HY11P52
Low Voltage Programming/
Lookup Table/PFM
Instruction Manual

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Low Voltage Programming/
Lookup Table/PFM

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1. Overview

HY11P52 is a new model added to the HY11P series and can also be positioned as an upgraded product of HY11P32, product advantages are as follows:

◆ **B**uilt-**I**n **E**PROM(**BIE**) 3.05V programming technology, no need to connect additional power when producing calibration and programming EPROM.

◆ The ADC output rate can be increased from the original 1Ksps to 2Ksps, suitable for other applications that require slightly faster ADC speed and 12-bit ENOB resolution.

◆ Enhanced VDDA fast startup function, only need VDDA power supply to be stable within 1m sec.

◆ The current consumption of the LCD driver function module is reduced to 10uA.

◆ The average power consumption of automatic weighing application can be saved by half (when ADC output rate = 2ksps).

◆ Through BIE 16bits instruction reading mode, it can read back the table data in the program memory (OTP ROM CODE), which can save the program space when the program needs to use the table lookup function in large quantities.

◆ Built-in LED backlight constant current control circuit, adopting automatic feedback design, can provide a maximum of 15mA current to drive white or blue light LED (power is provided by I / O, which can provide 10mA current; power is provided by VDD, which can provide 15mA current).

◆ Without using the new functions of HY11P52, the original code and PCB layout developed by HY11P32 can be used by translating the original code in HY11P52. The original hardware circuit and PCB can be used without any engineering changes.

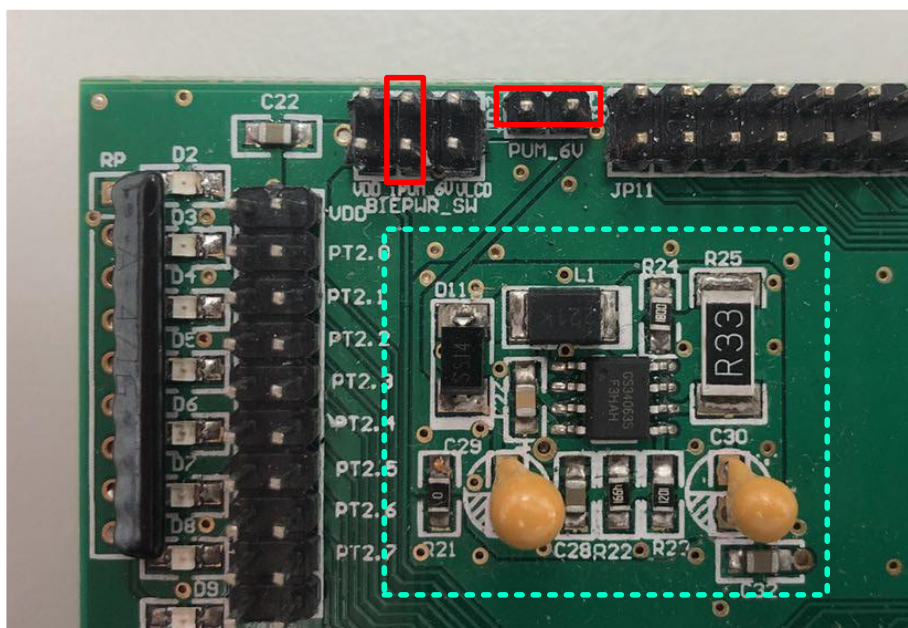## 2. BIE Low Voltage Programming Function

2.1. Description

Low-voltage programming control technology allows users to perform BIE block data programming without external programming voltage source. The BIE architecture is still the same as the existing architecture. For details, please refer to the chapter 22 of UG-HY11S14_EN.

(https://www.hycontek.com/wp-content/uploads/UG-HY11S14_EN.pdf)

2.2. ICE emulation description

Although the existing HY11S14-DK03 development tool (emulator) can support BIE low-voltage programming control technology, the VBIE power supply 6V required for low-voltage programming still needs to be externally input into the emulator's chip to perform the BIE programming operation smoothly. A booster circuit has been added to the PCBA of the emulator, after the short circuit of a specific pin is properly performed, the execution action is also programmed by calling the writing subroutine (**WR1WORDBIEDATA**).

