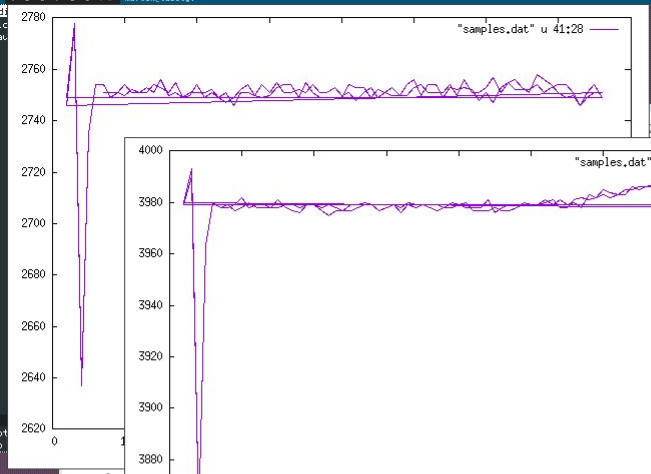
Stm32 DAC-ADC loopback

2020-07-30 martin kielhorn

Nucleo 476RG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2740
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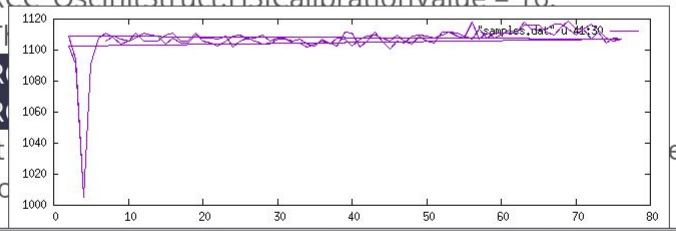
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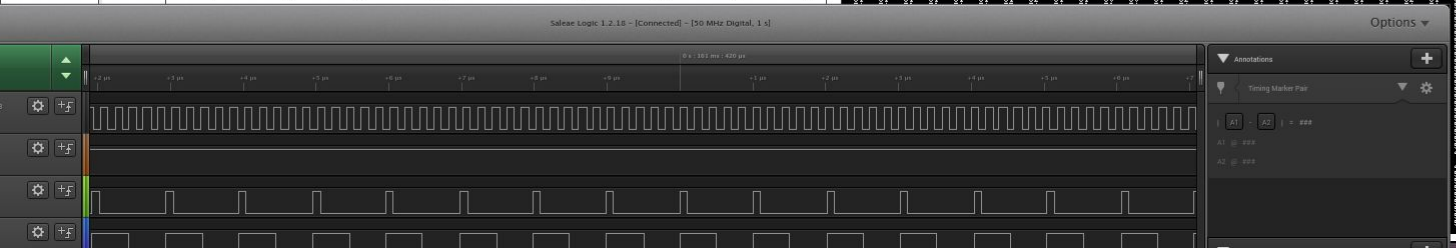
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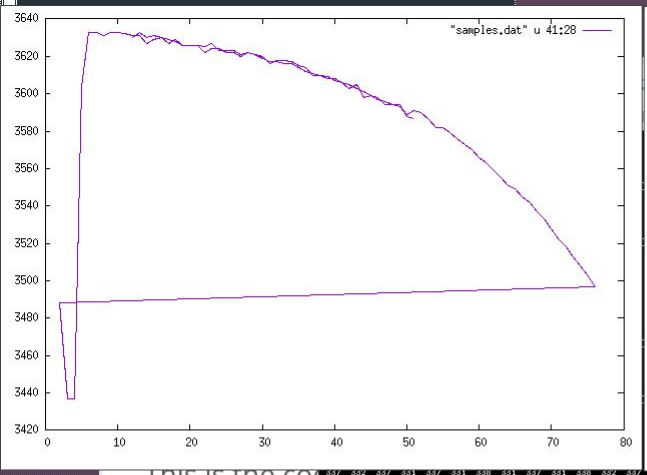
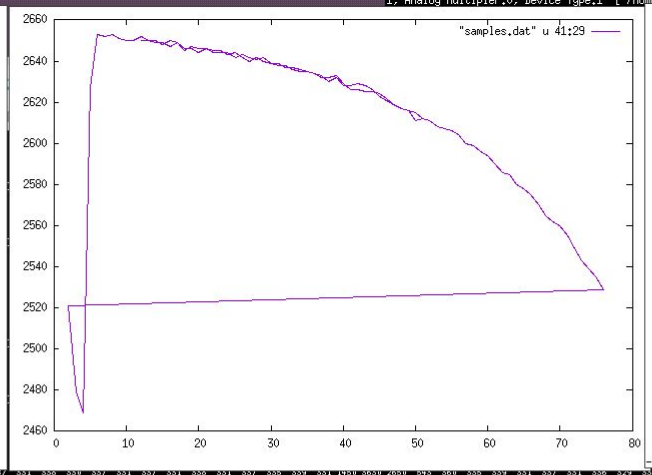
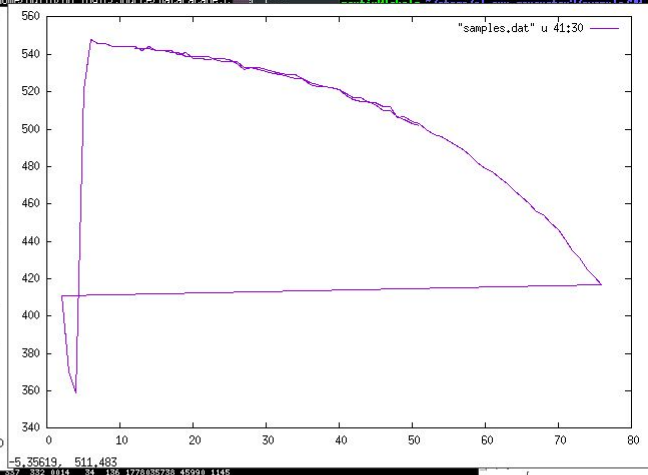
Options
Annotations
Timing Marker Pair







-5.35619, 511.483

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RCC_OscInitS
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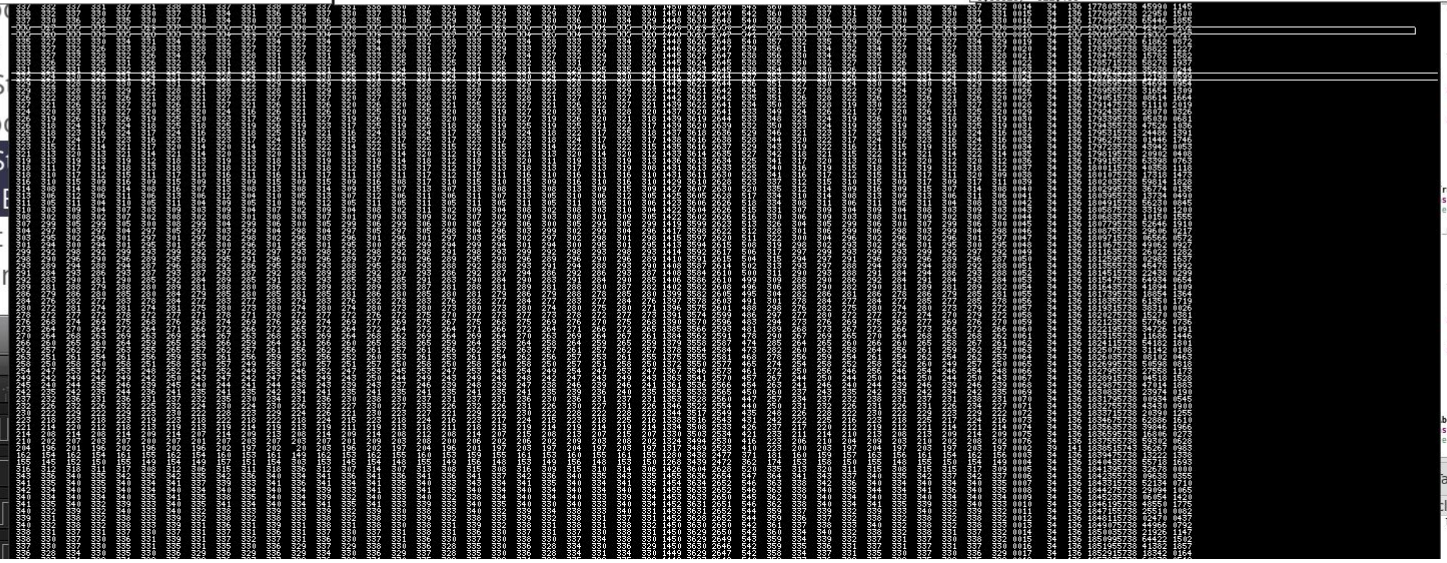
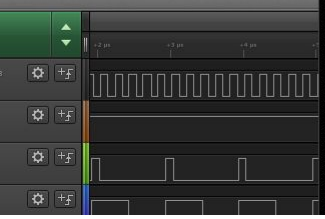
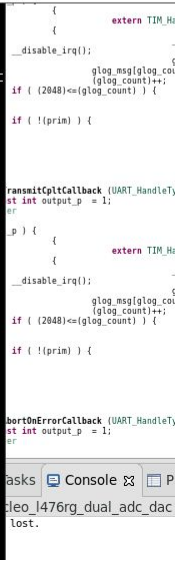
for the two ar







