AN644

Converting NTQ104/105/106 Designs to HCS200/300s

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INTRODUCTION

NTQ104/105/106 encoders have been used in many designs requiring the high security offered by the KEELOQ® code hopping system. With the introduction of Microchip's encoders, the HCS200/300 and the high-voltage HCS301, designers can do seamless conversions of their NTQ104/105/106 encoders to the new Microchip HCS200/300 devices. In addition, designers can convert their NTQ104/105/106 encoders to the new Microchip devices and take advantage of the extra features and lower cost of the new devices with minimal changes. This application note will help designers to do these conversion and take advantage of the features on the HCSXXX series to reduce the required component count.

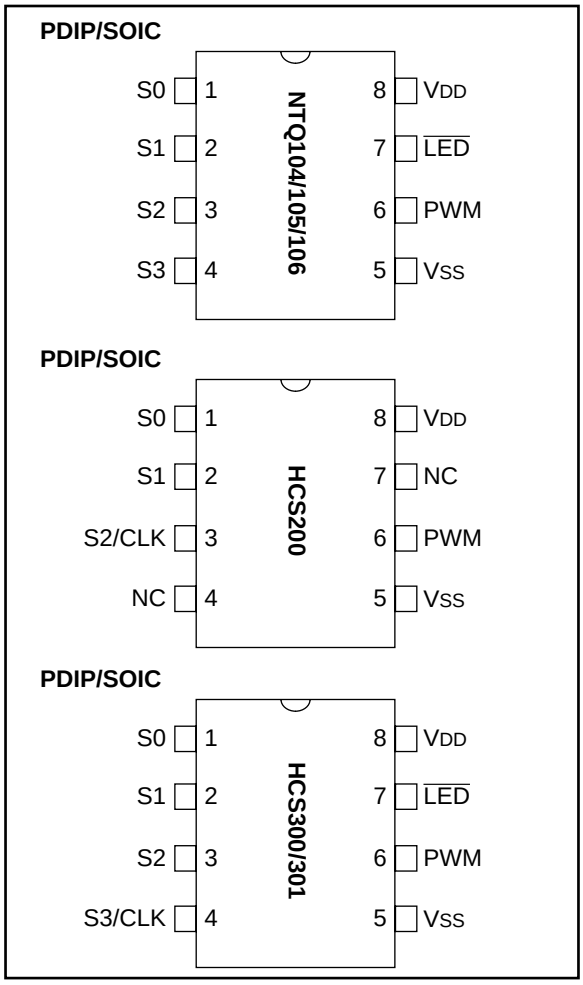


TABLE 1: SUMMARY OF FEATURES

Encoder	Function Codes	Operating Voltage	Programming Lines	Transmission Length
HCS300	15	2.0 to 6.3V	Clock + Data	66
HCS301	15	4.5 to 12.5V	Clock + Data	66

Note: The NTQ devices used a single bi-directional PWM line for programming, but required S3 to be pulled high to select programming mode. The NTQ and HCS devices, therefore, both require a 4-pin connection to program, but no external diodes are used.

TABLE 2: FUNCTIONS

Buttons Pressed S3 S2 S1 S0	NTQ104/106 Function Code	NTQ105 Function Code	HCS200 Function Code	HCS300/301 Function Code
0000	Reset	Reset	Reset	Reset
0001	X001	X001	X001	0001
0010	X010	X010	X010	0010
0011	X011	X011	X011	0011
0100	X100	Not supported	X100	0100
0101	X101	Not supported	X101	0101
0110	X110	Not supported	X110	0110
0111	X111	Not supported	X111 (Note)	0111
1000	Not supported	Not supported	Not supported	1000
1001	Not supported	Not supported	Not supported	1001
1010	Not supported	Not supported	Not supported	1010
1011	Not supported	Not supported	Not supported	1011
1100	Not supported	X100	Not supported	1100
1101	Not supported	X101	Not supported	1101
1110	Not supported	Not supported	Not supported	1110
1111	Not supported	Not supported	Not supported	1111 (Note)

Note: Seed transmission mode.

CONVERTING LOW VOLTAGE (3.0V TO 6.0V) DESIGNS

Low voltage designs do not require changes to the board layout since the NTQ and HCS devices are pin compatible. The HCS300 will support all the function codes available on the NTQ104/105/106.

The HCS200 can be used to replace the NTQ104/106, except where function X111 was used. Most designs, however, do not use function X111 and, therefore, can benefit from the extra functionality — in the HCS200, this button combination is used for the Secure Learning mode. The circuit diagram (Figure 1) shows the replacement of the NTQ devices with the HCS devices.

