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Application Note for a Programmable Discrete I/O System

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REVISION HISTORY

Revision	Date	Description of Change
AN-800_New	01/16/20	Initial Release

Introduction

This document describes the design of a universal programmable discrete I/O system. It is designed to operate with a standard 28 VDC aircraft power supply. Below is a block diagram of the system, using several Holt IC devices that interface to GND/Open and Supply/Open sensors and provide 28V current source and current sink load drivers. A 5V option drives low voltage loads. The reference schematic diagram in OrCAD Capture format has 24 programmable outputs and 24 programmable inputs. The example design is easily modified to match customer system requirements.

Discrete Outputs

Figure 1 shows the arrangement for driving four output loads programmable as GND low side drive or 28V/5V high side drive. The HI-8425 is used as the low side driver; this has the capability of sinking up to 200mA load current and up to 36V load voltage. For high side drive, the HI-8430 provides 5V and 28V drive with 200mA per channel capability. All of the Holt drivers have current limiting and temperature overload protection. The sense inputs into these devices are not used; input sensing uses three HI-8429 devices described later.

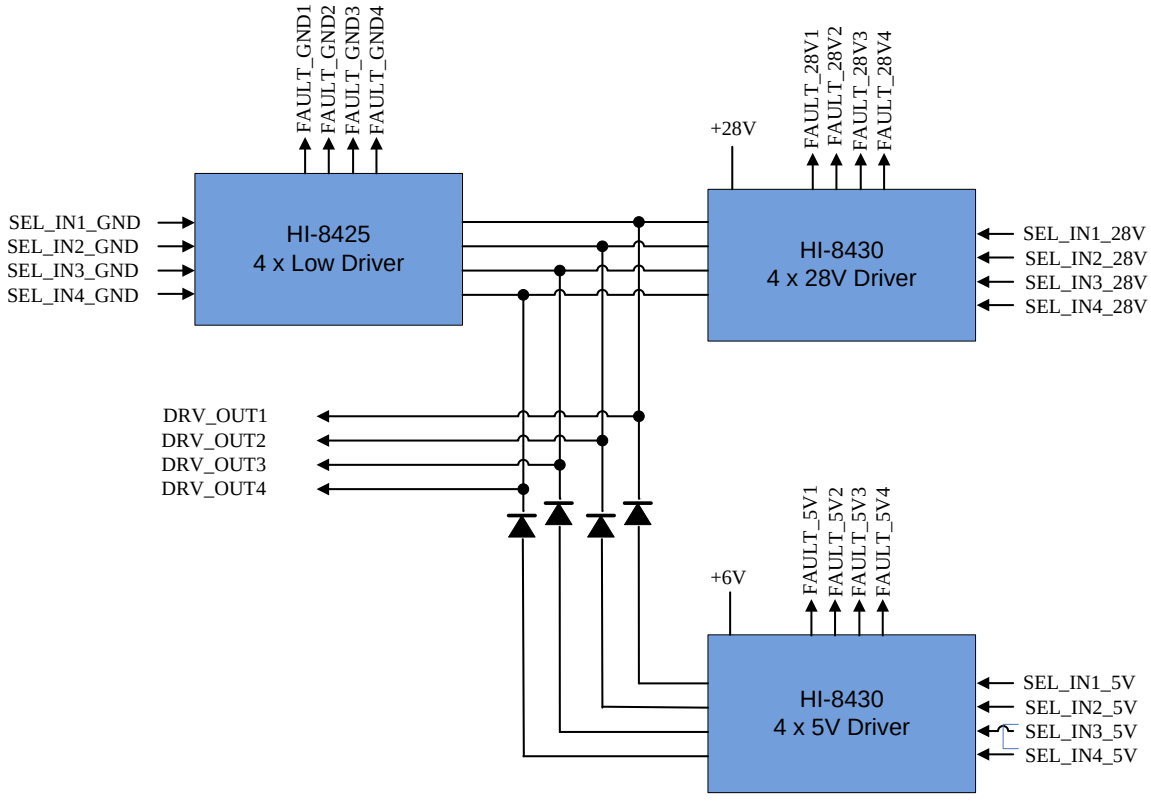


Fig 1 – Discrete Output Drive arrangement – 4 channels

For each channel, the three discrete driver outputs are connected in parallel; individual drivers are enabled by asserting the SEL_IN inputs of the respective IC package. The SEL_IN signals are connected to host microprocessor or FPGA GPIO outputs. The SEL_IN signals for unused drivers are held at 0V and those driver outputs are high impedance. Interlock logic is necessary to ensure that just one of the three output types is selected for each channel. If two or more outputs are selected for a channel, contention will result. No damage will occur since the Holt IC drivers have output protection. A protection diode is used to prevent damage to the 5V driver when the 28V driver is activated. The 5V HI-8430 has a drive voltage of 6V, with approximately 0.7V drop across the diode and the small drop across the driver transistor the output voltage will be very close to 5V. Each discrete driver has a FAULT indication output; one of these will go high if the corresponding driver has shut down due to overcurrent or overheating.