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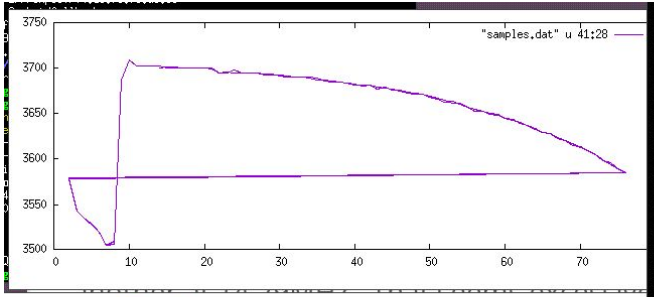
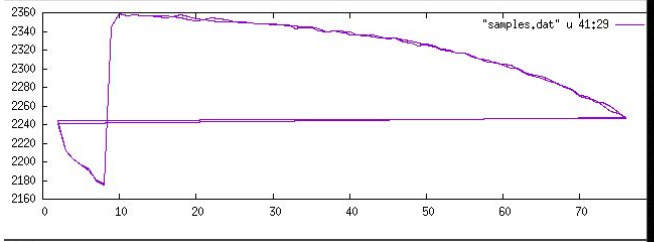
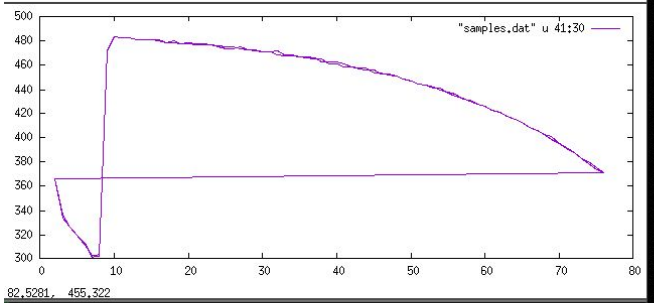






82,5281, 455,322

List of electronics for playing

Mouser p/n	Desc	price/EUR	
511-EV-VN7040AS	Stmicro power managment IC	4 (kit) 1.5 (IC)	https://nl.mouser.com/datasheet/2/389/ev-vn7040as-1848228.pdf https://www.st.com/resource/en/datasheet/vn7040as.pdf
512-FNB51060T1	3 phase IGBT insulated-gate bipolar transistor	10	https://nl.mouser.com/datasheet/2/308/FNB51060T1-D-1809484.pdf
771-BT151X-650R127	Planar passivated Silicon Controlled Rectifier	0.64	https://nl.mouser.com/datasheet/2/848/bt151x-650r-1520050.pdf
771-BYC10-600P	Hyperfast power diode		https://nl.mouser.com/datasheet/2/848/BYC10-600P-1383811.pdf
627-US30KB80R-7000	Bridge Rectifier 30A 800V	9	https://nl.mouser.com/ProductDetail/Shindengen/US30KB80R-7000?qs=cc8XvXgcw4OiEAk0iPumQw%3D%3D
BMX055	Gyro, accel, magnetic, 20pin lga	6	https://nl.mouser.com/datasheet/2/783/BST-BMX055-DS000-1509552.pdf

VN7040AS

High-side driver with MultiSense analog feedback for automotive applications

Max transient supply voltage	V_{CC}	40 V
Operating voltage range	V_{CC}	4 to 28 V
Typ. on-state resistance (per Ch)	R_{ON}	40 mΩ
Current limitation (typ)	I_{LIMH}	34 A
Standby current (max)	I_{STBY}	0.5 µA

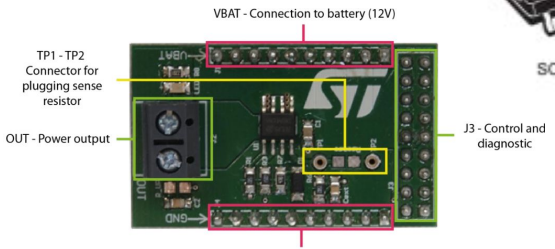
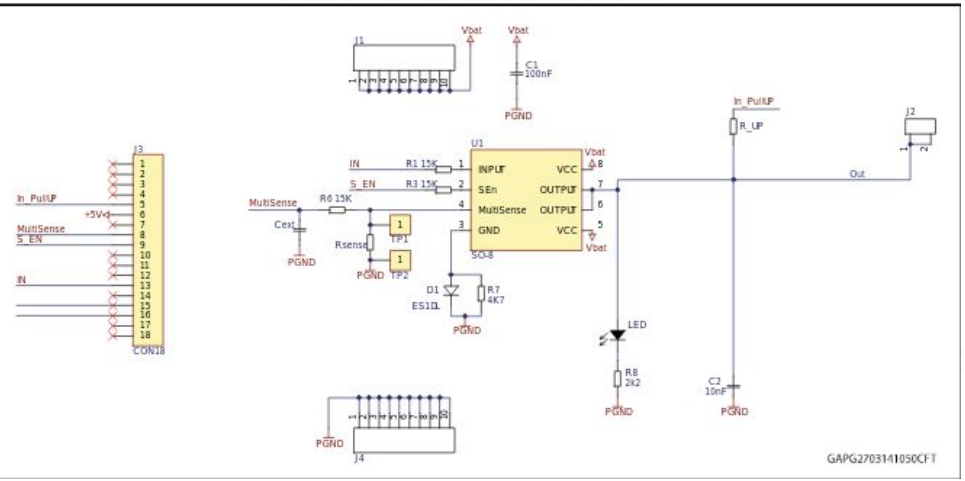
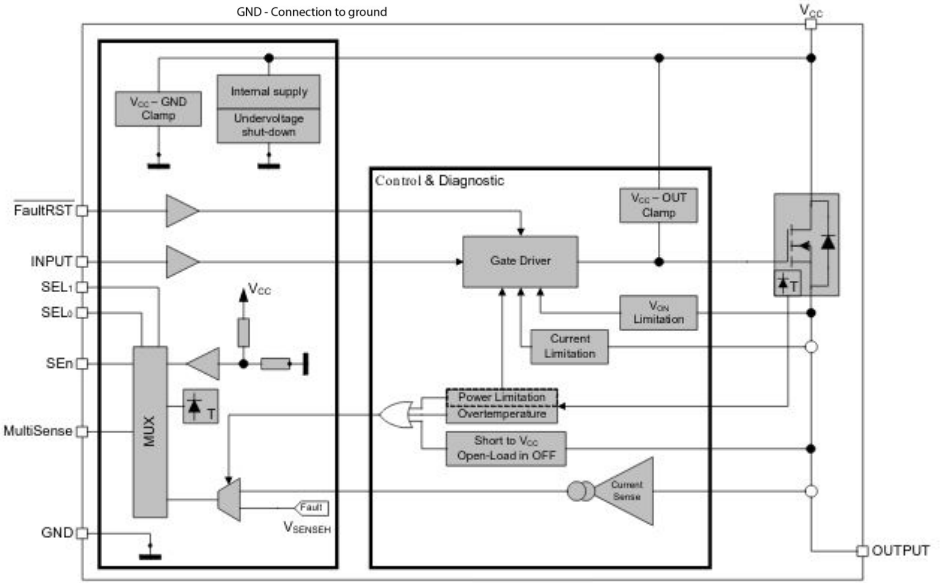


Figure 1: Evaluation board schematic





https://electronics.stackexchange.com/questions/188745/high-side-driver-and-low-side-driver

FNB51060T1

Motion SPM® 55 Series

Features

- UL Certified No. E209204 (UL1557)
- 600 V - 10 A 3-Phase IGBT Inverter Including Control IC for Gate Drive and Protections
- Low-Loss, Short-Circuit Rated IGBTs
- Separate Open-Emitter Pins from Low-Side IGBTs for Three-Phase Current Sensing
- Active-HIGH interface, works with 3.3 / 5 V Logic, Schmitt-trigger Input
- HVIC for Gate Driving, Under-Voltage and Short-Circuit Current Protection
- Fault Output for Under-Voltage and Short-Circuit Current Protection
- Inter-Lock Function to Prevent Short-Circuit
- Shut-Down Input
- HVIC Temperature-Sensing Built-In for Temperature Monitoring
- Optimized for 15 kHz Switching Frequency
- Isolation Rating: 1500 V_{rms} / min.

