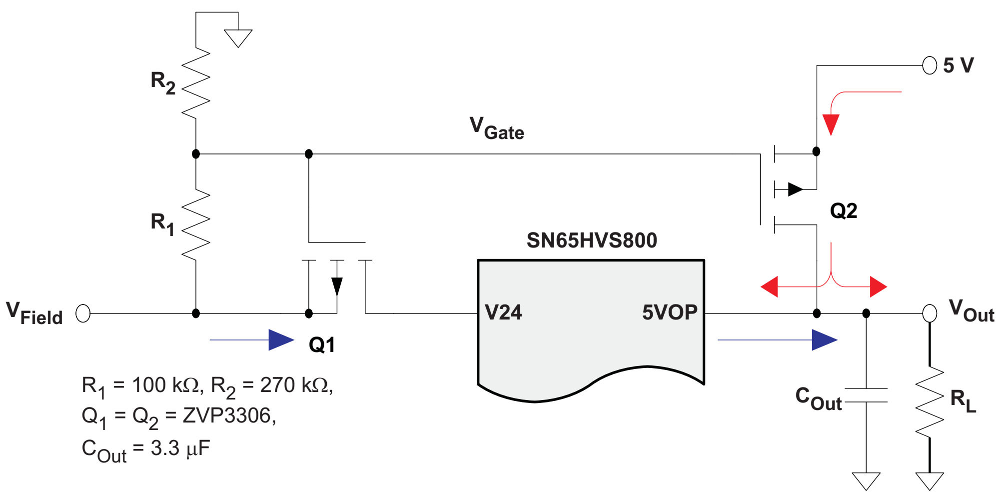


**Figure 3. Back-Supply Circuit**

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 $V_{Field}$ = 30V, the $V_{GS}$ of $Q_2$ stays well below its specified maximum of ±20V.

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

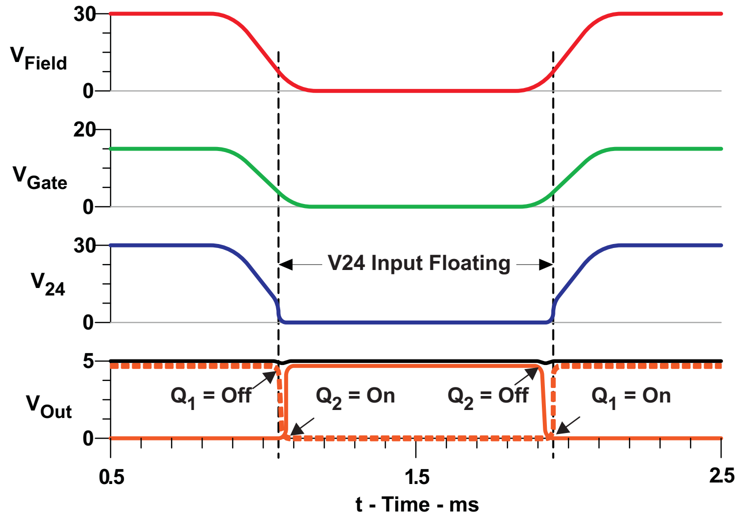


**Figure 4. Back-Supply Timing**

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 V24 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 5VOP.

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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