The way of using the booster circuit on the PCBA of the emulator is to short-circuit two places in the red box below to output a 6V voltage to the 97 pin (BIEPWR) on the chip of emulator, the blue box is the corresponding boost circuit. If the emulator PCBA on your hand does not have the relevant booster circuit, please confirm the version of the tool you have and the serial number on the emulator PCB board, and then contact your agent or HYCON FAE.
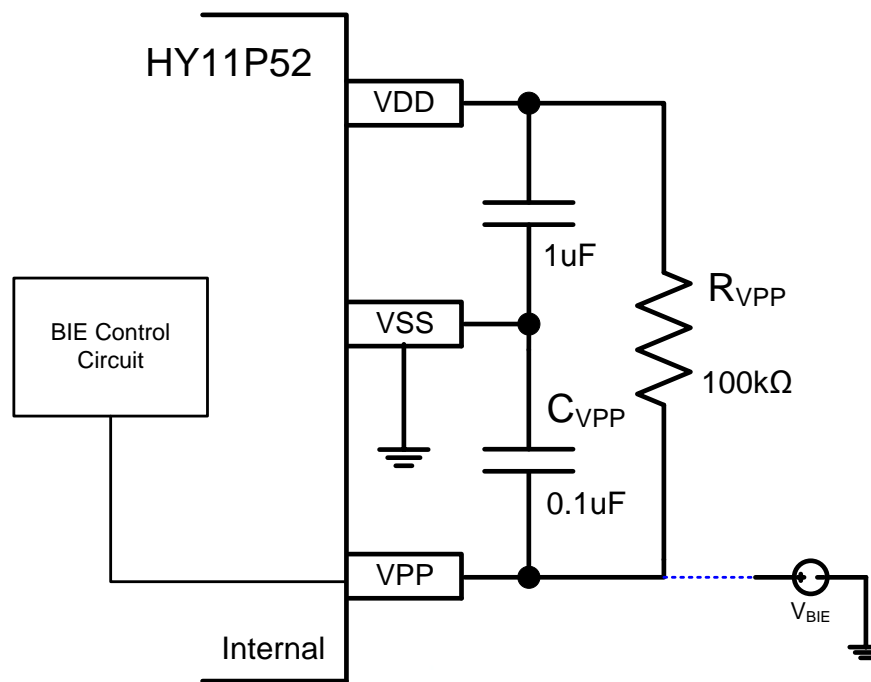
2.3. BIE Application Circuit

When using the BIE function, external parts of R_{VPP} and C_{VPP} must be connected, the recommended C_{VPP} capacitor value is 0.1uF, and the R_{VPP} resistance value is 100kΩ.

HY11P52

BIE Control Circuit

VDD

1uF

VSS

R_{VPP}

100kΩ

C_{VPP}

0.1uF

VPP

V_{BIE}

Internal

BIE Typical Application Circuit

2.4. BIE programming operation instructions

◆ BIE programming mode selection

When using an external V_{BIE} power supply (6V) to program BIE blocks, you can use the command to program one byte of data at a time in the BIE block;
When the low-voltage programming control circuit is started, the BIE block can be programmed without an external V_{BIE} power supply, but the programming subroutine (**WR1WORDBIEDATA**) must be called to perform programming; each time the programming subroutine is called to perform the programming operation, only one byte of data can be burned. the time spent is about 500msec.

PS: The time spent is calculated by CPUCK = 2MHz, CPUCLK = 00b, users need to switch the frequency source to CPUCLK = 00b by themselves when calling the programming subroutine (**WR1WORDBIEDATA**), If this subroutine is called when CPUCLK = 01b = 2MHz is set, the programming time will take about 1000msec.