Figure 1 shows four channels; for a 24-channel system, six identical blocks are required. Of course when channels have static type selection (high-side drive or 5V or 28V low side drive), 2 of the channels' driver outputs are unnecessary. In this case, channels are assigned to appropriate-type driver ICs to maximize efficiency.

Discrete Inputs

Three Holt HI-8429 devices provide sensor input interface; these are host-programmable as GND/Open or Supply/Open via SPI interface. The high and low thresholds also programmable within the range of 2 to 12V, using the same SPI interface; which "daisy chains" the 3 devices in series. The wetting current (current when the sense contact is closed) is approximately 1.2mA for GND/Open and 0.9mA for 28V/Open contacts.

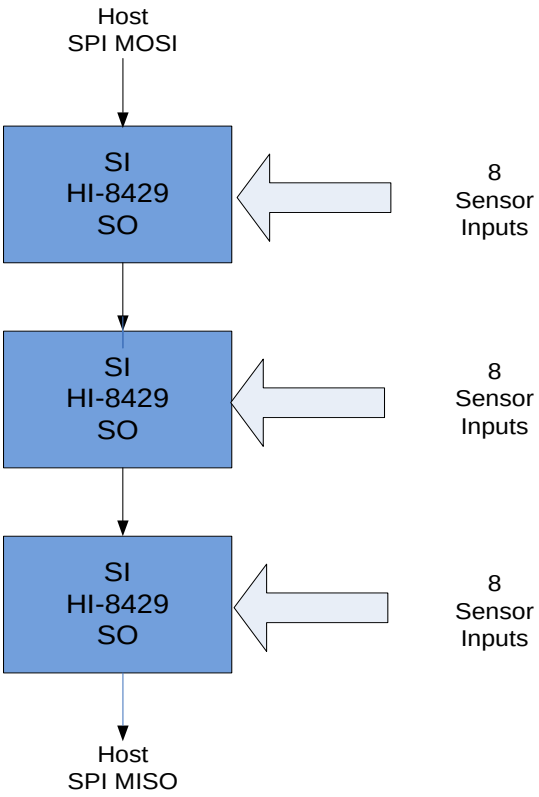


Figure 2 – Three HI-8429 devices configured as 24 sense input channels

Combining Discrete Inputs and Outputs

If desired, a sense input and an output can combined to provide a fully programmable discrete I/O pin, this shown on the schematic as jumpers J16 to J39.

Power Supplies

The unit will run from an aircraft 28V supply, plus 3.3V, 6V and 15V DC supplies, the lower voltage DC supplies can be derived from the 28V supply using DC-DC converters. Maximum current requirements are shown below, based on all outputs operating at maximum allowed current. The 28V and 6V currents are high due to the large drive current for 24 concurrent outputs:

28V	6A
6V	6A
15V	100mA
3.3V	10mA

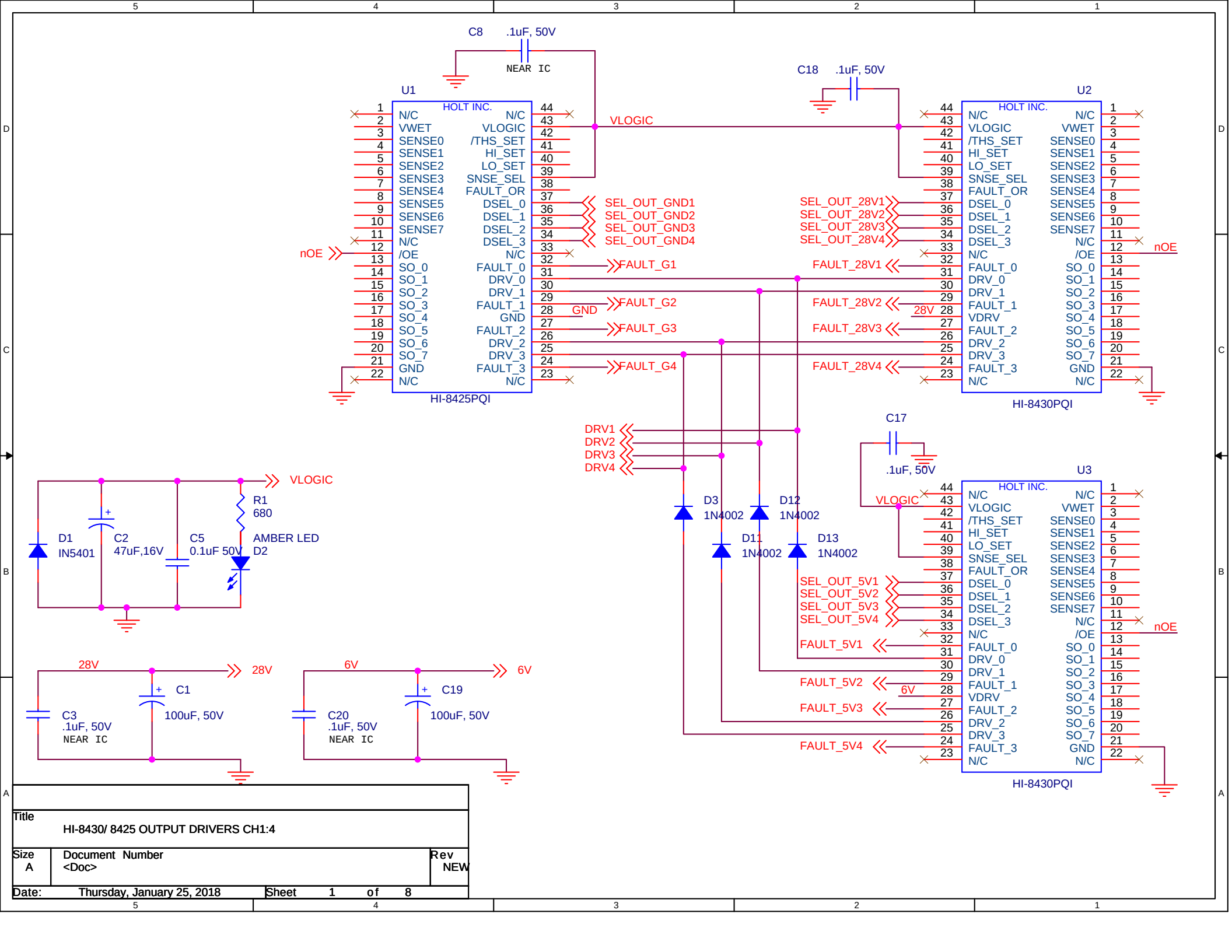
Because the total current is quite high, the board should be designed for good heat dissipation, using heavy ground planes under the HI-8425 and HI-8430s. The enclosure should have good air flow, a fan may be required to increase cooling.

System Control

No design example is provided for system control as this I/O function is probably part of a larger design. In practice, a microprocessor or FPGA with SPI interface and sufficient general purpose I/O fulfils the host control function.

Input Lightning Protection

The HI-8429 sense inputs have built-in lightning protection to RTCA/DO1060G Section 22 Level 3; Level 4 lightning protection can be achieved by following guidelines in Holts Application Note AN-305. The discrete outputs do not have lightning protection; however Holt provides recommendations in a guide available from our Applications or Sales Department.