Figure 1 shows a NTQ transmitter design where two diodes were used to allow programming with a 3-pin probe. This is not an optimum implementation since the diodes are only used during programming. The HCS300 circuit shows how the design can be simplified. The HCS200 does not have an $\overline{\text{LED}}$ output but $\overline{\text{LED}}$ power indication can be implemented by connecting the $\overline{\text{LED}}$ in line with the RF power or in-line with the HCS200 power. The clock pin for the HCS200 is on pin three. Interchangeability between the HCS200 and HCS300 can be achieved by using pin three for the clock in the HCS300 circuit.

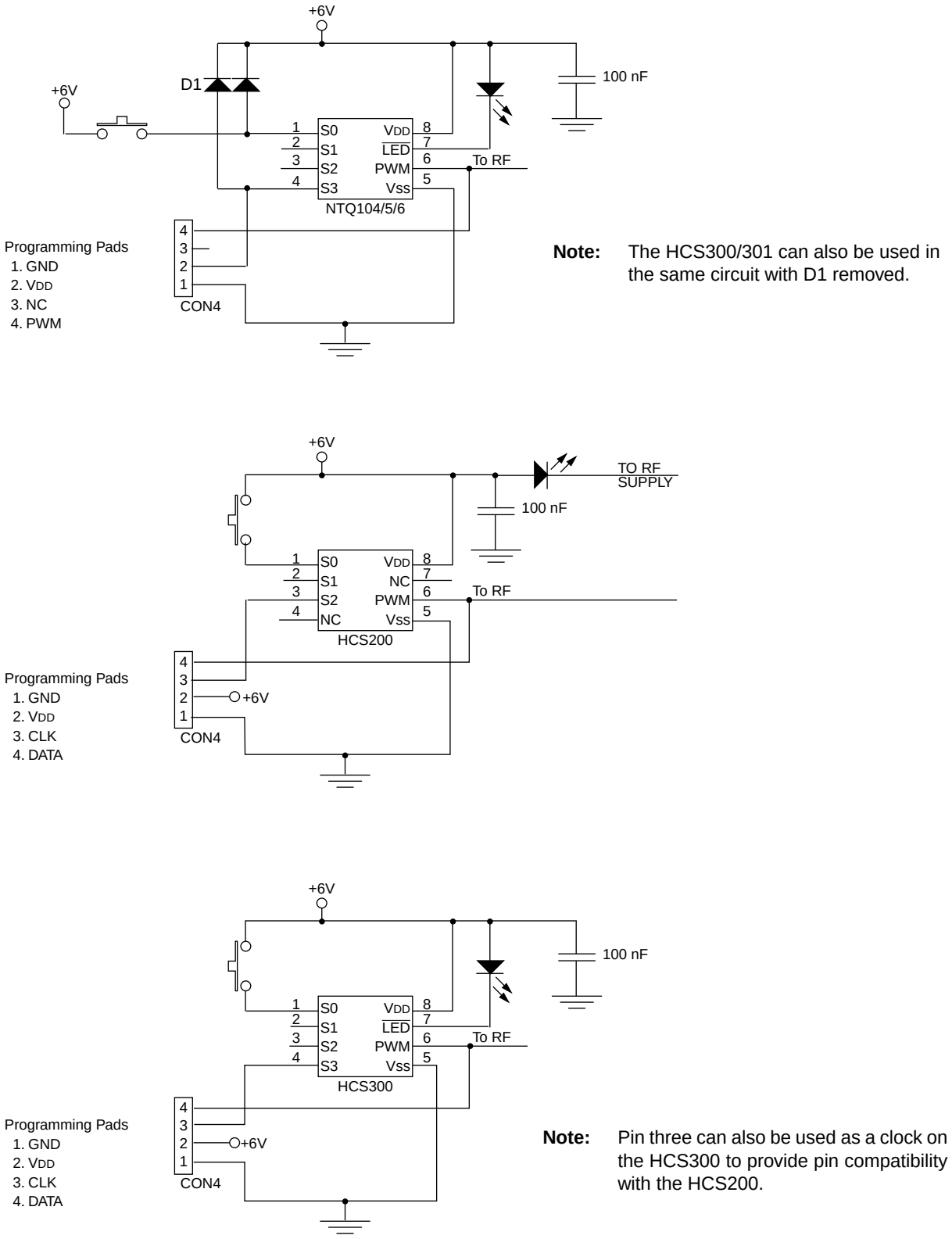
Figure 2 shows a typical multi-button transmitter design using the NTQ104/105/106. In this case no changes are required for the HCS300. The HCS200 will require the $\overline{\text{LED}}$ connected in-line of power indication and the clock line connected to pin three.

CONVERTING HIGH VOLTAGE (6.0V TO 12.0V) DESIGNS

The HCS301 has an on-board regulator that enables the device to operate with a 12V supply. This allows a significant reduction in external components. The steering diodes, protection resistors and zener diode are no longer required. Resistor R1 can be used to reduce the operating current. The PWM output voltage will swing between ground and V_{DD}. The circuit diagram (Figure 3) shows the simplified circuit.