◆ BIE program config instructions (using external V_{BIE} power 6V)

Use an external V_{BIE} power supply (6V) to program the BIE block, please refer to Section 22.1 of UG-HY11S14_EN about BIE instruction manual, the Write EPROM and Read EPROM programs are listed below:

WRITE EPROM:

```
BCF ADCCN1, ENADC, 0           ; disable ADC function before writing to EPROM
VPPCHK:
BTSS BIECTRL, VPP_HIGH, 0      ; Check if VPP voltage exists, and then continue
                               ; programming

JMP VPPCHK
MVL 10000000B
MVF BIEPTRH, 1, 0              ; BIEPTRH [7] = 1b start BIE block programming
                               ; function

MVL 00000000B
MVF BIEPTRL, 1, 0             ; Define EPROM programming position as 00H
MVL 12H                       ; Define written data [BIEDH, BIEDL] = [12H, 34H]
MVF BIEDH, 1, 0
MVL 34H
MVF BIEDL, 1, 0
BSF BIECTRL, BIEWR, 0         ; if BIECTRL [VPP_HIGH] = 0 or

                              ; BIEPTRL  >  3FH,
                              ; This instruction is invalid (BIEPTRH = 0x80)

                              ; If BIECTRL [VPP_HIGH] = 1 and BIEPTRL ≦ 3FH,

                              ; Then this instruction is valid (BIEPTRH = 0x80)
                              ; After the EPROM is written, BIECTRL [BIEWR] is
                              ; automatically cleared to 0
                              ; BIEPTRL automatically increments by 1, up to 3FH
WAITWRBIE:
BTSZ BIECTRL, BIEWR, 0        ; wait for judging the completion of EPROM writing

                              ; BIECTRL [BIEWR] is automatically cleared to 0

JMP WAITWRBIE
; BSF ADCCN1, ENADC, 0        ; Enable ADC function according to user needs
```

Note:

Disable ADC function before writing EPROM (ADCCN1 [ENADC] = 0b), then the ADC's anti-interference ability can be enhanced. Wait for the EPROM to be written, and then turn on the ADC function for signal measurement.

READ EPROM:

BCF ADCCN1, ENADC, 0	; Disable ADC function before reading EPROM
MVL 10000000B	
MVF BIEPTRH, 1, 0	; BIEPTRH [7] = 1b start BIE block programming
	; function
MVL 00000000B	
MVF BIEPTRL, 1, 0	; Define EPROM read position as 00H
BSF BIECTRL, BIERD, 0	; Read EPROM and store the data in temporary
	; registers BIEDH, BIEDL
	; After reading the EPROM, BIECTRL [BIERD] is
	; automatically cleared to 0
	; BIEPTRL (BIE_ADDR) automatically increments by
	; 1, up to 3FH
WAITRDBIE:	
BTSZ BIECTRL, BIERD, 0	; After waiting for judging EPROM reading, BIECTRL
	; [BIERD] is automatically cleared to 0
JMP WAITRDBIE	
MVF BIEDL, 0, 0	
MVF BUF0, 1, 0	; move BIEDL data to BUF0
MVF BIEDH, 0, 0	
MVF BUF1, 1, 0	; Move BIEDH data to BUF1
; BSF ADCCN1, ENADC, 0	; Enable ADC function according to user needs

Note:

Disable ADC function before reading EPROM (ADCCN1 [ENADC] = 0b), then the ADC's anti-interference ability can be enhanced. Wait for the EPROM to be read, and then turn on the ADC function for signal measurement.