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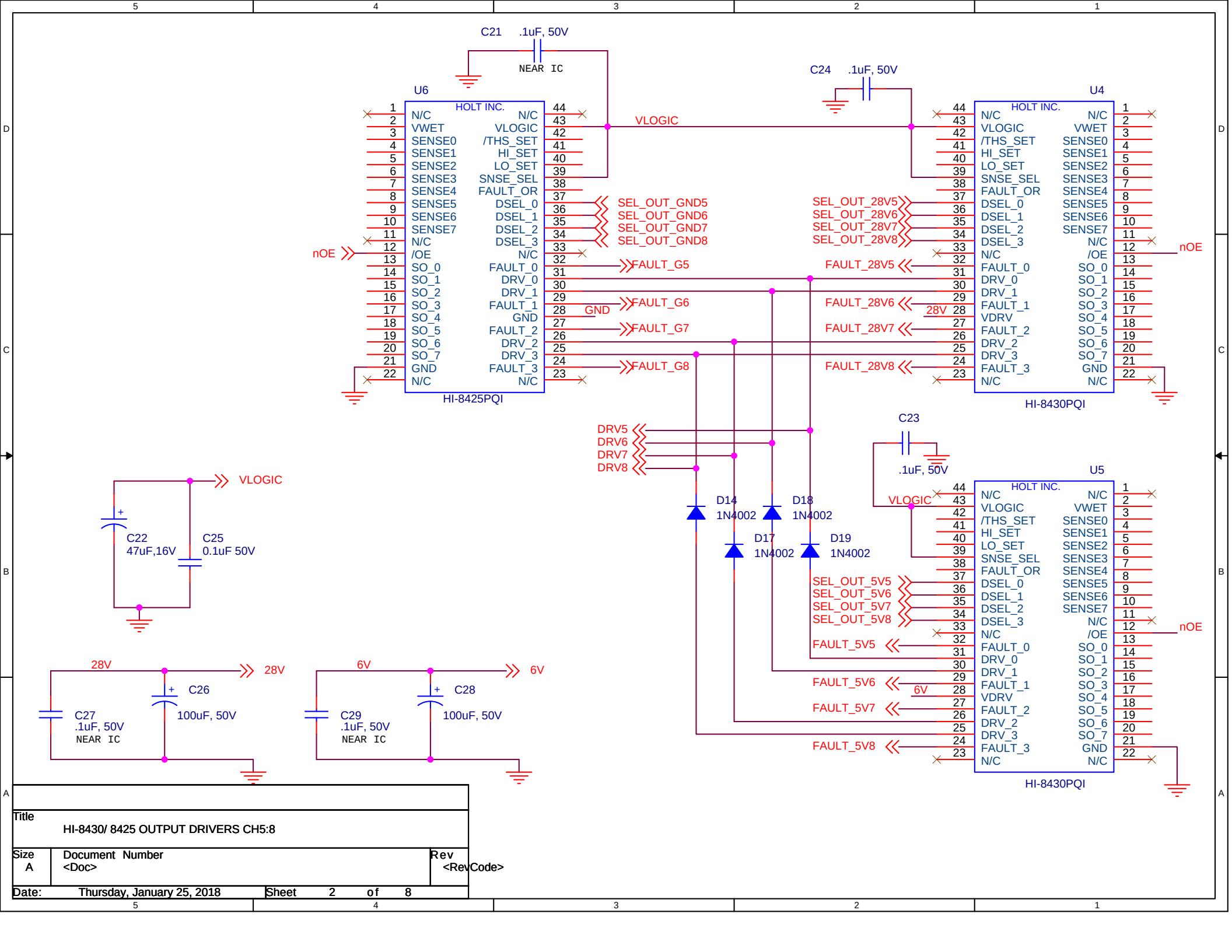

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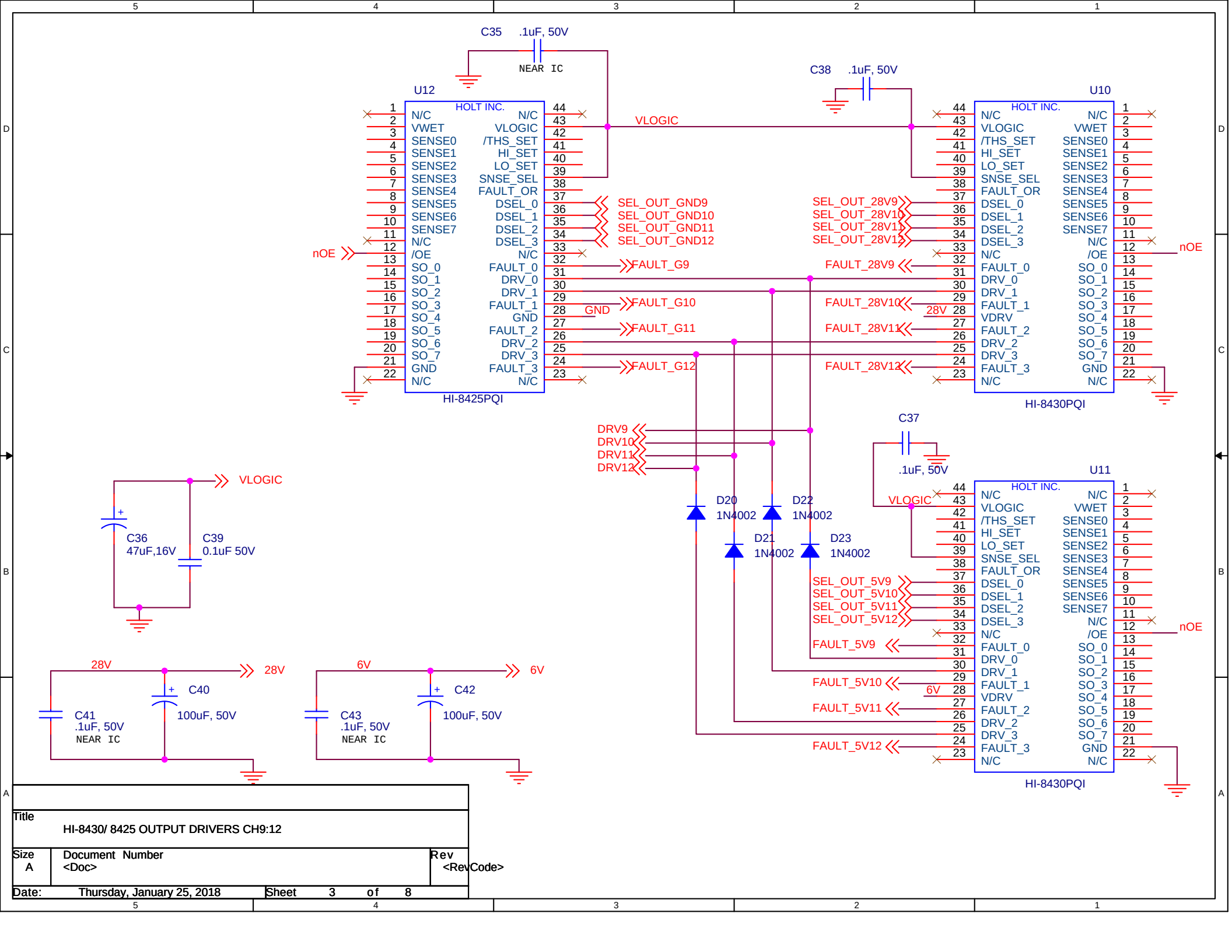