Applications

- Motion Control - Home Appliance / Industrial Motor

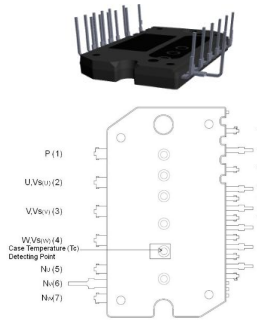
Absolute Maximum Ratings (T_J = 25°C, unless otherwise specified.)

Inverter Part

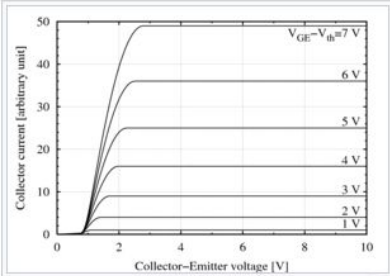
Symbol	Parameter	Conditions	Rating	Unit
V_{PN}	Supply Voltage	Applied between P - N_U, N_V, N_W	450	V
$V_{PN(Surge)}$	Supply Voltage (Surge)	Applied between P - N_U, N_V, N_W	500	V
V_{CES}	Collector - Emitter Voltage		600	V
± I_C	Each IGBT Collector Current	T_C = 25°C, T_J < 150°C	10	A
± I_{CP}	Each IGBT Collector Current (Peak)	T_C = 25°C, T_J < 150°C, Under 1 ms Pulse Width	20	A
P_C	Collector Dissipation	T_C = 25°C per Chip	21	W
T_J	Operating Junction Temperature	(Note 5)	-40 ~ 150	°C

Note:

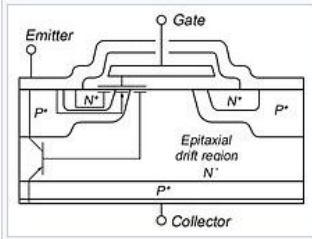
5. The maximum junction temperature rating of the power chips integrated within the Motion SPM® 55 product is 150°C.



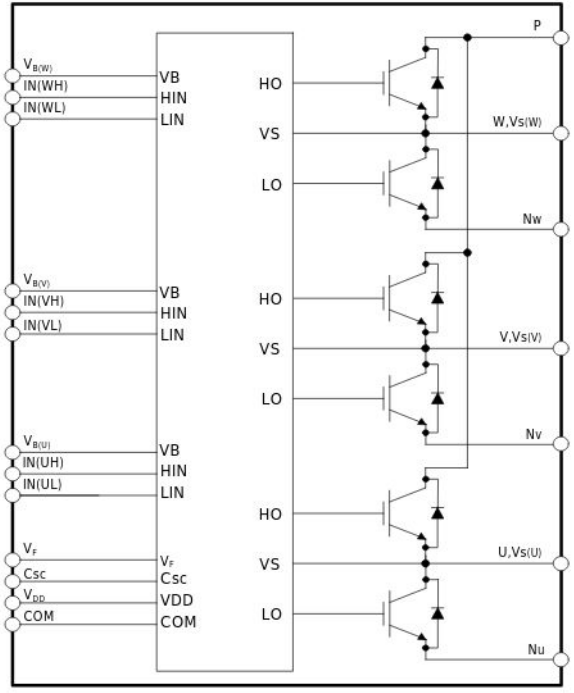
An insulated-gate bipolar transistor (IGBT) is a three-terminal power semiconductor device primarily used as an electronic switch which, as it was developed, came to combine high efficiency and fast switching. It consists of four alternating layers (P-N-P-N) that are controlled by a metal–oxide–semiconductor (MOS) gate structure without regenerative action. Although the structure of the IGBT is topologically the same as a thyristor with a 'MOS' gate (MOS gate thyristor), the thyristor action is completely suppressed and only the transistor action is permitted in the entire device operation range. It is used in switching power supplies in high-power applications:
variable-frequency drives (VFDs), electric cars, trains, variable speed refrigerators, lamp ballasts, arc-welding machines, and air conditioners.



Static characteristic of an IGBT



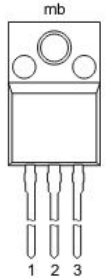
Cross-section of a typical IGBT showing internal connection of MOSFET and bipolar device



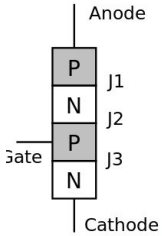
771-BT151X-650R127
Planar passivated Silicon Controlled Rectifier

An SCR can be brought from blocking mode to conduction mode in two ways:
Either by increasing the voltage between anode and cathode beyond the breakover voltage, or by applying a positive pulse at the gate. Once the SCR starts conducting, no more gate voltage is required to maintain it in the ON state.

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	K	cathode		
2	A	anode		
3	G	gate		
mb	n.c.	mounting base; isolated		

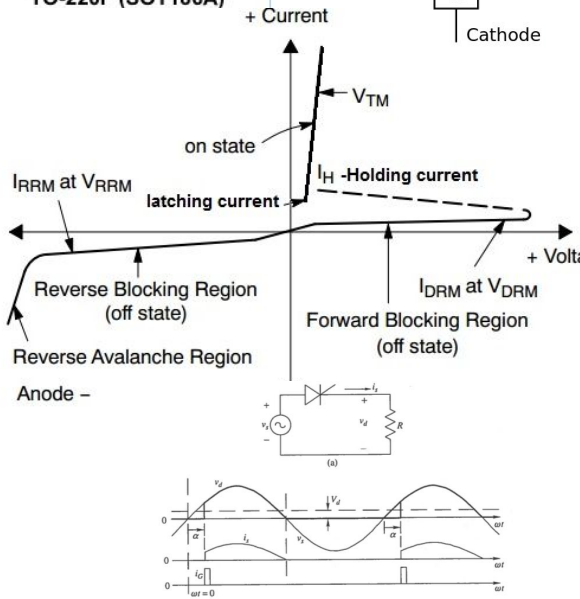


TO-220F (SOT186A)



Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{RRM}	repetitive peak reverse voltage			-	-	650	V
$I_{T(AV)}$	average on-state current	half sine wave; $T_h \leq 69$ °C		-	-	7.5	A
$I_{T(RMS)}$	RMS on-state current	half sine wave; $T_h \leq 69$ °C; Fig. 1; Fig. 2; Fig. 3		-	-	12	A
I_{TSM}	non-repetitive peak on-state current	half sine wave; $T_{j(init)} = 25$ °C; $t_p = 10$ ms; Fig. 4; Fig. 5		-	-	120	A
		half sine wave; $T_{j(init)} = 25$ °C; $t_p = 8.3$ ms		-	-	132	A
T_j	junction temperature			-	-	125	°C
Static characteristics							
I_{GT}	gate trigger current	$V_D = 12$ V; $I_T = 0.1$ A; $T_j = 25$ °C; Fig. 7		-	2	15	mA

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
dV_D/dt	rate of rise of off-state voltage	$V_{DM} = 436$ V; $T_j = 125$ °C; $R_{GK} = 100\ \Omega$; ($V_{DM} = 67\%$ of V_{DRM}); exponential waveform; Fig. 12		200	1000	-	V/µs
		$V_{DM} = 436$ V; $T_j = 125$ °C; ($V_{DM} = 67\%$ of V_{DRM}); exponential waveform; gate open circuit; Fig. 12		50	130	-	V/µs



SCRs are mainly used in devices where the control of high power, possibly coupled with high voltage, is demanded. Their operation makes them suitable for use in medium- to high-voltage AC power control applications, such as lamp dimming, power regulators and motor control.
SCRs and similar devices are used for rectification of high-power AC in high-voltage dc power transmission. They are also used in the control of welding machines, mainly GTAW (gas tungsten arc welding) processes similar. It is used as switch in various devices. Unlike an SCR, a TRIAC can pass current in either direction.