◆ BIE program config instructions (using low voltage programming control circuit)

When using the low-voltage programming control circuit to program the BIE block, the following actions must be performed:

WRITE EPROM:

BCF ADCCN1, ENADC, 0	; disable ADC function before writing to EPROM
MVL 10000000B	
MVF BIEPTRH, 1, 0	; BIEPTRH [7] = 1b start BIE block programming
	; function

Preliminary

```
MVL 00000000B
MVF BIEPTRL, 1, 0          ; Define EPROM programming position as 00H
MVL 12H                    ; Define written data [BIEDH, BIEDL] = [12H, 34H]
MVF BIEDH, 1, 0
MVL 34H
MVF BIEDL, 1, 0
MVF FSR0L, 0,0
MVF FSR_BUF, 1,0           ; protect FSR0 register value
                          ; If there is a need to protect the work register, please
                          ; protect the WREG register
BCF MCKCN2,1,0            ; Restore CPUCLK = 00b = 2Mhz
BCF MCKCN2,0,0
CALL WR1WORDBIEDATA        ; Enable LVD detection function,
                          ; The user must ensure that VDD ≥ 3.05V for
                          ; successful calibration
                          ; BIEPTRL > 3FH, this instruction is invalid
                          ; (BIEPTRH = 0x80)
                          ; BIEPTRL ≦ 3FH, this command is valid (BIEPTRH =
                          ; 0x80)
                          ; After EPROM writing is completed, BIEPTRL is
                          ; automatically incremented by 1, up to 3FH
                          ; Return WREG = 0, the byte data burning operation is
                          ; completed
                          ; Return WREG = 1; Insufficient VDD voltage or low
                          ; voltage control circuit failure
                          ; This subroutine is only for writing judgment, and does
                          ; not check the correctness of the programming value
MVF FSR_BUF, 0,0          ; restore FSR0 register value
MVF FSR0L, 1,0
                          ; BSF ADCCN1, ENADC, 0; Enable ADC function
                          ; according to user needs
BSF INTE1, GIE            ; the programming subroutine has turned off the
                          ; interrupt source GIE
                          ; After programming is complete, please open GIE
                          ; yourself
TFSZ WREG, 0              ; WREG judgment program, to judge whether the
                          ; programming is completed
JMP FAIL                  ; WREG = 0b, WRITE BIE FAIL
```

```
; ...; Other executive programs
FAIL:
IDLE
NOP
INCLUDE WR2.obj              ; WR2.obj file must be placed at the end of the
                            ; program

END
```

READ EPROM:

```
BCF ADCCN1, ENADC, 0        ; Disable ADC function before reading EPROM
MVL 10000000B
MVF BIEPTRH, 1, 0           ; BIEPTRH [7] = 1b enable BIE block read function
MVL 00000000B
MVF BIEPTRL, 1, 0           ; Define EPROM read position as 00H
BSF BIECTRL, BIERD, 0       ; issue the instruction to read EPROM and store the
                            ; data in the temporary register BIEDH / L
                            ; After reading the EPROM, BIECTRL [BIERD] is
                            ; automatically cleared to 0
                            ; BIEPTRL (BIE_ADDR) automatically increments by
                            ; 1, up to 3FH
WAITRDBIE:
BTSZ BIECTRL, BIERD, 0      ; wait to determine whether IECTRL [BIERD] is
                            ; automatically cleared to 0 after the EPROM read is
                            ; completed
JMP WAITRDBIE
MVF BIEDL, 0, 0
MVF BUF0, 1, 0              ; move BIEDL data to BUF0
MVF BIEDH, 0, 0
MVF BUF1, 1, 0              ; Move BIEDH data to BUF1
; BSF ADCCN1, ENADC, 0      ; Enable ADC function according to user needs
```

2.5. Programming Subroutine

◆ Affected Registers:
   Special Register: WREG, LVDCN, FSR0L, INDF0, INTE1[GIE].
   Data Register: 0F0h~0F4h.
◆ Keep Stack Layers:

Keep at least 2 stack layers to call this subroutine normally.

◆ Option Function:

The subroutine automatically starts the LVD low-voltage detection circuit inside the chip. After leaving the subroutine, the LVD function will be turned off.

PS: Users should note that when using this programming subroutine, make sure VDD $\geq$ 3.05V to ensure successful programming!