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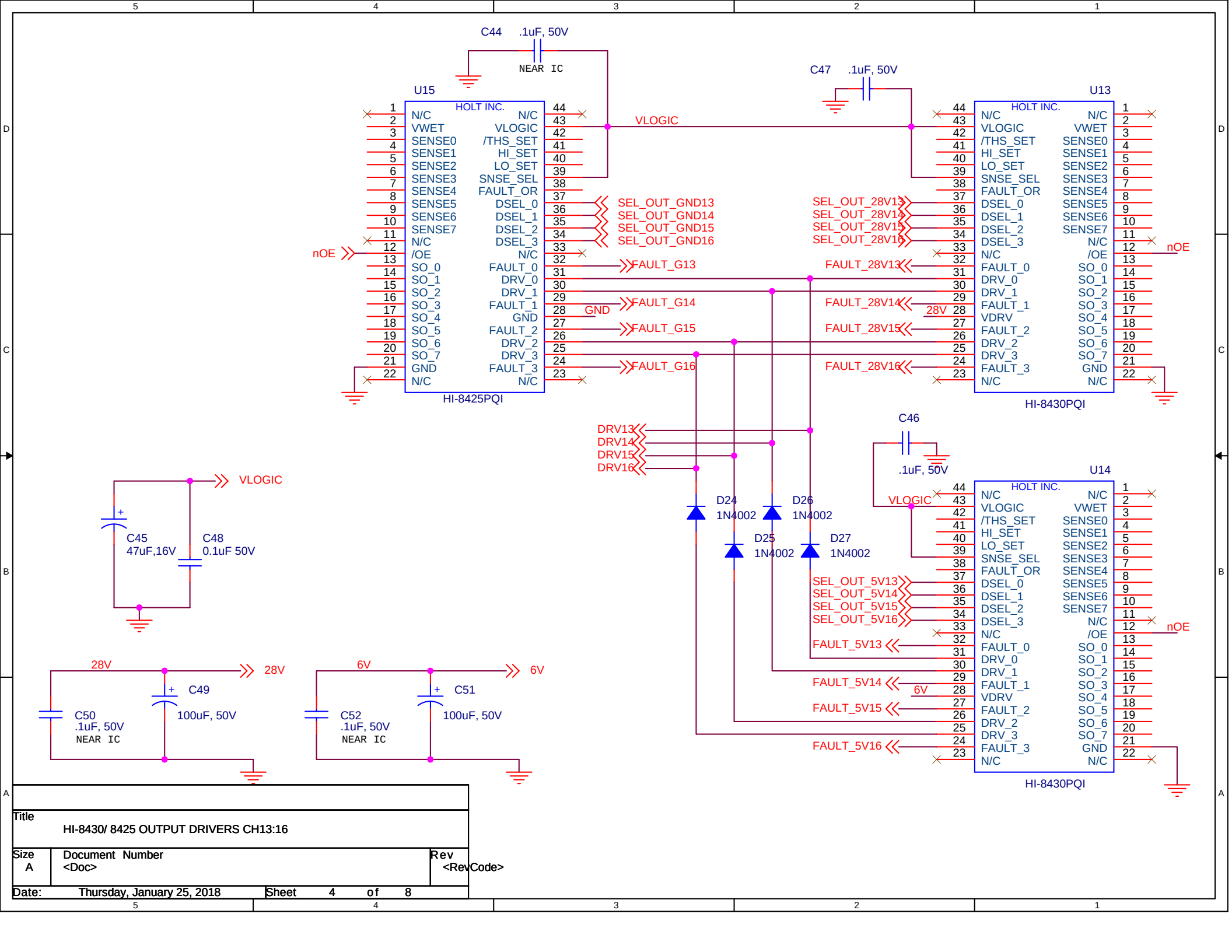