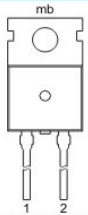
Hyperfast power diode in a SOD59 (2-lead TO-220AC) plastic package.

2. Features and benefits

- Fast switching
- Low reverse recovery current
- Low leakage current
- Low thermal resistance
- Reduces switching losses in associated MOSFET or IGBT

Symbol	Parameter	Conditions	Values	Unit
Absolute maximum rating				
V_{RRM}	repetitive peak reverse voltage		600	V
$I_{F(AV)}$	average forward current	$\delta = 0.5$; $T_{mb} \leq 127$ °C; square-wave pulse; Fig. 1; Fig. 2; Fig. 3	10	A
I_{FRM}	repetitive peak forward current	$\delta = 0.5$; $t_p = 25$ µs; $T_{mb} \leq 127$ °C; square-wave pulse	20	A
I_{FSM}	non-repetitive peak forward current	$t_p = 10$ ms; $T_{j(init)} = 25$ °C; sine-wave pulse; Fig. 4	150	A
		$t_p = 8.3$ ms; $T_{j(init)} = 25$ °C; sine-wave pulse	165	A

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
V_F	forward voltage	$I_F = 10$ A; $T_j = 150$ °C; Fig. 6	-	1.3	2	V
Dynamic characteristics						
t_{rr}	reverse recovery time	$I_F = 1$ A; $V_R = 30$ V; $dI_F/dt = 200$ A/µs; $T_j = 25$ °C; Fig. 7	-	12	18	ns

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	K	cathode	 TO-220AC (SOD59)	 001aaa020
2	A	anode		
mb	mb	mounting base; connected to cathode		

BMX055

Key features

• 3 sensors in one device	an advanced triaxial 16bit gyroscope, a versatile, leading edge triaxial 12bit accelerometer and a full performance geomagnetic sensor
• Small package	LGA package 20 pins footprint 3.0 x 4.5 mm², height 0.95mm
• Common voltage supplies	V_{DD} voltage range: 2.4V to 3.6V
• Digital interface	SPI (4-wire, 3-wire), I²C, 4 interrupt pins V_{DDIO} voltage range: 1.2V to 3.6V
• Smart operation and integration	All sensors can be operated individually 9-axis FusionLib software compatible

Accelerometer features

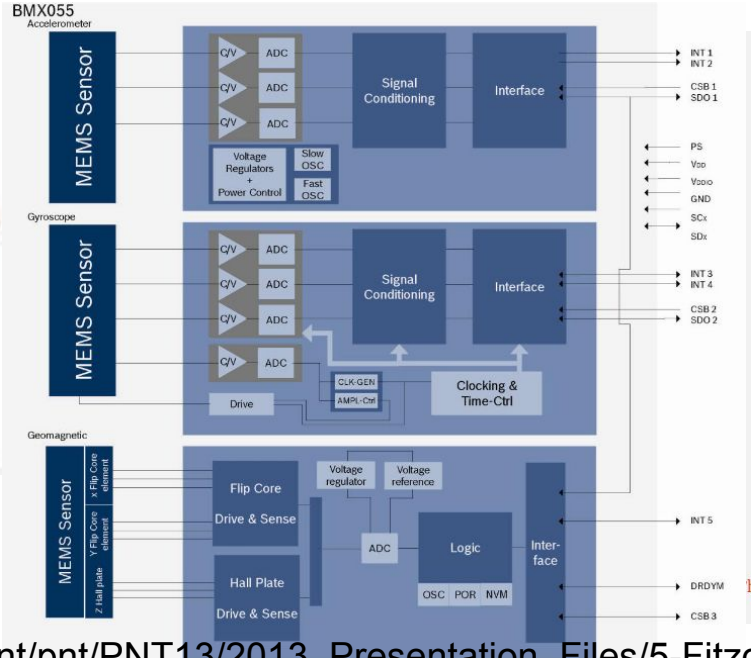
• Programmable functionality	Acceleration ranges ±2g/±4g/±8g/±16g Low-pass filter bandwidths 1kHz - <8Hz Integrated FIFO with a depth of 32 frames Motion-triggered interrupt-signal generation for - new data - any-motion (slope) detection - tap sensing (single tap / double tap) - orientation- & motion inactivity recognition - flat/low-g/high-g detection
• On-chip FIFO	
• On-chip interrupt controller	
• On-chip temperature sensor	factory trimmed, 8-bit, typical slope 0.5K/LSB.
• Ultra-low power IC	130µA current consumption, 1.3ms wake-up time, advanced features for system power management

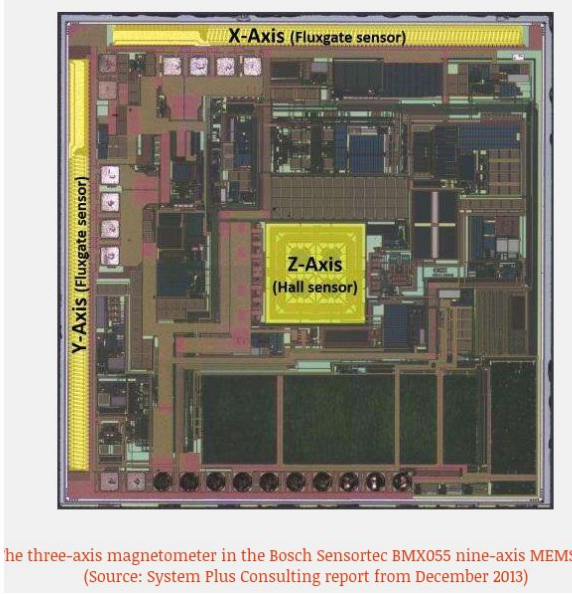
rroscope features

• Programmable functionality	Ranges switchable from ±125°/s to ±2000°/s Low-pass filter bandwidths 230Hz - 12Hz Fast and slow offset controller (FOC and SOC)
• On-chip FIFO	Integrated FIFO with a depth of 100 frames
• On-chip interrupt controller	Motion-triggered interrupt-signal generation for - new data - any-motion (slope) detection - high rate
• Low power IC	< 5mA current consumption, 30ms start-up time wake-up time in fast power-up mode only 10ms

Magnetometer features

• Flexible functionality	Magnetic field range typical 1300µT (x-, y-axis); ±2500µT (z-axis) Magnetic field resolution of ~0.3µT
• On-chip interrupt controller	Interrupt-signal generation for - new data - magnetic low-/high-threshold detection
• Ultra-low power	Low current consumption (170µA @ 10Hz in low power preset), short wake-up time, advanced features for system power management





he three-axis magnetometer in the Bosch Sensortec BMX055 nine-axis MEMS
(Source: System Plus Consulting report from December 2013)

https://web.stanford.edu/group/scpnt/pnt/PNT13/2013_Presentation_Files/5-Fitzgerald-PNT13.pdf