◆ Instruction Cycle:

249312

◆ Code Size:

61 instructions

◆ Function return value:

Return WREG = 1, which means that the VDD voltage is insufficient, or the low-voltage control circuit has failed.

Return WREG = 0, which means that the byte data is burned into the BIE block. However, only the programming is completed, and the correctness of the programming value is not checked. The user needs to check it by himself.

2.6. Precautions for use

The HY11P52 chip uses a low-voltage programming control circuit function, which is only suitable for the temperature range of 0℃ ～ 40℃, 3.05V $\leq$ VDD $\leq$ 3.4V. If the chip uses an external V$_{BIE}$ power supply (6V) to program the BIE block, the data can only be programmed through a single command (BSF BIECTRL, BIEWR, 0), and the programming subroutine (**WR1WORDBIEDATA**) cannot be used for programming in this mode, recording action to avoid errors during data burning.

◆ After starting the low-voltage programming control circuit, the voltage source must be set to 3.05V≤VDD≤3.4V for normal programming.
◆ When the low-voltage programming control circuit is started, the GIE interrupt control source is forcibly turned off.
◆ It is recommended to start all low-voltage programming control circuits for BIE block programming after the measurement is completed.
◆ The user should pay attention to the register which is affected after calling the subprogram.
◆ Development tools (emulators) currently cannot emulate low-voltage programming and 16bits table lookup functions;
◆ When the user uses the development tool (HY11S14-DK03) to emulate the HY11P52 low-voltage programming function, although it is not necessary to connect external VBIE power supply (6V) with external Power, it is still necessary to provide 6V power supply on PCBA, manually adjust Jumper to put the circuit to the specified position, so that the program can be executed normally. (If you do not use the low-voltage programming function on the emulator, you do not need to connect an external VBIE 6V power supply) .

3. 16BITs Lookup Table Control Descriptions

HY11P52 is H08B instruction set, and HY08B instruction does not support 16bits lookup table instruction. HY11P52 adds 16BITs lookup table instruction function based on HY08B.

ROM Code (program memory) lookup table function needs to set BIEPTRH [7] = 0b to achieve 16Bits lookup table function. Its BIEPTRH [2:0] / BIEPTRL [7:0] determines the 11-bit ROM Code read address, BIEPTRH [2: 0] is the address of Bit11 ~ Bit9, and BIEPTRL [7:0] is the address of Bit7 ~ Bit0, after checking the table, the data is placed in the BIEDH / BIEDL register.

3.1. ICE emulation descriptions

The existing ICE does not support the HY08B instruction 16bits lookup table instruction. When customers use ICE emulation, please follow the program config Instructions and verify it on the actual product.

3.2. 16bits Lookup table Control

◆ Program config Instructions is as follows:

```
MVL HIGH Table
MVF TBLPTRH, F, ACCE
BCF TBLPTRH, 7
MVL LOW Table
MVF TBLPTRL, F, ACCE
BSF TBLCTRL, TBLRD, 0
MVF TBLDL, 0, 0
MVF BUF0, 1, 0                ; move BIEDL data to BUF0
MVF TBLDH, 0, 0
MVF BUF1, 1, 0
```

Table:
```
DB 05AH, 0A5H
```

3.3. Precautions for use

When using ROM Code to look up the table, BIEPTRH [7] = 0b needs to be set to enable the function; BIEPTRH [6:3] needs to be set to 0000b forcibly.

To switch back to BIE programming and reading, you need to set BIEPTRH [7] = 1b to enable the function; BIEPTRH [6:0] needs to be forced to 0000000b, and BIEPTRL [7:6]

needs to be forced to 00b .

The ROM Code only allows the lookup table function to be accessed through instructions. Other write operations are considered invalid (BSF BIECTRL, BIEWR, 0). ROM Code lookup table and BIE programming and reading functions cannot be used simultaneously.