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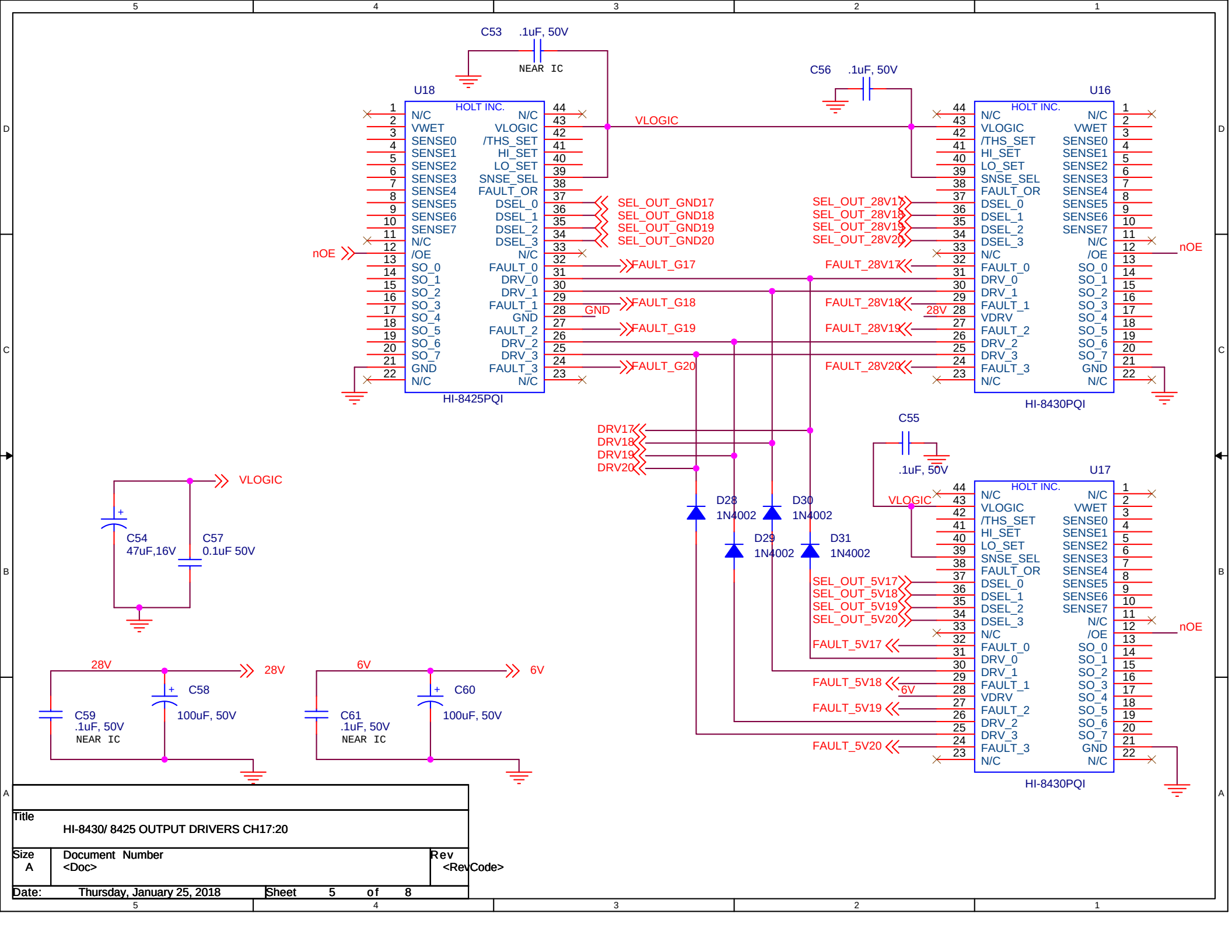