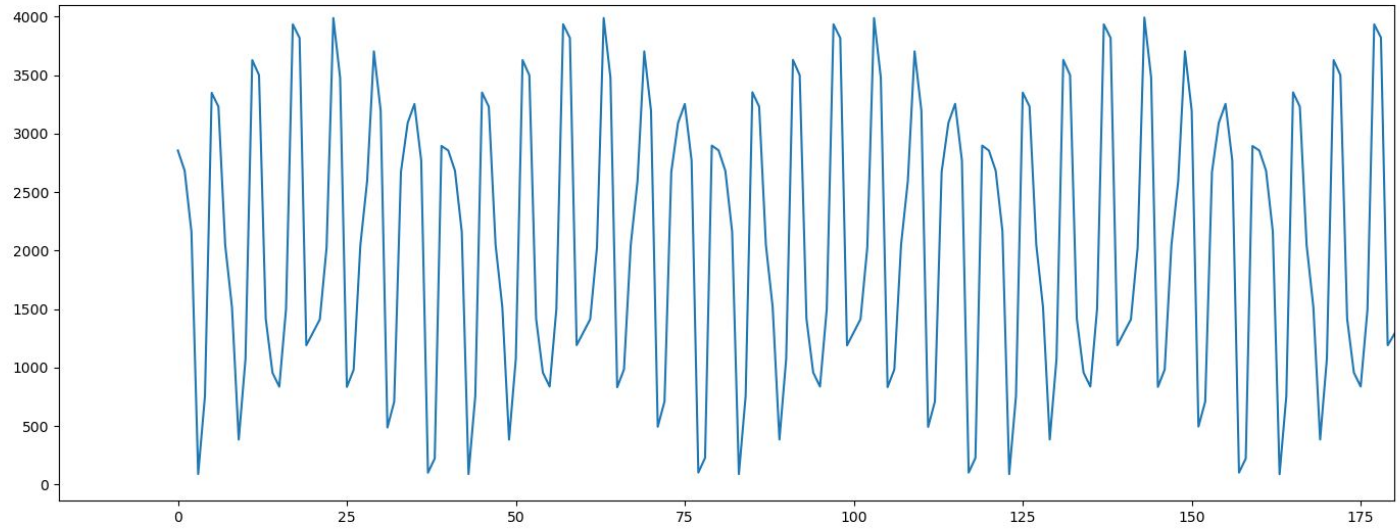
https://www.youtube.com/watch?v=xWB9dP1AtDU

Get image from optical mouse

https://en.wikipedia.org/wiki/MIDI

https://github.com/linthesia/linthesia/

https://github.com/ripxorip/stm32_usb_midi

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                                ;docopt
                                ;pathlib
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                                serial
                                ;(pd pandas)
                                ;(xr xarray)
                                ;(xrp xarray.plot)
                                ;skimage.restoration
                                ;(u astropy.units)
                                ;scipy.ndimage
                                ;scipy.optimize

                                ))
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                   :baudrate 115200 :timeout 1000000
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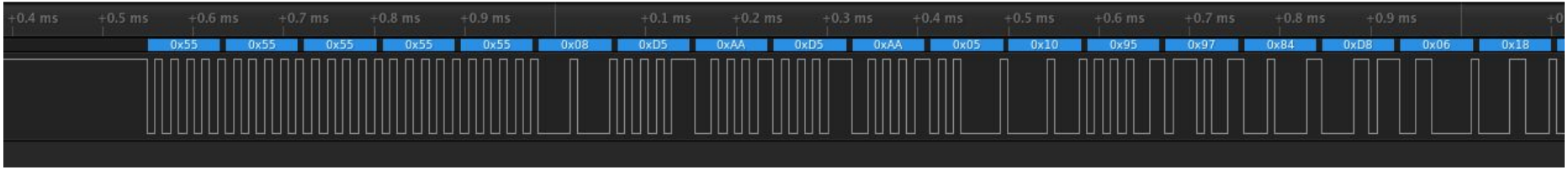
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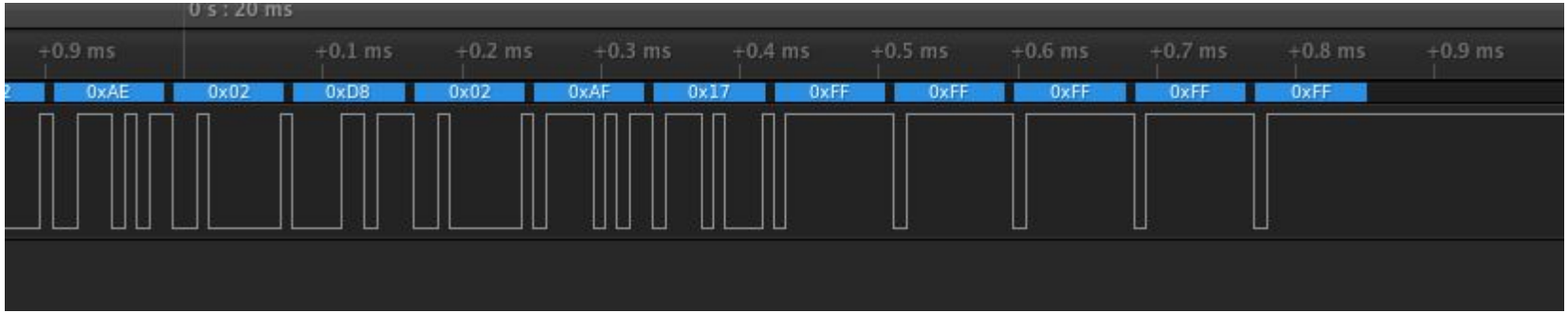
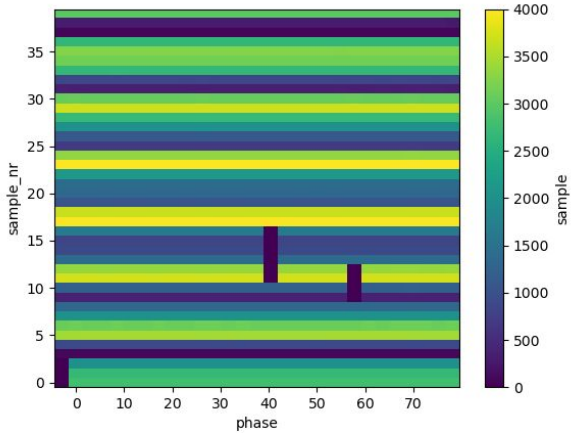
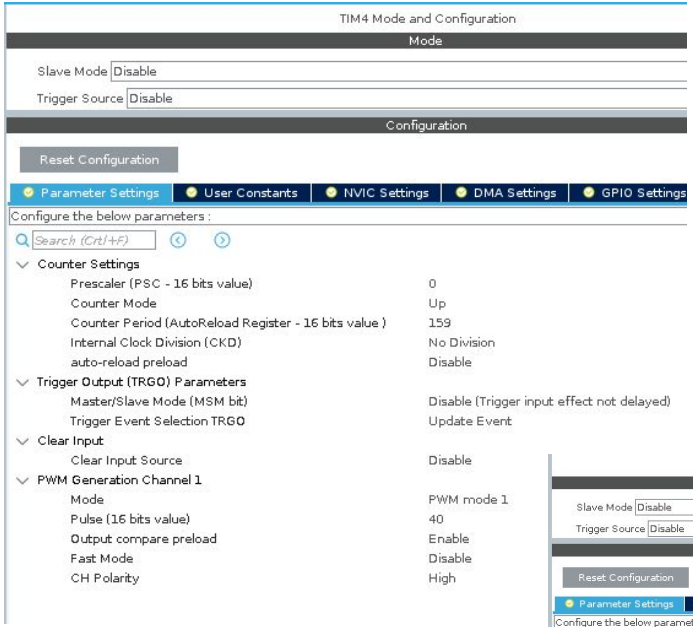
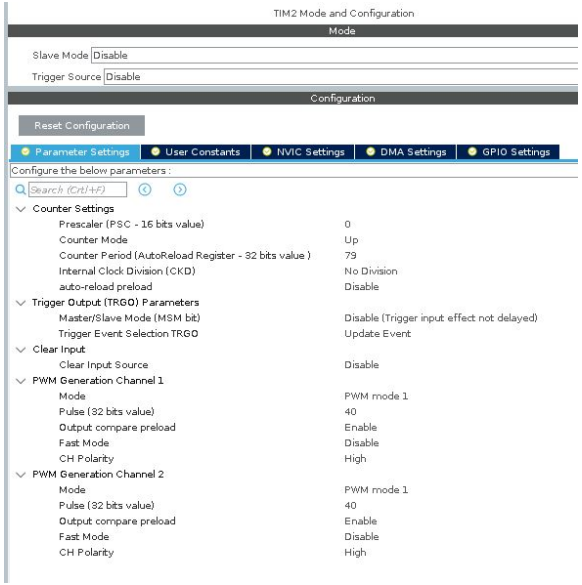
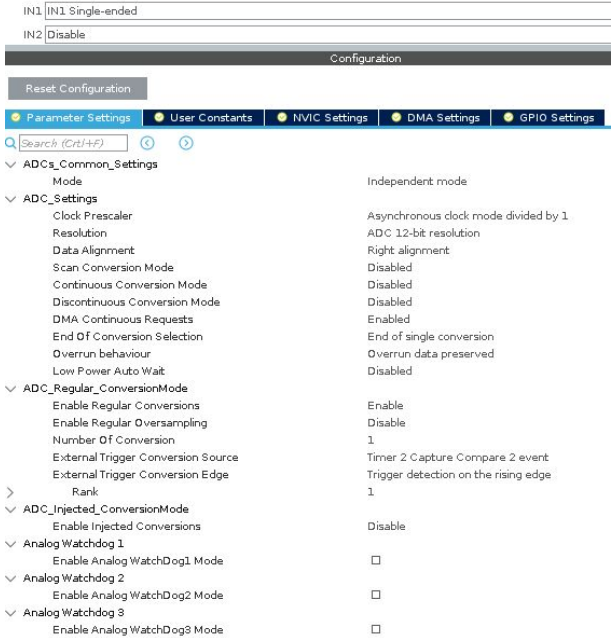
+0.8 ms
+0.9 ms
0x55
0x55
0x55
0x55
0x55
0x08
0xD5
0xAA
0xD5
0xAA
0x05
0x10
0x95
0x97
0x84
0xD8
0x06
0x18

