VIS Flags Documentation

Related pages

- [SGS ImageBitMasks](#)
- [VIS_ImageTools_M/FlagMap.py gitlab](#)
- issue #13589: Common flags definition in the DM
- task #5244: Bit mask propagation during data resampling and stacking

Flag bitmask values ¶

Bit	Bit Mask	Flag Value	Flag Name	Set	Description
0	0x00000001	1	INVALID	X	Convenience flag, combination of HOT, COLD, SAT, COSMIC, GHOST, CHARINJ, SATXTALKGHOST, ADCMAX, TXERROR
1	0x00000002	2	HOT	X	Hot pixel: pixel with a signal above a given threshold
2	0x00000004	4	COLD	X	Cold pixel: pixel which sensitivity is below a given threshold
3	0x00000008	8	SAT	X	Saturated pixel: pixel with a signal above CCD full well capacity
4	0x00000010	16	COSMIC	X	Cosmic ray: pixel affected by a cosmic ray
5	0x00000020	32	GHOST	X	Optical ghost: pixel affected by ghost
12	0x00001000	4,096	OVRCOL		Overflow column: pixel affected by a neighbouring saturated pixel
13	0x00002000	8,192	EXTOBJ		Extended object: pixel affected by an extended astronomical object
14	0x00004000	16,384	SCATLIGHT		Scattered light: pixel affected by non diffuse scattered light
15	0x00008000	32,768	CHARINJ	X	Charge injection: pixel part of charge injection line
16	0x00010000	65,536	NEARCHARINJ		Near charge injection: pixel affected by charge injection structure
17	0x00020000	131,072	SATXTALKGHOST	X	Saturated crosstalk ghost: pixel affected by electronic crosstalk from a saturated pixel
18	0x00040000	262,144	STARSIGNAL	X	Star signal: pixel affected by a star PSF
19	0x00080000	524,288	SATURATEDSTAR		Saturated star: pixel affected by a saturated star PSF
20	0x00100000	1,048,576	CTICORRECTION		CTI correction: pixel affected by CTI correction by more than 1 (TBD) ADU
21	0x00200000	2,097,152	ADCMAX	X	ADC maximum: pixel at maximum ADC value (65535) before VIS processing
22	0x00400000	4,194,304	TXERROR	X	Transmission error (pixel containing 0 ADU in VIS input raw frame)
23	0x00800000	8,388,608	STITCHBLOCK	X	Photolithographic stitch-block boundary, pixel may have a different size
24	0x01000000	16,777,216	OBJECTS	X	Objects detection map produced by SExtractor

The "Set" column contains an "X" when the flag is handled (and set) by the VIS PF.

Detailed flags description

bit 0 – INVALID

Convenience flag, primarily for MER, combination of HOT, COLD, SAT, COSMIC, GHOST, CHARINJ, SATXTALKGHOST, ADCMAX, TXERROR. **Pixels flagged wih INVALID have an arbitrary value and shall not be used for anything.**

bit 1 – HOT

Hot pixels are pixels which are much brighter than the average of the quadrant pixels. They are detected in dark frames and in flat exposures. In the master flat frame, HOT pixels are pixels which value is over 1.15. In the master dark frame, HOT pixels are pixels above 0.01 e-/s (#22191-66) or all the pixels in a column containing 200 or more HOT pixels (#22191-69).

bit 2 – COLD

Cold pixels are under-responsive pixels. Like hot pixels, they are detected in the master flat product, as having a value lower than 0.85.

bit 3 – SAT

The saturated pixel detection is the first operation of the VIS PF. The **SAT** flag is set for pixels which have a value greater than or equal to the quadrant Full Well Capacity (FWC).
The FWC value is copied in the FITS file HDU header of the corresponding quadrant:

```
SATLEVEL = 192000.0  / pixel saturation level in e-
SATURATE = 61935     / pixel saturation level in ADU
```

The **SATURATE** FITS keyword is used by SExtractor to filter saturated objects.

bit 4 – COSMIC

Pixel affected by a cosmic ray as detected by LA Cosmicx (https://github.com/cmccully/lacosmicx).