The HCS300/301 can also be used in the same circuit without changes.

FIGURE 1: CONVERTING NTQ104/105/106 TO HCS200/300



Note: The HCS300/301 can also be used in the same circuit with D1 removed.

Note: Pin three can also be used as a clock on the HCS300 to provide pin compatibility with the HCS200.

FIGURE 2: CONVERTING NTQ104/105/106 TO HCS200/300

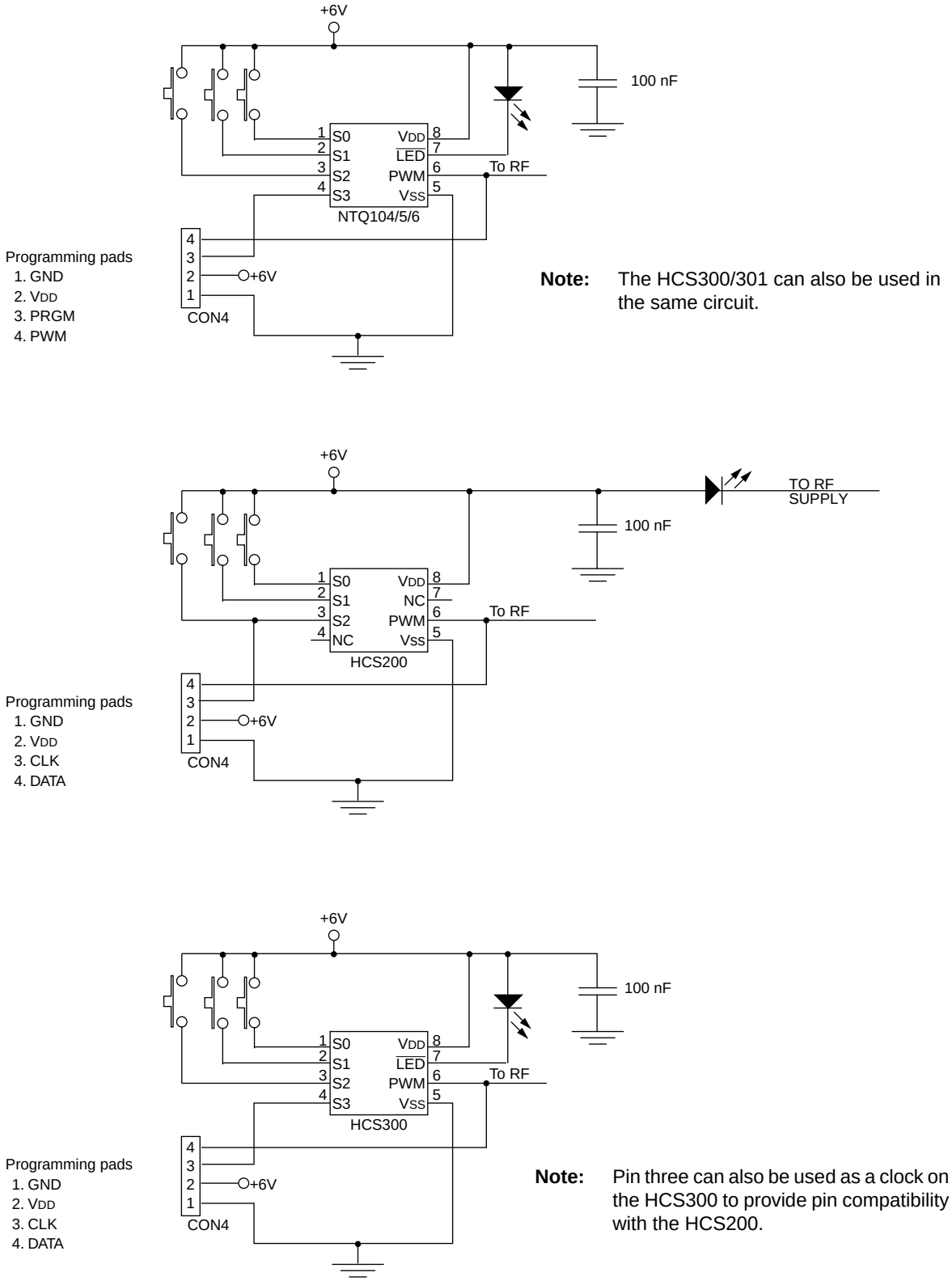
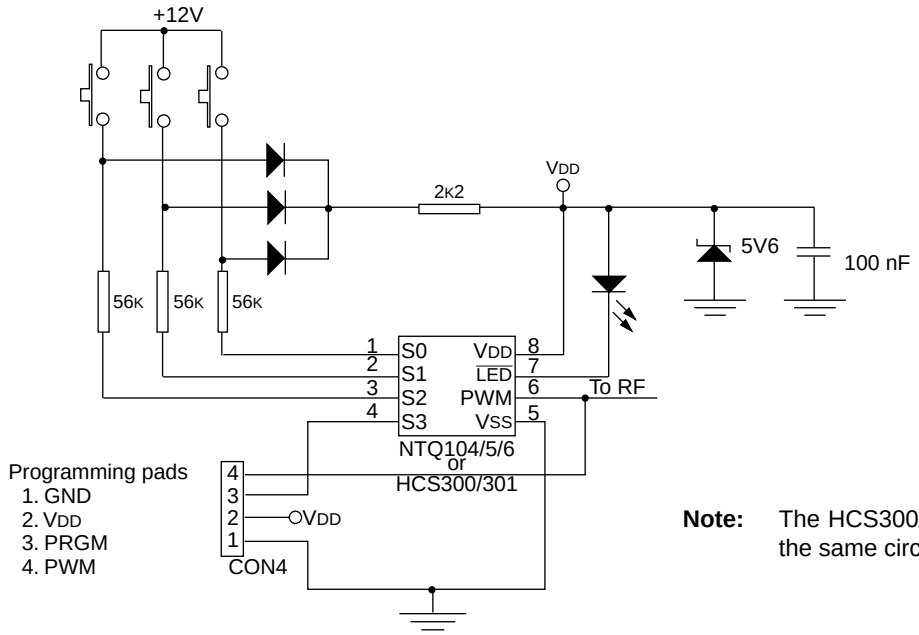
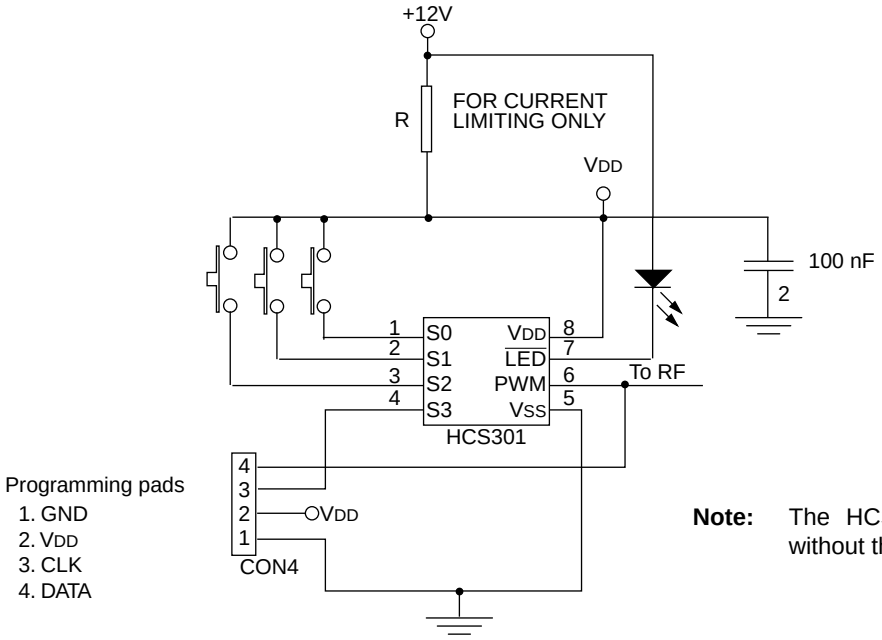