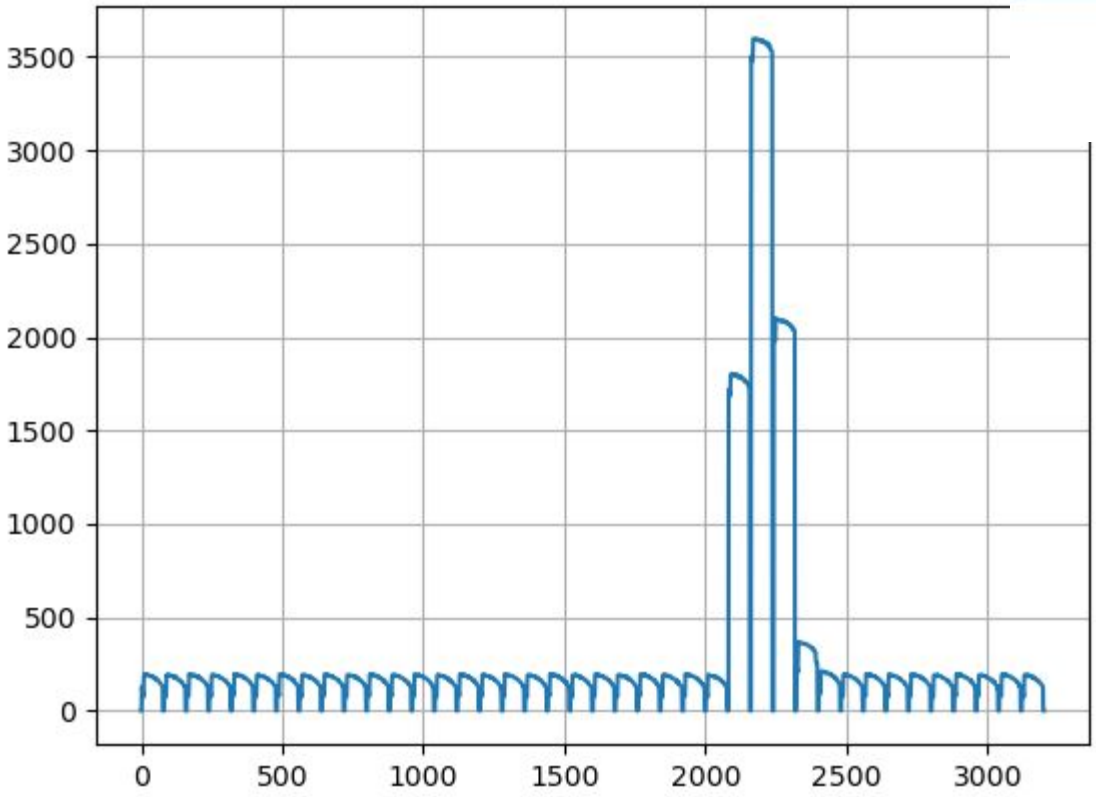

0 s : 20 ms
+0.9 ms
+0.1 ms
+0.2 ms
+0.3 ms
+0.4 ms
+0.5 ms
+0.6 ms
+0.7 ms
+0.8 ms
+0.9 ms
0xAE
0x02
0xD8
0x02
0xAF
0x17
0xFF
0xFF
0xFF
0xFF
0xFF


sample_nr
phase
sample
0
5
10
15
20
25
30
35
0
10
20
30
40
50
60
70
0
500
1000
1500
2000
2500
3000
3500
4000


TIM4 Mode and Configuration
Mode
Slave Mode Disable
Trigger Source Disable
Configuration
Reset Configuration
Parameter Settings
User Constants
NVIC Settings
DMA Settings
GPIO Settings
Configure the below parameters :
Search (Crtl+F)
Counter Settings
Prescaler (PSC - 16 bits value) 0
Counter Mode Up
Counter Period (AutoReload Register - 16 bits value) 159
Internal Clock Division (CKD) No Division
auto-reload preload Disable
Trigger Output (TRGO) Parameters
Master/Slave Mode (MSM bit) Disable (Trigger input effect not delayed)
Trigger Event Selection TRGO Update Event
Clear Input
Clear Input Source Disable
PWM Generation Channel 1
Mode PWM mode 1
Pulse (16 bits value) 40
Output compare preload Enable
Fast Mode Disable
CH Polarity High

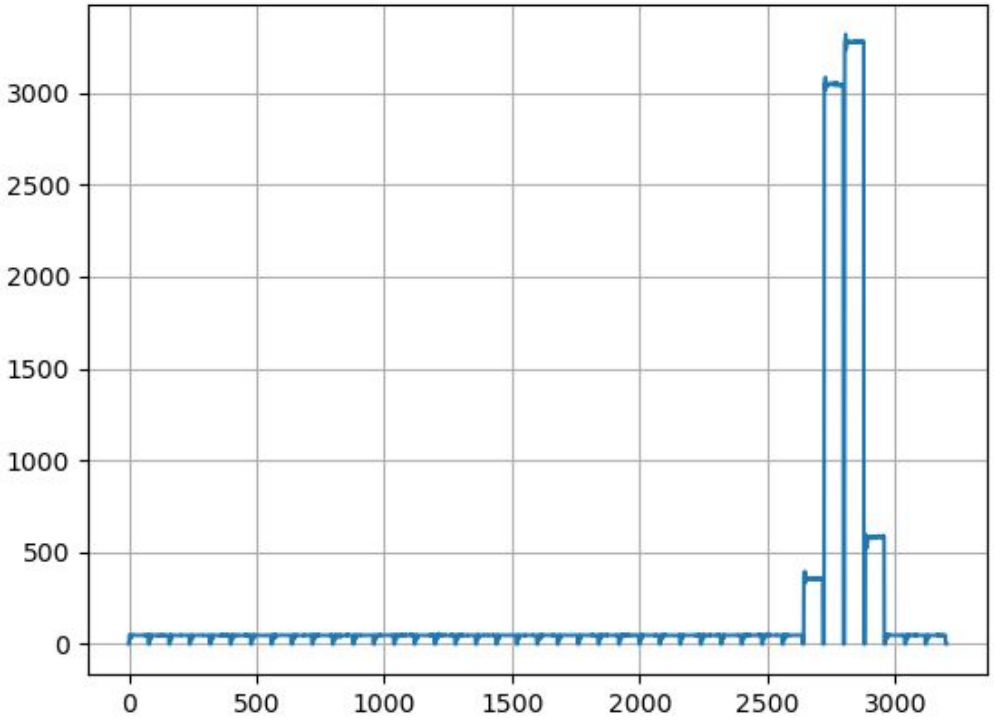

TIM2 Mode and Configuration
Mode
Slave Mode Disable
Trigger Source Disable
Configuration
Reset Configuration
Parameter Settings
User Constants
NVIC Settings
DMA Settings
GPIO Settings
Configure the below parameters :
Search (Crtl+F)
Counter Settings
Prescaler (PSC - 16 bits value) 0
Counter Mode Up
Counter Period (AutoReload Register - 32 bits value) 79
Internal Clock Division (CKD) No Division
auto-reload preload Disable
Trigger Output (TRGO) Parameters
Master/Slave Mode (MSM bit) Disable (Trigger input effect not delayed)
Trigger Event Selection TRGO Update Event
Clear Input
Clear Input Source Disable
PWM Generation Channel 1
Mode PWM mode 1
Pulse (32 bits value) 40
Output compare preload Enable
Fast Mode Disable
CH Polarity High
PWM Generation Channel 2
Mode PWM mode 1
Pulse (32 bits value) 40
Output compare preload Enable
Fast Mode Disable
CH Polarity High