bit 5 – GHOST

The **GHOST** flag identifies pixels affected by an optical ghost image produced by the defocused reflection of a very bright object on the back face of the dichroic plate. The algorithm description and illustrative plots and results   can be found here

bit 12 – OVRCOL

bit 13 – EXTOBJ

bit 14 – SCATLIGHT

bit 15 – CHARINJ

Flags pixels belonging to charge injection lines. Charge injection lines are 2 lines of pixels per quadrant which are at the opposite side of the readout register. They can't be read (see below) but are physically present in the CCD images, in the form of 4 consecutive horizontal lines at the center of the CCD images (2 quadrants glued head-to-head, see   EUCL-EC-ICD-8-001 Data Product Description v0.1 documentation).

The charge injection lines can be set to static voltages through the configuration of the voltages IG1 and IG2. They can dump charge on the image area pixels if the timings of the injection and the voltages of IG1, IG2 and Injection Drain are set as needed for that to happen, but you can't actually read them out because they don't have the phase electrodes which make possible to clock charge, as the image area pixels have (the "Iphi's") (Ruyman Azzollini 14 Dec. 2020).

bit 16 – NEARCHARINJ

bit 17 – SATXTALKGHOST

Flags a victim pixel affected by electronic crosstalk from a saturated source pixel in a different quadrant of the same ROE. Since electronic crosstalk happens before Analog-to-Digital Conversion, if a source pixel is ADC saturated (65,535), we can't know its 'real' value when it affects the victim pixel. So this flag identifies pixels affected by non-negligible electronic crosstalk at a level that can't be estimated and corrected for.

bit 18 – STARSIGNAL

Currently in the VIS pipeline, star pixels are flagged using a fat/saturated PSF scaled in brightness using the magnitude of the star and then applying a 2 ADU threshold. The flagged stars come from the input refernce catalogue. Note that this flagging misses long diffraction star spikes.

bit 19 – SATURATEDSTAR

bit 20 – CTICORRECTION

bit 21 – ADCMAX

Set when a pixel value is 65,535 ADU in the VIS PF input raw frame.

bit 22 – TXERROR

This flag bit is set when a pixel in VIS input raw frame contains 0. This normally indicates a transmission error either inside the satellite or between the satellite and the ground (lost packet), or any missing data for any other reason.

bit 23 – STITCHBLOCK

Photolithographic stitch-block boundary, in which pixels may have a different size, which may slightly affect locally the image astrometry and photometry. It's here for now just for documentation purposes, as it's not used anywhere in the VIS PF yet. Be warned, however, that you may not want to use these pixels to do very precise science.

bit 24 – OBJECTS

Objects detection map produced by SExtractor. It's also produced by the VIS_FlagObjects pipeline running on short duration exposures, to flag sky signal in flat field images taken with the same pointing as the VIS_FlagObjects input exposure.

Software interface

VIS Flags bitmasks are defined in the   **VIS_ImageTools** project, starting with version **3.7** (January 2021).

A standardisation across different MER input was decided in October 2021 (#13589#note-48) which led to the introduction of the INVALID flag, which broke flagmap compatibility between VIS PF v4.x and VIS PF 5.x.

They are declared in Python as a dictionary of 32 bit integer values. These integers are not unsigned because we don't need bit 31 yet, and unsigned int is not a native FITS datatype, it must be handled with a special BZERO card scaling (https://heasarc.gsfc.nasa.gov/docs/software/fitsio/c/c_user/node26.html), which might introduce handling issues.

```python
VIS_FLAGS = {
  'GOOD':          np.int32(0x00000000),
  'INVALID':       np.int32(0x00000001), # bit  0
  'HOT':           np.int32(0x00000002), # bit  1
  'COLD':          np.int32(0x00000004), # bit  2
  'SAT':           np.int32(0x00000008), # bit  3
  'COSMIC':        np.int32(0x00000010), # bit  4
  'GHOST':         np.int32(0x00000020), # bit  5
  'OVRCOL':        np.int32(0x00001000), # bit 12
  'EXTOBJ':        np.int32(0x00002000), # bit 13
  'SCATLIGHT':     np.int32(0x00004000), # bit 14
  'CHARINJ':       np.int32(0x00008000), # bit 15
  'NEARCHARINJ':   np.int32(0x00010000), # bit 16
  'SATXTALKGHOST': np.int32(0x00020000), # bit 17
  'STARSIGNAL':    np.int32(0x00040000), # bit 18
  'SATURATEDSTAR': np.int32(0x00080000), # bit 19
  'CTICORRECTION': np.int32(0x00100000), # bit 20
  'ADCMAX':        np.int32(0x00200000), # bit 21
  'TXERROR':       np.int32(0x00400000), # bit 22
  'STITCHBLOCK':   np.int32(0x00800000), # bit 23
  'OBJECTS':       np.int32(0x01000000), # bit 24
}
```