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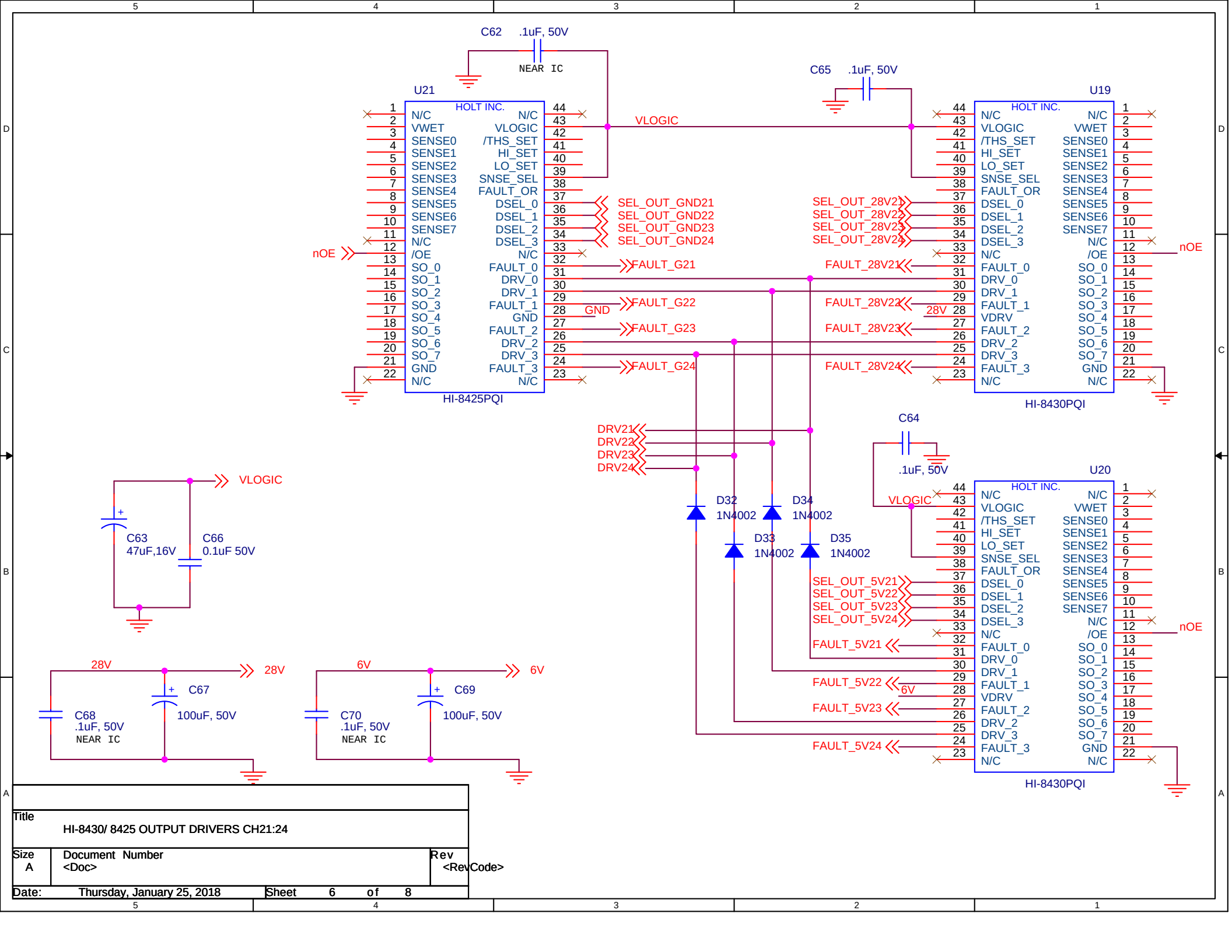