IN1 IN1 Single-ended
IN2 Disable
Configuration
Reset Configuration
Parameter Settings
User Constants
NVIC Settings
DMA Settings
GPIO Settings
Search (Crtl+F)
ADCs_Common_Settings
Mode Independent mode
ADC_Settings
Clock Prescaler Asynchronous clock mode divided by 1
Resolution ADC 12-bit resolution
Data Alignment Right alignment
Scan Conversion Mode Disabled
Continuous Conversion Mode Disabled
Discontinuous Conversion Mode Disabled
DMA Continuous Requests Enabled
End Of Conversion Selection End of single conversion
Overrun behaviour Overrun data preserved
Low Power Auto Wait Disabled
ADC_Regular_ConversionMode
Enable Regular Conversions Enable
Enable Regular Oversampling Disable
Number Of Conversion 1
External Trigger Conversion Source Timer 2 Capture Compare 2 event
External Trigger Conversion Edge Trigger detection on the rising edge
Rank 1
ADC_Injected_ConversionMode
Enable Injected Conversions Disable
Analog Watchdog 1
Enable Analog WatchDog1 Mode
Analog Watchdog 2
Enable Analog WatchDog2 Mode
Analog Watchdog 3
Enable Analog WatchDog3 Mode



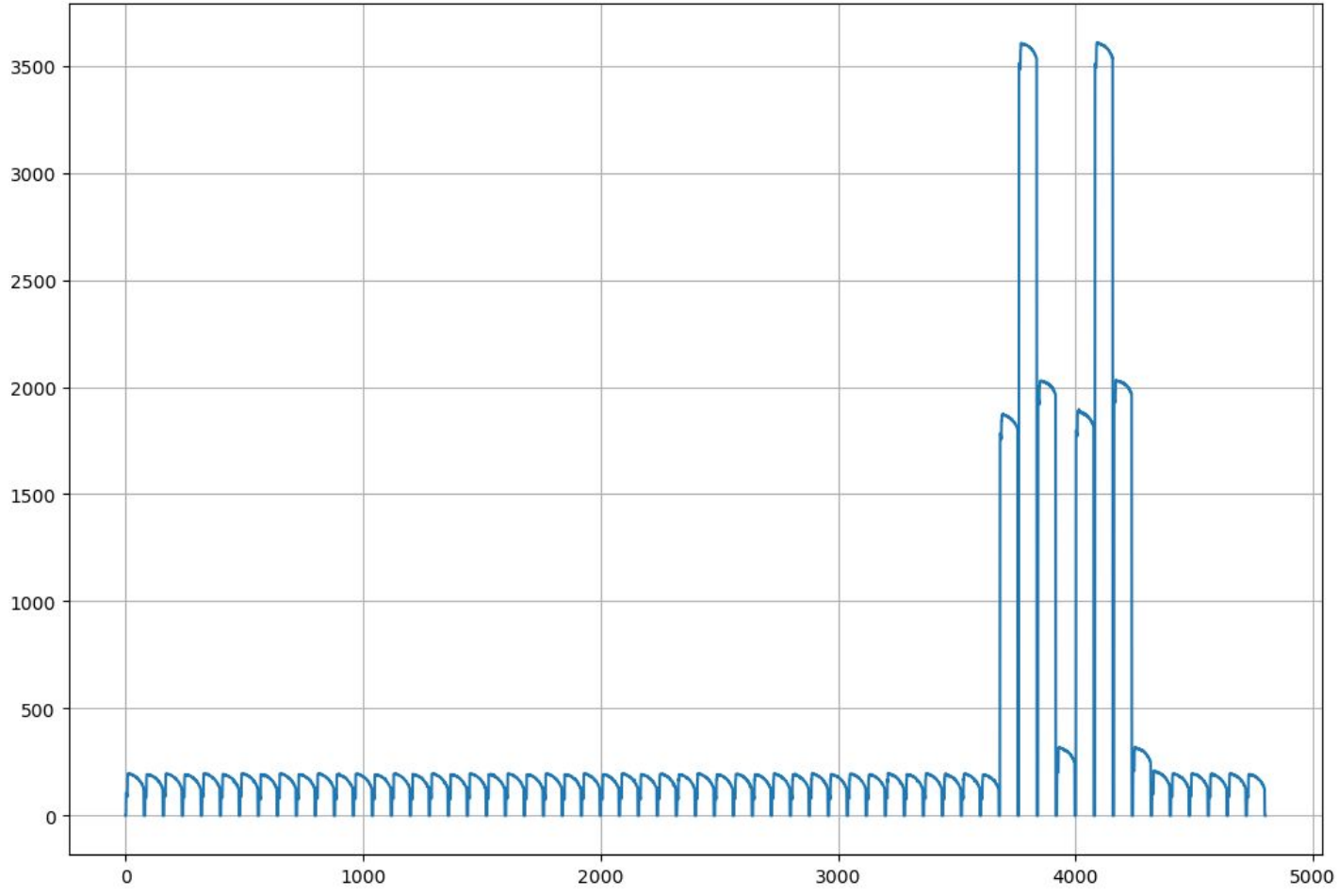
DAC Out1 Settings

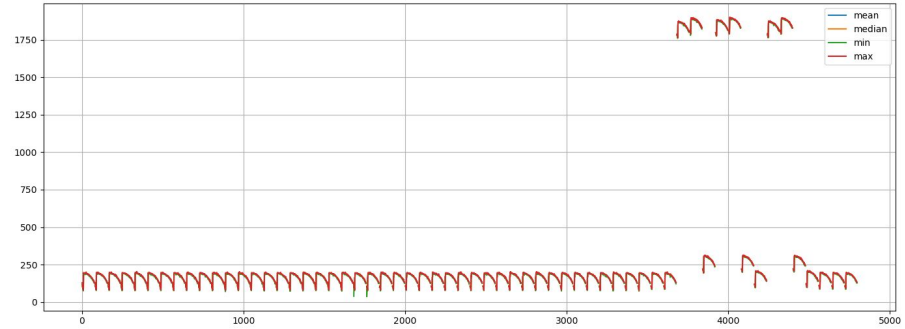
Output Buffer	Disable
Trigger	Timer 4 Trigger Out event
Wave generation mode	Disabled
User Trimming	Factory trimming
Sample And Hold	Sampleandhold Disable