The new INVALID flag introduced in version 5.0 of the VIS PF is a combination of other flags, which indicates that a pixel must not be used for science or image stacking. The list of flag names to combine to produce the INVALID flag is declared in the same FlagMap.py python file, along with tools to use it:

```python
# names of the flags used to build the INVALID flag
INVALID_BITNAMES = ('HOT', 'COLD', 'SAT', 'COSMIC', 'GHOST', 'CHARINJ', 'SATXTALKGHOST', 'ADCMAX', '

# INVALID flag bitmask (eg. print(f"{FlagMap.INVALID_BITMASK:b}") -> '11000100000000000111110')
INVALID_BITMASK  = np.int32( sum( [VIS_FLAGS[bitname] for bitname in INVALID_BITNAMES]))

# build/update the INVALID flag in 'flagmap' by combining the flags in 'INVALID_BITNAMES'
def set_invalid_flag( flagmap):
  flagmap[np.nonzero( flagmap & INVALID_BITMASK)] |= VIS_FLAGS["INVALID"]
  return

# set to 0 all the 'INVALID' flagged pixels in an array 'weighmap' with same shape as 'flagmap'
def set_invalid_pixels_to_zero( weightmap, flagmap):
  set_invalid_flag( flagmap)
  weightmap[ np.nonzero( flagmap & VIS_FLAGS["INVALID"])] = 0
  return
```

You can use the flag dictionary from any Python source code as follows:

```python
from VIS_ImageTools_M.FlagMap import VIS_FLAGS

import numpy as np

for flag_name, value in VIS_FLAGS.items():
  if flag_name != "GOOD":
    print(f"| {int(np.log2(value)):2d} | 0x{value:08x} | {value:10,d} | {flag_name:14s} |")

print("STARSIGNAL" in VIS_FLAGS)

print(f"{VIS_FLAGS['ADCMAX']:_b}")

print(VIS_FLAGS["GHOST"].dtype)
```

gives:

```
|  0 | 0x00000001 |          1 | INVALID       |
|  1 | 0x00000002 |          2 | HOT           |
|  2 | 0x00000004 |          4 | COLD          |
|  3 | 0x00000008 |          8 | SAT           |
|  4 | 0x00000010 |         16 | COSMIC        |
|  5 | 0x00000020 |         32 | GHOST         |
| 12 | 0x00001000 |      4,096 | OVRCOL        |
| 13 | 0x00002000 |      8,192 | EXTOBJ        |
| 14 | 0x00004000 |     16,384 | SCATLIGHT     |
| 15 | 0x00008000 |     32,768 | CHARINJ       |
| 16 | 0x00010000 |     65,536 | NEARCHARINJ   |
| 17 | 0x00020000 |    131,072 | SATXTALKGHOST |
| 18 | 0x00040000 |    262,144 | STARSIGNAL    |
| 19 | 0x00080000 |    524,288 | SATURATEDSTAR |
| 20 | 0x00100000 |  1,048,576 | CTICORRECTION |
| 21 | 0x00200000 |  2,097,152 | ADCMAX        |
| 22 | 0x00400000 |  4,194,304 | TXERROR       |
| 23 | 0x00800000 |  8,388,608 | STITCHBLOCK   |
```

```
| 24 | 0x01000000 | 16,777,216 | OBJECTS           |

True
10_0000_0000_0000_0000_0000
int32
```

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Updated by sylvain mottet 10 days ago · 21 revisions

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