4. PFM Control Loop Circuit Descriptions

When driving high-voltage LED backlights, 3V battery power can easily cause drive failure after the battery voltage drops. HY11P52 uses a simple PFM control loop to increase the driving voltage to achieve the voltage to drive the LED backlight.

HY11P52 uses feedback input judgment to control the PFM output frequency, which has achieved the purpose of outputting stable voltage, the PFM module and the LVD module share the same circuit. Please switch between them for application development. Only a single module function can be used at the same time.

4.1. ICE emulation descriptions

The existing ICE does not yet support the PFM control loop circuit, when customers use ICE emulation, please follow the program config Instructions and verify it on actual products.
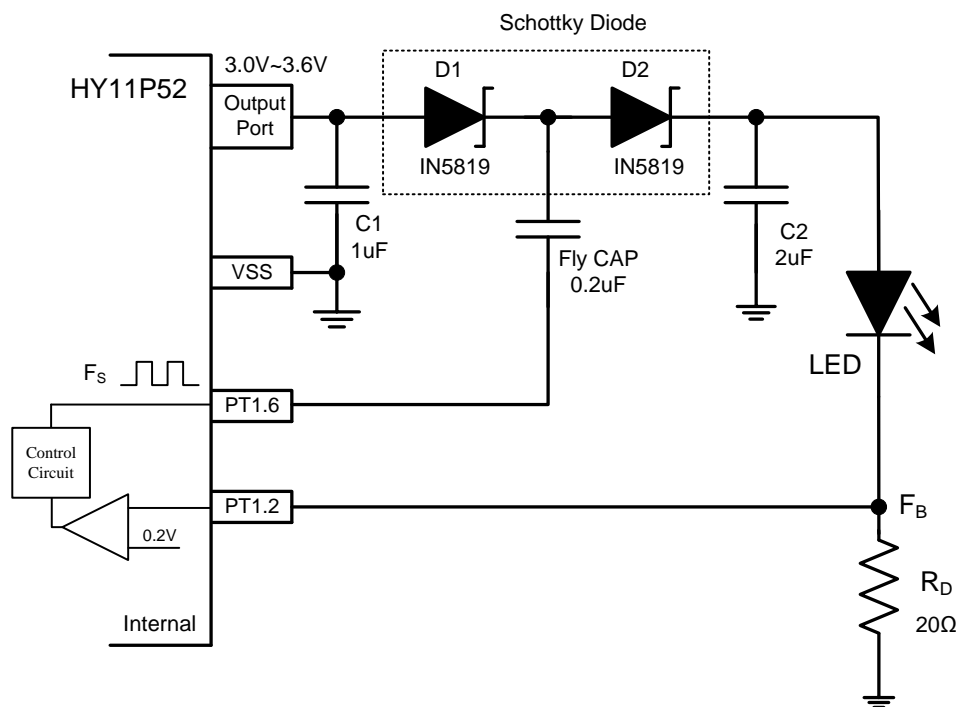
4.2. Hardware Circuit

Power supply voltage stabilizing capacitor C1, 1uF.

Schottky Diode IN5819, D1, D2.

Fly Cap, 0.2uF

Output capacitor C2, 2uF.

Detection Resistance, RD, 20Ω

PFM Typical Application for LED Applications

4.3. Program config instructions

PFM control loop start setting: PWMRCN [ENLEDP] = 1.

Using this control loop, PT1.2 needs to be set as an input pin, and PT1.6 needs to be set as an output pin.