FIGURE 3: CONVERTING NTQ104/105/106 TO HCS301



Note: The HCS300/301 can also be used in the same circuit.



R = 1.5k for 12V battery.
R = 0R for 9V battery.

Note: The HCS301 must be programmed without the battery connected.

PROGRAMMING

It is suggested that programming be done without the battery connected. The programming probe supplies 5V during programming and damage to the probe may occur if for instance the transmitter is powered with a 12V battery.

COMPATIBILITY WITH DECODERS

NTQ109/NTQ110 Decoders

These decoders only receive 56-bit codes. Transmissions from HCS200/300 transmitters are, therefore, truncated to 56 bits. With the NTQ109/110 option selected in the programming software supplied with the PG306001 programmer, HCS200/300 transmitters will be programmed with a 24-bit serial number meaning the higher than 24 bits will all be zero. The 24-bit serial number will be used for key generation. An HCS200/300 transmitter is fully compatible with NTQ109/110 decoders if programmed correctly.

PIC16C56 and EEPROM Based Decoders, and HCS509 Decoder

PIC16C56 based HCS509 decoders automatically distinguish between NTQ104/105/106 56-bit transmissions and HCS200/300 66-bit transmissions. The decoder will generate the key from the longer 28-bit serial number if a 66-bit transmission is detected.

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