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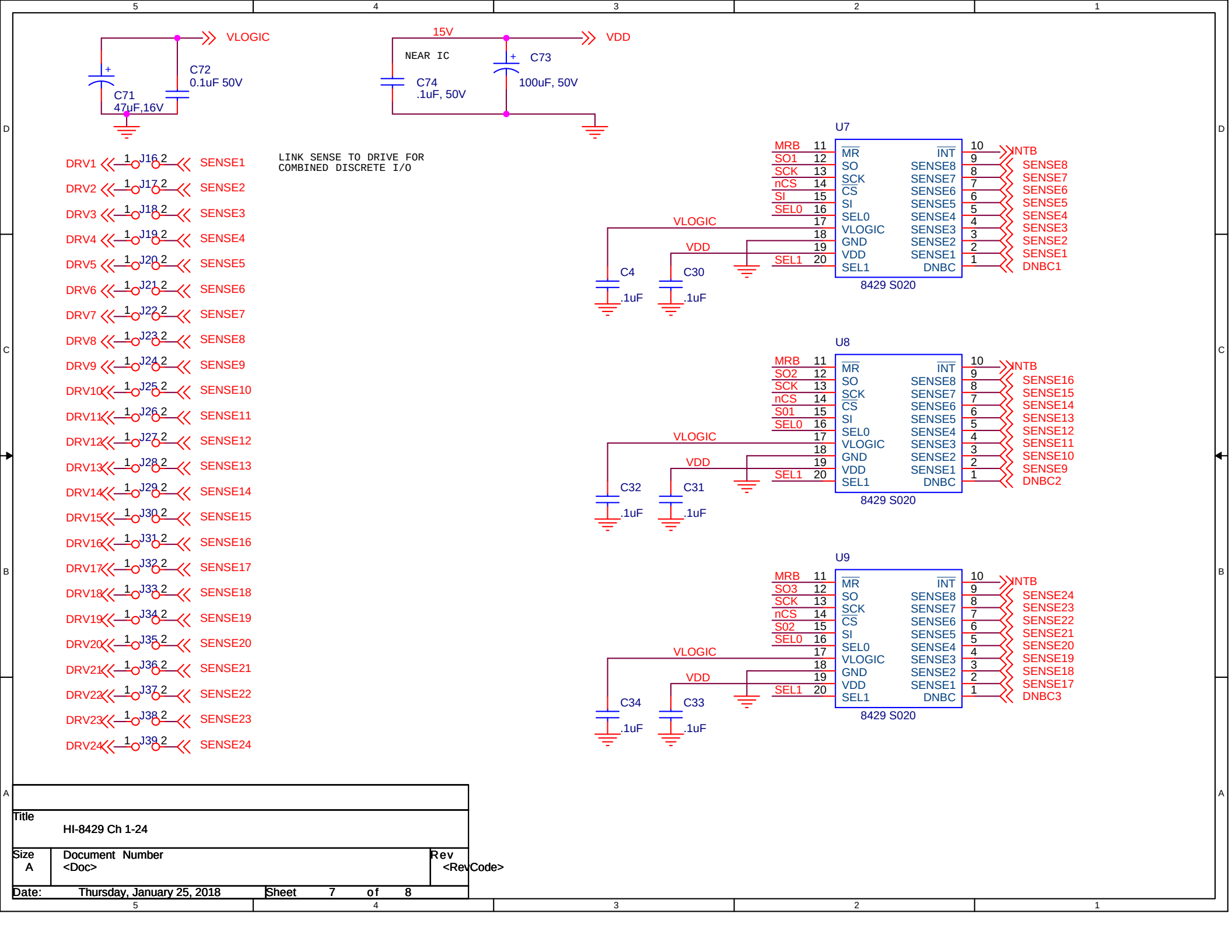

Title: HI-8429 Ch 1-24		
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Signals descriptions

DRV24:1These are the drive outputs up to 200mA, they can source or sink, each one has choice of 0V, 28V or 5V drive

SEL_OUT_G1:24These are the Select inputs to drive a 0V output, the corresponding other two input SEL_OUT28Vn and SEL_OUT_5Vn must be set to low.

SEL_OUT_28V1:24These are the Select inputs to drive a 28V output, the corresponding other two inputs SEL_OUTGn and SEL_OUT_5Vn must be set to low.

SEL_OUT_5V1:24These are the Select inputs to drive a 5V output, the corresponding other two inputs SEL_OUTGn and SEL_OUT_28Vn must be set to low.

FAULT_G24:1These are the fault outputs for all the ground drivers, will go high if output current limiting occurs, current will fold back to ~10mA

FAULT_28V_24:1These are the fault outputs for all the 28V drivers, will go high if output current limiting occurs, current will fold back to ~10mA

FAULT_5V_24:1These are the fault outputs for all the ground drivers, will go high if output current limiting occurs, current will fold back to ~10mA

SENSE24:1These are sense inputs and can be programmed for GND/Open or Supplu/Open, in the case of Supply open the pull up is to Vdd which is 15V.
The thresholds and sensor type are individually programmable through SPI.

28V This is the supply for the 28V drivers

6VThis is the supply for the 6V drivers, outputs will supply close to 5V as there is 0.6V diode drop in series with them

VLOGICThis is the supply for the device logic and should be 3.15 to 3.45V

VDDThis is the supply for the HI-8429 devices, is will pull up the GND/Open sensors, and should be in range 14.25 to 15.75V

NOTES:

The FAULT_OR outputs could be used to generate an interrupt but because this output is not open drain a diode would need to be used on each output
and then inverted to get an active low

In GND/Open mode the HI-8429 pulls up the input to VDD (15V) not 28V as was requested, if 28V is required then an external pull up resistor to 28V is needed.

The HI-8425/HI-8430 sense inputs are not used as they are not independantly programmable and would have to be set in banks or 4.

Thresholds for the sense inputs are only programable in Bank of 8 but the sense type is idependantly programable.

Title: Signal Descriptions/Notes		
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