4.4. Program Example

```
CLRF PT1PU, A
MVL 01000000b                    ; PT1.2 needs to be set as an input pin, PT1.6 needs to
                                 ; be set as an output pin

MVF TRISC1,1,0
BSF PWMRCN, ENLEDP, 0            ; start PFM control loop
```
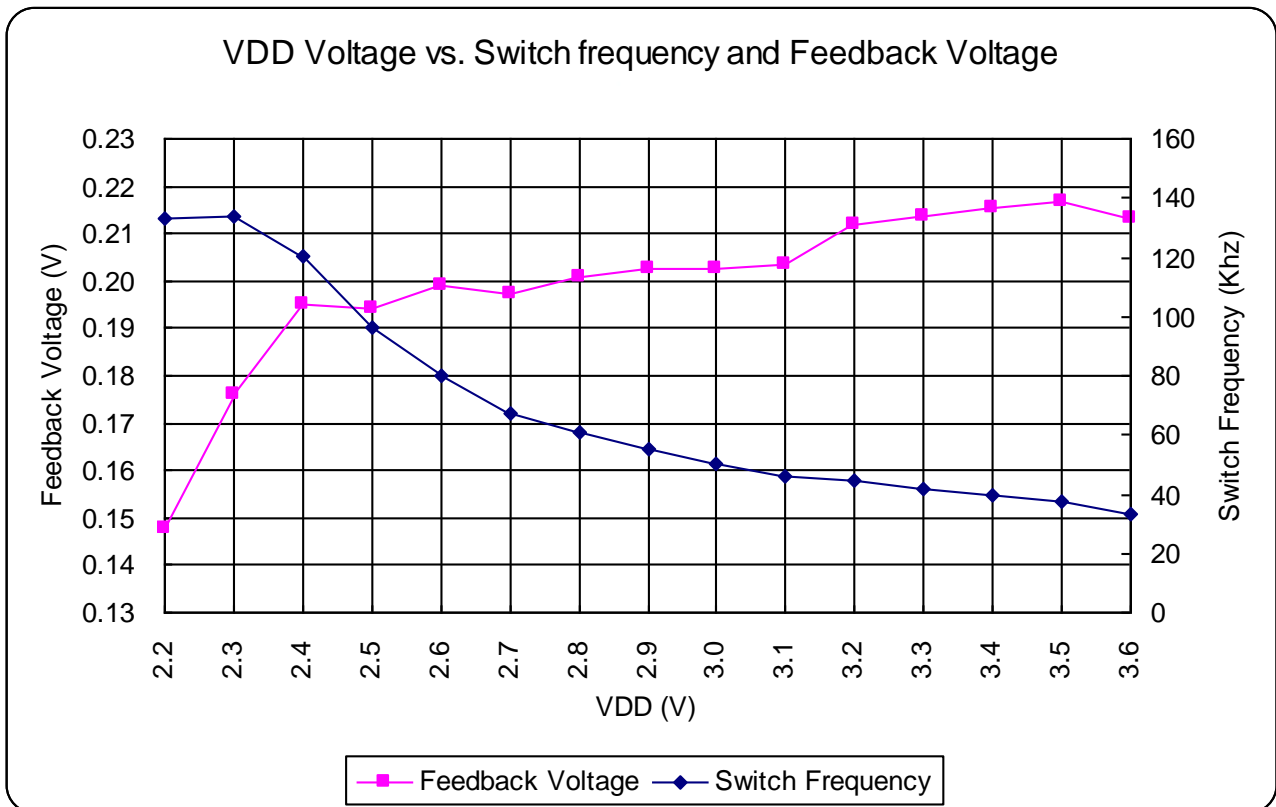
4.5. Electrical Specifications

The following lists the typical relationships between VDD and Switch frequency (FS) and Feedback Voltage (FB).

VDD Voltage vs. Switch frequency and Feedback Voltage Chart

5. ΣΔADC Faster Output Setting

HY11P52 ΣΔ ADC provides a faster output function, you can set OSR = 128 by setting OSR [3:0] = 1010b, which is a fast output setting with an equivalent ADC output rate of about 2Ksps.

Program config Instructions is as follows:

```
MVL 01000010B
MVF ADCCN3,1,0                    ; set HY11P52 ΣΔ ADC output frequency to 2Ksps
```

6. Attachment Program

WR2.obj

WR2.OBJ:

7. Revisions

The following describes the major changes made to the document, excluding the punctuation and font changes.

Version	Page	Date	Revision Summary
V03	All	2020/02/21	First edition