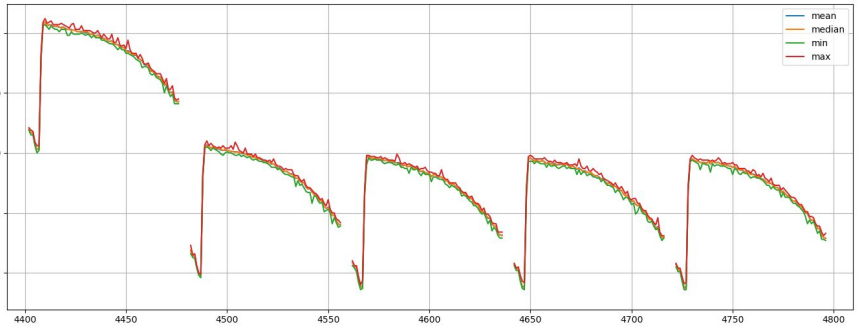


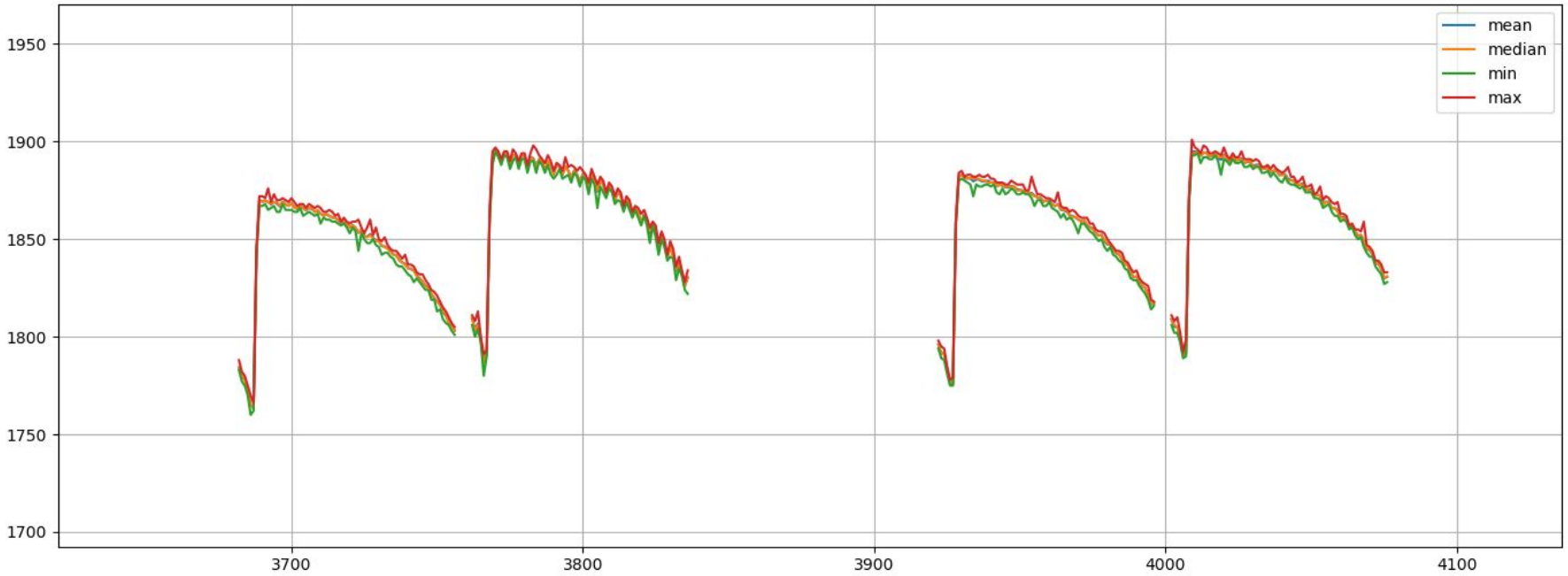
DAC Out1 Settings

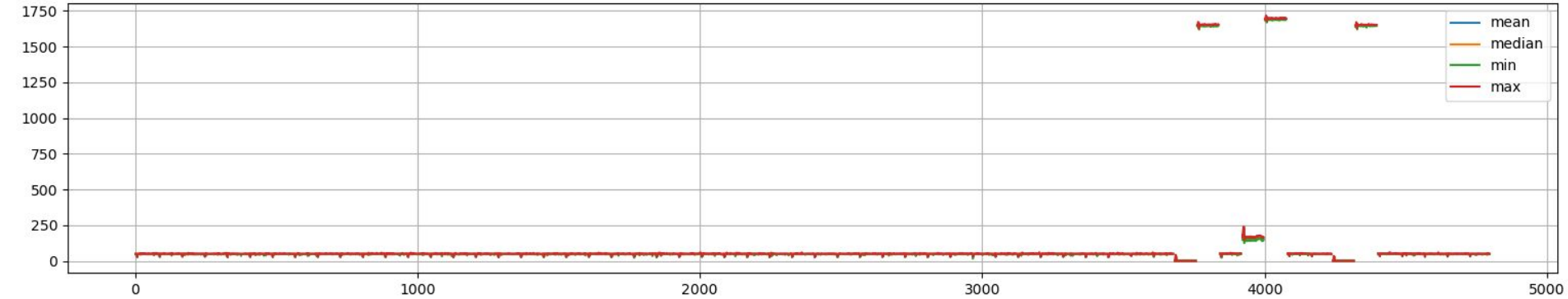
Output Buffer	Enable
Trigger	Timer 4 Trigger Out event
Wave generation mode	Disabled
User Trimming	Factory trimming
Sample And Hold	Sampleandhold Disable

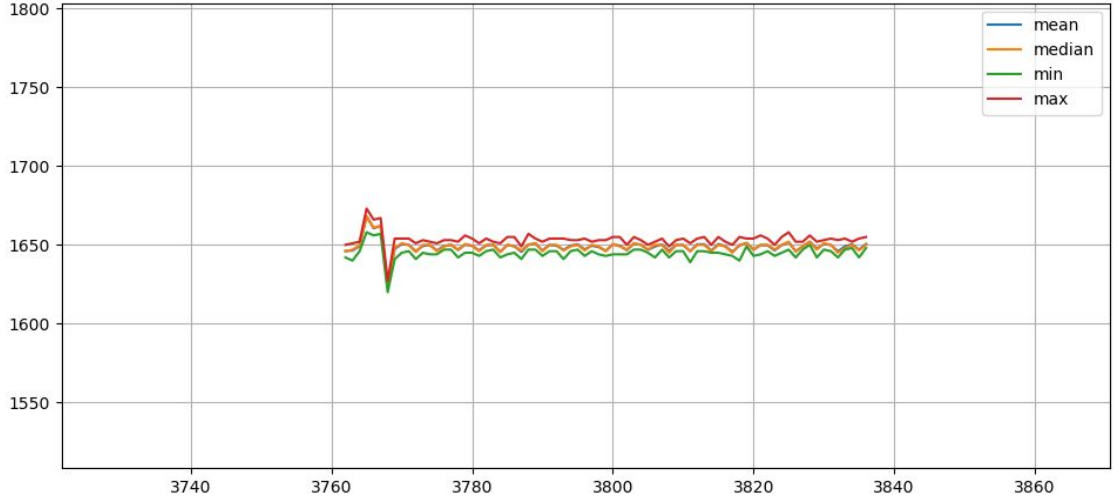

3500
3000
2500
2000
1500
1000
500
0
0
1000
2000
3000
4000
5000

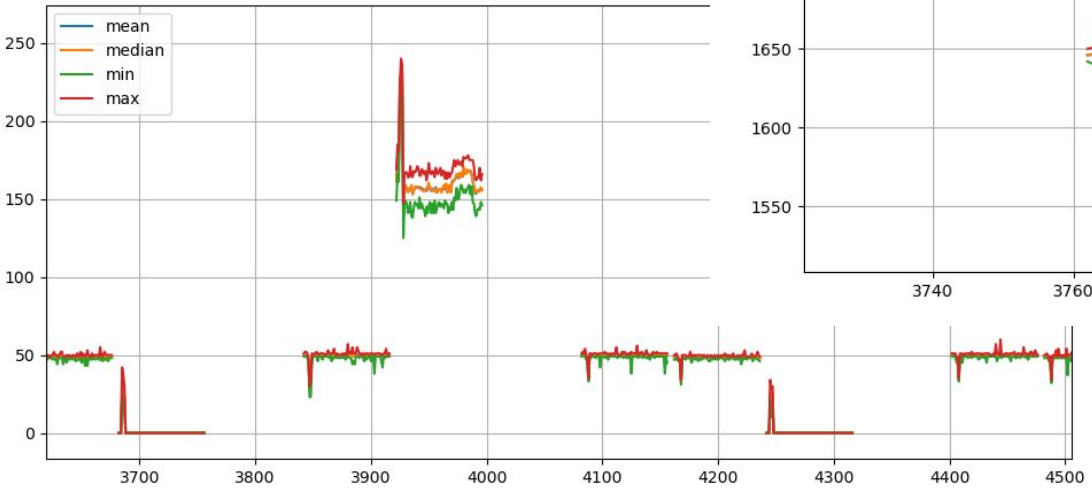

mean
median
min
max
1750
1500
1250
1000
750
500
250
0
0
1000
2000
3000
4000
5000


mean
median
min
max
300
250
200
150
100
4400
4450
4500
4550
4600
4650
4700
4750
4800


mean
median
min
max
1950
1900
1850
1800
1750
1700
3700
3800
3900
4000
4100


mean
median
min
max
1750
1500
1250
1000
750
500
250
0
0
1000
2000
3000
4000
5000


mean
median
min
max
1800
1750
1700
1650
1600
1550
3740
3760
3780
3800
3820
3840
3860


mean
median
min
max
250
200
150
100
50
0
3700
3800
3900
4000
4100
4200
4300
4400
4500